# THE DEPARTMENT OF CONSERVATION
# STATE OF INDIANA



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# LAKE MAXINKUCKEE

## A PHYSICAL AND BIOLOGICAL SURVEY

BY

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# THE INSECTS

## Introduction

Unfortunately, no entomologist was assigned to the party studying the lake. No special study was, therefore, made of the insects. This is regretted, because so many species of insects or their larvæ bear an important relation to the life of the lake. The number of species that enter directly into the menu of the fishes of the lake is undoubtedly many and the total quantity consumed must be very great.

Such study of the insects as we were able to make was therefore purely incidental and necessarily very disconnected and incomplete. From time to time examples in various groups were collected. These were sent to the Bureau of Entomology of the United States Department of Agriculture, to the specialists of which we are indebted for their identification. For assistance in identifying the species in the various orders we are indebted to several specialists. Professor W. S. Blatchley has helped us with the Orthoptera, Dr. O. A. Johannsen with the Diptera, and Mr. E. P. Van Duzee with the Hemiptera and other groups.

An exception to this general statement may be made in the case of the Odonata, which were collected and reported upon by Dr. Charles B. Wilson, who spent a part of two summers at the lake and secured such species as were to be found during that time.

## ORDER APTERA

### THE SPRING-TAILS

Snowfleas, probably *Achorutes nivicola*, were exceedingly abundant about the edges of the pools and ponds, especially about the woodland pond near Farrar's. They were very active, leaping from the moist leaves about the pond into the water or rather upon its surface. In places they would turn the snow black. On the occasion of a heavy snowfall late in winter an old inhabitant remarked: "This snow will remain until the bugs eat it up." He said that this was common belief and that in parts of Pennsylvania some of the late heavy snows disappeared, not by melting, but by being consumed by snowfleas! A curious superstition.

The snowfleas as they grow, often shed their skins on the surface of the water, the skin remaining as a thin, white pellicle.

On March 17, 1901, they were abundant on the snow, and on November 1, 1904, many were seen at the edge of the lake.

## ORDER EPHEMERIDA

### THE MAY-FLIES

The May-flies are probably the most important insects in relation to the fishes of the lake. Their eggs are laid in the water, the larvæ are aquatic, and both are fed upon by fishes. The May-flies themselves, at the close of their brief lives, fall upon the surface of the lake by the millions and furnish a vast amount of food to many species of fishes

Early in April the May-fly larvæ begin to be conspicuous about the margins of the lake and in the ponds and quiet streams. They were first noted in numbers on April 4 (1901), and throughout the winter they were found more or less frequently in the bottom dredgings. About the fourth of April, they began to crowd up near the shore in great numbers with a peculiar wriggling motion. On April 5 they were found in immense numbers in a ditch and some small ponds near the Assembly grounds. On April 6, millions were seen in this ditch and they were very plentiful in many other places. They continued very abundant until about the fifteenth when they began to decrease in numbers, but the larvæ were noted on the 19th, 20th, and 22nd. The first May-fly imago was noted on May 2. The next day many were seen in the woods indulging in an aerial dance. On the fourth, many were seen in the town of Culver, dancing in the air. From that date they kept increasing in numbers, while at the same time their larvæ casts were more and more abundant in the water along the shore. By May 17, the woods were filled with insects on the wing, many of them May-flies, and the larvæ were abundant in windrows at the water's edge. From May 18 to 21, they were noted by the millions. On May 19 and 20 great numbers of casts and dead adults were observed in the water and along the shore, and dead or dying adults were very abundant in the grass and weeds around the lake. On May 22, they began copulating and laying their eggs in the water, at the same time being caught in great numbers by the various kinds of fishes. The straw-colored minnows snapped them up greedily. We caught a number of the May-flies and threw them on the water where they were promptly seized by the fishes. They continued in considerable numbers until May 25, when a good many were seen, but none flying, and all rather numb. Not many were seen on the 26th. A few were noted in the afternoon of the 27th and 28th, and on the 29th a few stragglers were seen. On the 28th one was observed emerging and several noted that had just emerged. In

the evening a great many were seen flying about and on the grass. They leave their cast-off skins on the grass a few steps back from the lake shore. None could be seen on June 1, but on June 22 one was seen, the last of the season.

All the above applies to a long, blackish, rather robust species with three long caudal setæ.

On June 7, were seen a few of a second species, more slender than the other and with only two caudal setæ.

It is a common belief about the lake that many fishes die as a result of gorging themselves with May-flies, but this opinion was not sustained by the examination which was made of the stomachs of a considerable number of fishes found dead during May-fly time.

In addition to the larger May-flies of early summer, a diminutive form of a light brown color, but semitransparent, was present in immense numbers in autumn, emerging one night, and laying their eggs on the surface of the water during the next day and evening. These were present in such numbers that they formed regular drifts about the base of a large bullseye lamp set on the pier, the insects flying toward the pier light and becoming tangled up together by their long and delicate caudal stylets. Although probably as abundant numerically as the large May-flies of spring, these minute forms did not attract the attention that the former did, because of their pigmy size and inconspicuous coloration. The lisping of the minnows and other little fishes such as skipjacks, along shore on fine autumnal evenings, was caused by their snapping at these little insects as they deposited their eggs on the water surface.

A remarkable feature about the May-flies is their habit of moulting after the wings have formed, and after they have flown a little distance from the lake. It is astonishing how such a thin transparent membrane as their wings can be shed. The dark, heavy species alights on the grass to make this last change but a light transparent species of late summer is often not able to shed the skin from its caudal stylets, but bears the entire cast-off clothes on these, and is thus greatly impeded in its flight.

The larvæ of some of the large dark May-flies feed on the softer portions of old, dead leaves, in the bottom of the water, and some of them will, in a very short time, completely skeletonize a leaf, leaving only the delicate lace-work of the veins.

## ORDER ODONATA

### THE DRAGON-FLIES

By Charles B. Wilson

#### INTRODUCTION

Like the May-flies, the Dragon-flies are all aquatic and constitute the most important group of insects to be found about the lake. They are also the most attractive and graceful, in spite of the obnoxious name of "snake-feeders," which has been bestowed upon them in the common local vernacular. They have not, of course, the remotest connection with snakes, nor are they poisonous or harmful in any way, as is popularly supposed. They are strictly carnivorous and often cannibalistic in all stages of development, the larger imagos and nymphs habitually eating the smaller ones.

But they feed chiefly upon other animals such as flies, insect larvæ, small crustaceans, worms, leeches, fish-fry and tadpoles. They seem to relish especially house-flies and culicids, and thus become of great economic importance through the destruction of these pests. That the curse of house-flies and mosquitoes is kept so delightfully within bounds at Lake Maxinkuckee is very largely due to the untiring ministrations of the dragon-flies.

Their eggs are either laid in the water or inserted into the tissues of some water plant or floating fragment.

As soon as the egg is hatched the nymph begins devouring other animals. Of course, it has to be content at first with very small ones, but as it increases in size and strength it becomes able to kill larger and larger ones until finally it includes small fish and tadpoles among its prey.

The full-grown nymph of one of the larger dragon-flies is fully two inches in length with a stout muscular body and strong legs. As soon as it is fully matured the nymph crawls up out of the water on a rush stem, the leaf of a water plant, a stake, a board, or other convenient support, usually during the night or very early in the morning. As soon as it becomes dry the skin splits along the back, and the fully developed dragon-fly emerges. These old nymph skins may be found about the lake during the entire summer, and often in the early morning the newly emerged imago may be seen perched on the skin or close by. Thirty skins were taken one morning from the inside of a boathouse on the west side of the lake.

That the dragon-flies enumerated in the following list play a very important part in the economy of the fish life of the lake may be seen from several considerations.

1. They destroy multitudes of insect adults and larvæ that would otherwise serve as fish food; they are voracious feeders and they keep at it all their lives.

2. The nymphs of the larger dragon-flies are strong and agile enough to catch and eat the helpless fry of many of the larger fishes. They greatly prefer insect larvæ but will kill the fish rather than go hungry.

3. On the other hand, many of the insects destroyed are obnoxious to man. This is especially true of the mosquitoes, gnats, etc., which form the dragon-flies' favorite food.

4. The dragon-flies themselves, both adults and larvæ, are eaten by the fish. The young nymphs when first hatched are nearly as good fish-food as insect larvæ, and are easily overpowered by the small fish which frequent the shallow water where they live. As the nymphs grow larger they become too wary and too powerful for these small fishes. At the same time they keep coming closer and closer to the shore so that the larger fish do not get a chance to capture them. This explains why so few nymphs were found in the fishes' food during July and August. During the winter and in the early spring, when other food is scarce, these dragon-fly larvæ must share with the minnows in supplying food for the larger fish.

That the adult dragon-flies are eaten by the larger fish is a matter of both direct observation and inference. Repeatedly in the effort to capture some of the more wary dragon-flies a specimen would be knocked helpless into the water by a blow from the net. Often on these occasions before it could be picked up there would come a swirl in the water and it would disappear down some fish's throat. It was difficult, of course, to identify the fish with certainty, but *Libellula pulchella* and *L. luctuosa* were eaten this way on several occasions by Large-mouthed Black Bass, while *Celithemis eponina* was taken by the Redeye. Several of the smaller damsel-flies were taken by smaller fish. Reliable anglers also testify that they have seen fish following a pair of dragon-flies, like *Celithemis eponina,* which fly about close to the surface over the deep water, the female repeatedly dipping her abdomen beneath the water to deposit her eggs, and that the fish often jump for the dragon-flies.

Again, dragon-flies are constantly getting into the water, particularly during a high wind and after they have finished depositing their eggs. A careful watch was kept for such individuals every day, but in only one instance during the entire summer was a dragon-fly observed floating on the water. Even this one was

swallowed by a fish before it could be picked up; the inference, of course, is that the others were similarly disposed of.

5. Dragon-fly nymphs in all probability prey on leeches amongst their other food, and leeches are the most fatal parasites that infest the lake, killing numbers of fish annually. Anything that tends to reduce the number of leeches, therefore, will have great economic value because they have very few enemies so far as known.

This relation between dragon-fly nymphs and leeches is worthy of careful study in the future. The author greatly regrets that the lateness of the season prevented the acquiring of any positive data on this point.

Specimens of every dragon-fly mentioned in the following list were collected and personally identified by the author. The species are arranged according to the admirable list of "The Dragon-flies of Indiana" by E. B. Williamson, as published in the Report of the State Geologist of Indiana for 1900.

Many additional facts have been taken from this list and the author also wishes to acknowledge his indebtedness to Mr. Williamson for valuable criticism and advice given in private correspondence, and for the last four species here reported, which were collected by Mr. Williamson at Lake Maxinkuckee in May, 1900. The author could not begin his collecting until the middle of July, and it is practically certain that the months of May and June would add ten or a dozen more species to the list.

## LIST OF SPECIES

### 1. BOYERIA VINOSA (Say)

A rare species, shy and wary, and a strong flier. It was not positively identified around any of the lakes visited, but was thought to have been seen flying over Lost Lake on several occasions. Three pairs were seen along the Tippecanoe River on September 4, the females depositing their eggs in the edge of the weeds along the banks. One of these pairs was captured.

### 2. AESCHNA CONSTRICTA Say

A species seen only occasionally during the summer, but becoming more common during the autumn, and finally in the middle of September congregating in considerable numbers around Hawk's marsh, which is situated about a quarter of a mile inland from the west shore of the lake. This species, as noted by Williamson, prefers the shelter of the bushes and rushes, and returns constantly

to alight on the twigs and branches after roaming about in search of food. It is very active, a strong flier, and often mounts to a considerable height in pursuit of its prey.

Although the abdomen of the male is seen to be highly colored with blue on close examination, both sexes appear dull brown when flying about.

#### 3. PERITHEMIS DOMITIA (Drury)

One of the smallest species, frequenting the lily-pads and pickerel-weed, flying close to the water, and habitually keeping below the larger and stronger species as noted by Needham.

The males congregate on the lily-pads some little distance from the shore and are difficult to catch because they are very wary. They can dodge a net with facility, and especially because they fly so close to the water that it is very hard to manipulate the net.

The females are found closer to the shore and are not nearly so numerous as the males. Their flight here in Indiana is anything but "rather weak and a bit clumsy" as Needham records for New York State. The author spent two hours one afternoon in early September along the edge of the pickerel-weed at Twin Lakes endeavoring to catch some of these females which could be seen occasionally flying about, and finally had to come away without securing a single specimen. The females seen were always unattended by a male and deposited their eggs close to the shore amongst the Chara and Spirogyra. One specimen that had been swept into the water by the net was seized and eaten by a fish, apparently a Warmouth Bass.

The adults of both sexes were obtained at Lake Maxinkuckee, Lost Lake, Bass Lake and Twin Lakes. They were especially common at Lost Lake around the Outlet where several nymphs were also obtained August 15, just ready to come forth as imagos.

#### 4. CELITHEMIS EPONINA (Drury)

One of the skimmers and the largest of the genus in the State, both sexes rust-colored throughout, with large brown spots on the wings, the male more brightly colored than the female.

This species and *Libellula luctuosa* were the two most common dragon-flies at all the lakes visited. They appeared before our arrival and were still roaming about at the middle of September. The female of this species is nearly always held by the male when depositing her eggs, and the two are seen flying about together more frequently than any other species. Since the eggs are deposited in the clean water, often a long distance from any vegeta-

tion, the species is more conspicuous than most others. Then, too, both sexes, but especially the male, are inquisitive, and perch on the very tops of the rushes to watch the intruder. If disturbed they return again and again to the same spot. This species is also less dependent on the weather than most others and may be seen flying about on cloudy days, during a high wind, or even in a drizzling rain.

The nymphs of this species are broad and flattened, with the lateral margins of the last two segments conspicuously serrate. They prefer a stump, a board, or the post of a wharf for their final transformation and the dried nymph skins may be found in such localities and often on the inside of boathouses.

Adults of both sexes were taken at Lake Maxinkuckee, Lost Lake, Bass Lake, Twin Lakes, Yellow River and Hawk's marsh.

A pair of this species which had been brushed into the water was immediately seized and swallowed by a large bass, probably *Micropterus salmoides.*

#### 5. CELITHEMIS ELISA (Hagen)

Not as common as the preceding species and considerably smaller. In the coloration the red is more prominent, particularly toward the tip of the wings. The sexes do not fly about together as does *C. eponina;* the female keeps well out of sight among the rushes and dense vegetation back from the water's edge.

The male, however, perches on the tips of the rushes and is nearly as inquisitive and conspicuous as the preceding species.

The nymphs are similar to *C. eponina* but smaller, and they prefer a rush stem for their final transformation, and the dried nymph skins are found in such places.

Adults were obtained at Lake Maxinkuckee, Lost Lake, and Bass Lake; the nymphs were obtained from Lost Lake.

#### 6. CELITHEMIS FASCIATA Kirby

A rare species only seen once during the entire summer. It can be distinguished at once from the two other species of the genus by its color, the general tone and the spots on the wings being black rather than reddish brown. It is about the size of *elisa* and resembles it in its habits, the female remaining hidden among the vegetation along shore, while the male roams about in the rushes over the water.

About a dozen specimens were obtained at Twin Lakes on August 31, and they were the only ones seen.

7. LEUCORHINIA INTACTA (Hagen)

This is the species commonly known as "whiteface," the designation expressing the chief peculiarity, a white face sometimes tinged with yellow but always contrasting strongly with the surrounding dark color. It frequents the marshy flats around the lake, flying close to the water among the stems of the water plants, so that it requires some search to find one and more maneuvering to capture it. The eggs are laid close to the shore and the only female seen ovipositing was perched on a rush stem with the posterior half of its abdomen beneath the water. The nymphs are large with an ovate abdomen, the dorsal hooks of which are as long as the segments which bear them. Found in Lake Maxinkuckee and Lost Lake.

8. SYMPETRUM VICINUM (Hagen)

This is an autumnal species, not appearing until late in the summer, and is one of the smallest found. It resembles the following species closely in size and body color, and the two can be distinguished only by the shape and size of the hamulæ and abdominal appendages of the male, and by the structure of the vulvar lamina in the female. It flies about as much over the shore as it does over the water, and like the following species has a habit of hovering in the air, holding itself stationary by the rapid vibration of its wings.

It was found in considerable numbers in Hawk's marsh and along the Tippecanoe River, and was the last species to be seen after frost came.

9. SYMPETRUM CORRUPTUM (Hagen)

Very similar to the preceding in coloration, especially after the original markings have disappeared and the body has become a dark red. It is considerably larger than *vicinum*, is a more rapid flier, and rather more wary; and for these reasons very difficult to capture.

Only a few specimens obtained from Yellow River late in August.

10. ERYTHEMIS SIMPLICICOLLIS (Say)

This species has a wide distribution and is especially common around the swamps and marshes and along shore. Hawk's marsh, the southern inlet, and Green's marsh between Lost Lake and Lake Maxinkuckee, swarmed with these dragon-flies during the entire summer. They usually remain in the shelter of the dense herbage, and often squat on the ground like Gomphus.

When they alight it is nearly always near the ground or the

water. They may often be taken pairing in such places, and prefer to lay their eggs in the shallow water along shore, amongst the yellow algæ, where the water is scarcely deep enough to cover them. They feed largely on Diptera.

Found at Lost Lake, Lake Maxinkuckee, Twin Lakes, Yellow River, and Tippecanoe River.

#### 11. PACHYDIPLAX LONGIPENNIS (Burmeister)

A very cosmopolitan species found over the whole United States, Mexico, and the Bahama Islands. Both sexes are swift fliers, and as the males, which are most in evidence, hover near the surface of the water and in among the vegetation they are difficult to catch. The females remain at some distance from the water when not ovipositing, and so are less difficult to capture. When ovipositing both sexes fly in and out among the cow-lilies and arrowheads where it is hard to strike with a net, and when they do alight it is usually on the sides of the lily stems close to the water. This species has the curious habit of drooping its wings and elevating its abdomen when resting, so that the insect appears to be trying to stand on its head. As Williamson remarks, this simply furnishes the large Libellulas an excellent mark to nip at, and the author has repeatedly seen *L. luctuosa* and *L. pulchella* snap at the tip of the elevated abdomen and drive the Pachydiplax away, but has never seen one of the latter killed.

This species was found during the entire summer in every locality visited.

#### 12. LIBELLULA LUCTUOSA Burmeister

This was the most abundant of all the dragon-flies, and was found on all the lakes visited. It seems to prefer the higher and drier ground and was not usually found near low and swampy places. It is a strong flier and often pauses and holds itself stationary by rapid vibration of its wings.

It is also inquisitive, searching into everything, and often returning to the same place when missed by the net. When fishing, the author has repeatedly seen them snap at the cork float on the fishing line, both while it was in the air during the casting and while it was floating on the surface of the water.

When alighting they often prefer the side of a rush stem, or even the bare ground. The eggs are deposited in the shallow water near the shore, the female hovering over the spot and repeatedly dipping her abdomen beneath the surface in almost the same place. The black markings of the wings make this species very conspicuous, especially in the male where they are contrasted

with white. A male of this species was the only dragon-fly found during the entire summer floating in the water. On two occasions when knocked into the water by the net, imagos were seen to be eaten by Redeyes.

Found on the northern and western shores of Lake Maxinkuckee, at Lost Lake, Twin Lakes, and Bass Lake.

#### 13. LIBELLULA INCESTA Hagen

An extremely wary species, the males frequenting the tall reeds and rushes along shore. They are constantly on the watch and will not allow the collector to approach near enough to strike them with the net. They are also easily frightened and at once retire out of sight and remain hidden. No female was found during the entire season, and they must have been concealed in the grass away from the water's edge.

This species was only rarely seen around Lake Maxinkuckee and Lost Lake, but was fairly common along the Outlet between the two lakes.

#### 14. LIBELLULA CYANEA Fabricius

Like the preceding, only the males of this species were found, and they frequented the tall reeds and rushes along the Outlet in company with *incesta*. They were not quite so wary and they also stay closer to the ground, alighting on the sides of the rushes or on broken stems. The bi-colored pterostigma and the tinges of color adjacent to it, and also at the base of both pairs of wings, can be distinguished at some distance and at once separate this species from any with which it would be likely to become confused. The females kept themselves so closely hidden that not one was seen during the season.

Found rarely in Lake Maxinkuckee and commonly along the Outlet in company with *incesta*.

#### 15. LIBELLULA QUADRIMACULATA Linnæus

This beautiful species was the most widely distributed and, next to *L. luctuosa*, the most abundant of the large dragon-flies.

It is especially a pond-loving species, but was found also along the banks of the two rivers visited, along the banks of several of the cross-country ditches, around pools in the country barnyards, and even occasionally skimming the fields at some distance from the water. It is a strong flier and fairly wary. It also alights but seldom and keeps excellent watch. But it is also quite curious, and once or twice when the net was held out quietly it flew up near enough to be caught.

A bass, presumably *Micropterus salmoides*, was seen to rise and seize an imago of this species which had been knocked into the Yellow River with a sweep of the net. Another imago was seized and swallowed under similar conditions in Lake Maxinkuckee by a fish which could not be distinctly seen.

To these direct observations may be added the fact that, in spite of their abundance, not a single example was found floating on the water during the summer. The eggs are deposited near the shore, by repeated dips of the abdomen beneath the surface at nearly the same spot, similar to the practice of *L. luctuosa*.

The sexes are occasionally seen paired, but the female is usually alone during egg deposition.

Found at all the localities visited but especially abundant along the west shore of Lake Maxinkuckee.

#### 17. PLATHEMIS LYDIA (Drury)

A large and beautiful species, as strong a flier as the preceding, and considerably more wary. The old pruinose males are very conspicuous, their white bodies showing at a very long distance against the dark background. They also proved to be the most difficult to capture of any species, and only after repeated trials and numerous disappointments could one be gotten into the net. This species seems to prefer the creeks and inlets rather than the open water of the ponds. The sexes do not pair during ovipositing, and the female has a curious habit of placing her eggs in the water on the top of an old lily-pad whose center has become submerged.

The male is a tireless forager and flies back and forth over the same beat until the supply is apparently exhausted.

Found in the Outlet between Lake Maxinkuckee and Lost Lake, at the South Inlet, and along several streams emptying into the Yellow River.

#### 18. CALOPTERYX MACULATA (Beauvois)

This beautiful black damsel-fly does not come out in the open but sticks to the banks of the small streams where the thick vegetation throws always a cool shade. They fly slowly and not very strongly with a sort of fluttering motion.

Their black wings, unmarked save by the white pterostigma in the female, and the bright metallic sheen on the abdomen, make them conspicuous amid the foliage. They congregate in considerable numbers, and where conditions are favorable the banks of the stream will be fairly lined with them.

Their eggs are deposited amid the weeds and loose débris near the bank, the sexes pairing during oviposition.

A single male was captured on the Outlet between Lake Maxinkuckee and Lost Lake. They were found in great numbers on the Yellow River, Tippecanoe River and in some of the cross-country ditches to the west of Culver.

#### 19. HETAERINA AMERICANA (Fabricius)

A species that is common around rocky ripples in the streams and rivers where the water is shallow and the banks are grown up with the water willow, Dianthera. It stays close to the water's edge on the leaves of the willow and does not fly far even when disturbed. When flying, the bright red spots at the base of the wings of the male make it conspicuous but on alighting these spots are concealed by the folding of the wings. The eggs are deposited on the willow leaves at the water's edge, and the sexes are paired during the process. A blind sweep of the net along the willows at such times will often capture ten or a dozen pairs.

Very common along the Outlet, at Yellow and Tippecanoe rivers, and in the cross-country ditches to the west of Culver.

#### 20. HETAERINA TRICOLOR (Burmeister)

This species frequents the same localities as the preceding, and is very similar to it, the chief difference being in the posterior wings of the male, which are brown instead of red.

It is not therefore as conspicuous when flying as the preceding, but when at rest the only appreciable difference is one of size, *tricolor* being a little the larger. Its eggs, like those of the preceding species, are deposited in the weeds at the water's edge, the sexes pairing during oviposition.

Found at Tippecanoe and Yellow rivers, and in a cross-country ditch close to the Tippecanoe.

#### 21. LESTES UNGUICULATUS Hagen

This species is somewhat smaller and not so dark colored as the two which follow. The dorsal surface of the abdomen is an iridescent, metallic green, turning to pruinose in mature specimens. The white color at either end of the pterostigma furnishes a good mark for identification.

It flies swiftly and hides in the dense vegetation around the marshes and along the shore, coming out only to lay its eggs.

Found in considerable numbers at Hawk's marsh late in August and rarely along the Outlet between Lake Maxinkuckee and Lost Lake.

#### 22. LESTES FORCIPATUS Rambur

Nearly as large as *rigilax*, the males with slender and nearly black abdomens, the pterostigma entirely black in both sexes.

This is also a swift flier and a frequenter of the marshes and sedges, but it does not seem to remain concealed as persistently as *unguiculatus*. Williamson says it is the first of its genus to appear in spring, and it was found late in August at Hawk's marsh, where it was taken in connection with the preceding species. It was not found elsewhere.

#### 23. LESTES VIGILAX Hagen

Notably larger than the preceding species and more brightly colored, its colors, however, harmonize so well with its environment as to effectually conceal it. It is a slender and graceful species, preferring the rushes and weeds around the lake rather than along the streams. Its eggs are deposited amid the rush stems and the sedges, the sexes pairing during oviposition. The male retains such a firm hold of the female at this time that the two may not only be taken together but they may be killed and placed in the preservative still fastened together.

Found in special abundance in Lost Lake around the Outlet and at the South Inlet of Lake Maxinkuckee and rarely along the western shore of the latter lake.

#### 24. ARGIA MOESTA PUTRIDA (Hagen)

A large and dull-colored species which frequents the open shore where there is plenty of sunshine. They do not alight so much as the other species on the weeds and grasses but upon boards, sticks, stones, etc. They are not as lively as the other species and allow a close approach and easy capture.

In every instance observed the eggs were being deposited in the yellow, filth-laden algæ close to the shore. The male also, in these particular instances, held his body suspended above the female at an angle of about 45° by the rapid vibration of his wings. He was not seen to be drawn under the female, but the observations were very limited.

Found only at Aubeenaubee Bay in Lake Maxinkuckee and amid the pickerel-weed on Lost Lake.

#### 25. ARGIA VIOLACEA (Hagen)

A common species which remains all summer and may be found along the shores of the lake anywhere. It prefers the dense vegetation close to the shore, and is also found along the banks of the

cross-country ditches. The sexes are usually found paired and the eggs are deposited in the tissues of decaying weeds and stems floating at the surface. During oviposition the male holds his body suspended in the air after the manner just described for *putrida*. The eggs are large and dark-colored and can be easily found in the decaying tissues. The violet color of the male shows up plainly among the blue and red, the orange and the brown of the species with which it associates, and is a distinguishing character.

Found in all the localities visited.

#### 26. ARGIA SEDULA (Hagen)

This species is found with the preceding in the rank vegetation along streams and ditches. The males of the two species can be told at once by their color, violet in *violacea* and a deep blue in *sedula*. The females can then be told by their association with the males. The eggs are deposited similarly to those of *violacea* in the tissues of decaying matter floating at the surface. This species is not nearly so common as the preceding and was found in only two localities, along the Outlet between Lake Maxinkuckee and Lost Lake and at the South Inlet.

#### 27. ARGIA APICALIS (Say)

This species is similar to *putrida* but is brighter colored and is not found in similar localities, preferring the streams and rivers to the open lake shore. Here it lives amid the rank vegetation, venturing out only after food or for the purpose of depositing its eggs. These latter, furthermore, are never deposited in the dirty algæ near the shore but in the clearer water some distance out.

About 20 specimens of this species, including both sexes, were taken on the Tippecanoe River in September.

#### 28. CHROMAGRION CONDITUM (Hagen)

This species was found in considerable numbers at Hawk's marsh in company with two species of Lestes. They seemed to prefer this cool, shaded swamp, and were not seen in the open or anywhere along the lake shores. They were mating and the females were depositing their eggs in the few pools near the center of the water where any water was visible. Of necessity the eggs were laid in the weeds and lily-pads with which the pools were nearly choked. Several specimens of both sexes were secured.

#### 29. NEHALENNIA IRENE Hagen

A very small but handsome species found in the damp vegetation along some stream or ditch. In addition to its small size it is

bright green in color, and easily overlooked in the green foliage. The sexes are usually paired and the female deposits her eggs on the stems of rushes lying in the water. The eggs are pale in color and fastened on the surface rather than inserted in the substance of the rush.

Found along the outlet below Lost Lake.

#### 30. NEHALENNIA POSITA (Hagen)

Another tiny species, even smaller than the preceding, living amongst the cow-lily stems and pads out in the open lake. The male is usually bronze-black in color, ornamented with bright yellow and is much easier to distinguish than *irene*. The eggs are laid similarly on floating vegetation.

Found among the cow-lilies in Lost Lake, and in the South Inlet of Lake Maxinkuckee, where it is fairly common.

#### 31. ENALLAGMA HAGENI (Walsh)

A brightly marked blue species found in great numbers on the rushes in shallow water along the shores of Lake Maxinkuckee and Lost Lake. It was more abundant in July than in August, and had nearly disappeared by the last of the latter month. The sexes are nearly always paired and the female seems to prefer depositing her eggs on a broken or floating rush stem. The eggs are dark in color and are fastened on the surface of the floating material in great black patches. The males of this species like those of Argia have the habit of holding themselves in the air by a rapid beating of the wings while the female is ovipositing. As many as 50 or 60 couples may often be seen on the same rush stem, literally covering all the available space. They are quite tame, allowing the boat to pass so close that one could touch them by extending the arm.

#### 32. ENALLAGMA CARUNCULATUM Morse

Another bright blue species, a little larger than the preceding and not nearly as common. The two were found associated on the rushes in Lake Maxinkuckee and cannot be distinguished with certainty except by an examination of the abdominal appendages in the male. Their habits of pairing and oviposition are similar, but the eggs found were not as dark in color as those of *hageni*. This species probably occurs on the other lakes but did not happen to be found on the days when those lakes were visited.

33. ENALLAGMA DIVAGANS Selys

A much darker species appearing almost black when flying and found in company with the two preceding on the rushes in the open lake. The habits of oviposition are similar but only a few couples were found and the species appears to be rare.

34. ENALLAGMA EXSULANS (Hagen)

Another of the darker species, the black showing mostly when flying. It is, next to *hageni*, the most abundant species among the rushes, and was also found in the open herbage along the banks of the Yellow River.

35. ENALLAGMA SIGNATUM (Hagen)

An orange and black species easily recognized by its colors. The abdomen is noticeably slender, the black markings showing more prominently in the male while flying, and the orange markings of the female. When at rest both sexes show the orange markings plainly enough to distinguish them from the associated species of the genus. Then, too, they are not common among the rushes, but prefer the lily-pads at some distance from the shore.

Found in the outlet of Lost Lake and in the South Inlet of Lake Maxinkuckee.

36. ISCHNURA VERTICALIS (Say)

This is one of the species in which "at the time of imagination two distinct color types of females appear." In one of these the black, bluish, or grayish colors predominate, while the other is brilliantly streaked with orange. Both of these types were found with the green and black males upon the lily-pads in the outlet of Lost Lake early in August. Their flight was markedly weak and there was no trouble in capturing them. They alight, however, only on the tops of the lily-pads and so the net must be carried down into the water in order to capture them.

37. ISCHNURA KELLICOTTI Williamson

This species also has both the black and the orange females, the former seemingly the more abundant. It was not found anywhere around the lake with the exception of a single male taken at the South Inlet. But it was common at Hawk's marsh and many specimens of both sexes and of both types of females were secured there. The bright blue on the upper surface of the pterostigma of the anterior wings of the male serves to distinguish this species from the preceding. This is a species first discovered by Williamson and therefore of peculiar interest in the state.

38. ANOMALAGRION HASTATUM (Say)

This is another genus with two types of female, the orange and the black. It is found flying about in the shelter of the pickerel-weed along the shores of Lost Lake and at the South Inlet of Lake Maxinkuckee, and also at Hawk's marsh. It sticks closely to the weeds and does not usually venture very far from them even to get its food. Both sexes alight on the side of a weed stem when ovipositing and the female then backs down into the water. The species was fairly common at the places mentioned.

Mr. E. B. Williamson of Bluffton, Indiana, reports the following species not found by the present writer at Lake Maxinkuckee:

39. *Anax junius*, May 24, 1900, two males and one female.
40. *Tetragoneuria cynosura*, May 21 and 25, 1900, two males.
41. *Tramea lacerata*, May 21 and 25, 1900, two males.
42. *Enallagma calverti*, May 27, 1900, two males and one female.

A few of our field notes for May and June, 1901, may be given here. May 1, first dragon-fly seen; 5th, several dragon-flies; 14th small dragon-fly; 15th, many small dragon-flies (Agrionids) tenerals arise out of grass in damp ponds; 16th, dragon-flies of various sorts, mostly slender, as yesterday, some robust forms; all look pale; 18th, some large dragon-flies seen; 20th, dragon-flies come out of the water, emerging in great numbers; 22d, some dragon-flies came out; 23d, a good many dragon-flies seen, both large ones and slender steel-blue ones; some of the latter copulating; 29th, one large and one small dragon-fly seen; 30th, several dragon-flies seen.

June 3, many slender steel-blue dragon-flies copulating on rushes; 6th, great numbers of small dragon-flies in grass near lake; 8th, many dragon-flies, a small slender species coming out of cases at noon; 12th, dragon-flies, small ones quite abundant. Saw two large teneral dragon-flies in morning and several larvæ in afternoon; 17th, multitudes of small blue-green dragon-flies near Outlet Bay in evening; 20th, dragon-flies laying; 21st, good many small dragon-flies; 22d, dragon-flies plentiful.

In 1904, a rather slender red-bodied dragon-fly was noted ovipositing, and another was seen October 18. They seemed at this time to be the most abundant species. They were noted copulating and flying about October 26 and 27 and so on until November first.

Two years after the completion of the above list, another visit was made to the lake earlier in the season and a number of addi-

tional species were observed. These are probably as common as many of the original list, but they escaped notice during the first season, or they may have appeared and disappeared previous to the beginning of observations.

#### 43. GOMPHUS EXILIS Selys

Common on the banks of the Outlet June 28, 1909, where it alighted on the grass and on the lily-pads and spatter-docks over the water. Of nine captured, eight were males, all of which were feeding on teneral damselflies.

#### 44. GOMPHUS LIVIDUS Selys

Captured at the Gravelpit on the west shore of the lake July 1, in the grass along shore and back some distance from the water. Unlike most species of this genus, it alights on trees and bushes as well as on the ground.

#### 45. GOMPHUS FURCIFER Hagen

A single female was captured at the Gravelpit in company with the preceding species July 3. She was holding a teneral Tetragoneuria, which was about half eaten.

#### 46. GOMPHOIDES OBSCURA (Rambur)

Common along the sandy beaches on the western side of the lake June 30. A pair that were mating and several single males and females were secured. This species has the habit of perching on the reeds out in the water after the manner of Celithemis, but it chooses short and stiff reeds rather than tall ones that sway in the wind. It flies only a short distance from its perch and returns to the same spot repeatedly. In 1909 these dragonflies were still common on July 15, but none was seen in other years.

#### 47. ANAX JUNIUS (Drury)

Common around Lost Lake and along the Otulet on June 26, but not any seen on Lake Maxinkuckee. Afterward, on July 14, a single male was secured at Norris Inlet.

#### 48. EPICORDULIA PRINCEPS (Hagen)

Common in Lake Maxinkuckee and Lost Lake June 27, where they were patrolling the shore after the usual manner of this species. A single one was seen at Norris Inlet July 14. These are the only records for the species.

#### 49. TETRAGONEURIA CYNOSURA (Say)

Common at Lost Lake where it flies about over the water continually for long periods without alighting. Eight specimens were secured at the Gravelpit on Lake Maxinkuckee July 3, but the species disappeared very quickly after that date.

#### 50. LADONA EXUSTA (Say)

A few were seen on the east bank of the Outlet along the edge of the woods July 4, in company with *Libellula incesta* and *L. cyanea*. Several pruinose males were captured, and the species was afterward seen along the west shore of Lake Maxinkuckee.

#### 51. LIBELLULA PULCHELLA Drury

Common along the west shore of Lake Maxinkuckee in 1909. A large and powerful dragonfly which captures and eats many moths and small butterflies as well as other insects. It is more watchful and wary than many of the other species, but while eating, can be approached easily.

#### 52. TRAMEA LACERATA Hagen

A single male captured as it was flying along the shore of Lake Maxinkuckee. The black bases of the hind wings are very conspicuous when the insect is on the wing and make it easy to identify. Many were seen along the west shore, particularly at the Gravelpit, and it was also noted at Norris Inlet on July 14.

#### 53. SYMPETRUM RUBICUNDULUM (Say)

Several specimens were captured in Hawk's marsh in 1908, and a single male on the banks of the Outlet in 1909.

#### 54. LESTES CONGENER Hagen

A single pair taken together in Hawk's marsh August 24, 1908.

#### 55. ENALLAGMA GEMINATUM Kellicott

A single pair taken together in Lost Lake August 22, 1908.

#### 56. ENALLAGMA POLLUTUM (Hagen)

Two pairs taken together in Lost Lake on the lily-pads August 22, 1908, and a single male on the lily-pads at Norris Inlet August 25.

## ORDER ORTHOPTERA

GRASSHOPPERS, CRICKETS, KATYDIDS, ETC.

Even if they had nothing to do with the lake and its life, a discussion of the insects of the region, or, indeed, of the insects of any region, without mention of the Orthoptera would be, to use a singularly unhappy but hackneyed simile, like the play of Hamlet with Hamlet left out; for there is no other group of insects more prominent, perhaps one could even say so prominent, in the consciousness of men. What the gaudy butterflies are to the eye, the Orthoptera are to the ear. Indeed, grouping the various insects according to the sensations caused by the most familiar members we might say that we know the Hemiptera by the sense of smell,* the Diptera by the sense of touch, the Lepidoptera by the sense of sight, the Hymenoptera through their works and indirectly by the sense of taste, and the Orthoptera by the sense of hearing.

This group it is that adds to the thought of insect life nearly all of its lyrical element; and it is probably on account of this that the one notable exception is popularly known as the "locust", just as country boys think of the chimney swift as a "swallow" because of its general similarity in habits. As will be seen later, however, one group of these insects is of peculiar interest and bears a special relation to the life of the lake.

Not all the Orthoptera are choral. There are the cockroaches, which are, very fortunately, scarce or absent in the houses about the lake. A wild, or native species was, however, abundant and nearly ate the bindings off of some books kept in the tent, and the lank, silent walking-sticks, *Diapheromera femorata,* were not rare in woodlands. Of greatest economic importance were the grasshoppers.

This group of insects is important because certain species enter so largely into the food supply of many species of fishes. By all odds the most popular as well as the most killing bait used by the anglers who frequent the lake is the grasshopper. It is a choice bait and always attractive, not only to both species of black bass, but also to the rock-bass, bluegill and yellow perch, and not wholly rejected by the warmouth, crappie, calico bass, wall-eyed pike, pumpkinseed and other sunfishes.

It has been shown elsewhere in this report that the small boys who sell grasshoppers to the anglers at this lake derive therefrom an annual income of at least $200.

*We feel mosquitoes, smell bugs, taste honey (and if reports of lumber camps are to be believed, some of the men eat the large black ants for their acid taste and intoxicating effects), see butterflies, and hear crickets, grasshoppers and katydids.

Fortunately for the angler, grasshoppers of various species are abundant in the fields, meadows and waste places about Lake Maxinkuckee. The prairie meadows to the west of the lake have always been favorite localities for the hoppers, but in season they are abundant everywhere. They become popular for bait and are in demand just as soon in the summer as they have attained proper size and are in sufficient numbers to be secured in large quantities. This may happen as early as the first week in July; though usually the anglers will not be using hoppers exclusively until toward the latter part of that month.

In 1901, a few anglers began using hoppers as early as July 5, and with good success. On July 7, grasshoppers were heard singing in considerable numbers. August is, however, the best month. It was observed in 1900 and 1903, which were particularly good fishing seasons, that nearly all the good catches made in that month were on grasshoppers. They continue to be used just as long as they can be found, which will ordinarily be until about the last of September or just before the first frosts have come. In 1900 they were in use at least as late as October 1.

Several different species are used; the principal one being *Melanoplus differentialis,* a large red-legged species, abundant in all fields, particularly among ragweeds along the edges of cornfields. Another species of the same genus, *M. bivittatus,* is equally good, though somewhat less common. Still another is *M. femur-rubrum.* Various other species are used; indeed, almost any kind of grasshopper appeals more or less strongly to most of our freshwater spiny-rayed game fishes.

In September and October when it is difficult to get grasshoppers, black crickets (of the genus *Gryllus*) make good bait, particularly for bluegills.

Katydids of various species (particularly *Pterophylla camellifolia* and *Neoconocephalus robustus*) are common. They were first heard singing July 23. From then on they could be heard every favorable night.

In 1900 we became especially interested in a particularly musical, broad-winged katydid (*Pterophylla camellifolia*) that took up its station in a large white oak tree near our cottage. We first took note of it on the evening of July 23. From that date on it was heard on every suitable quiet night until September 27 when it missed although the night was a favorable one. The next night it was heard again and it continued noisy nearly every night for more than three weeks. About the 18th of October its song began to

weaken, particularly on the coolest nights, when it would give only a few very weak calls, usually consisting of "she did"; sometimes of "she did, she did," slow, deliberate, and weak. On the night of October 24 we heard a single low, weak, slowly uttered "she did," after which it became quiet and we heard it no more.

Crickets, especially the common black field cricket (*Gryllus assimilis lactuosus*), were fairly common and musical, especially in the fall. Our notebooks have many records of their singing, the earliest entry being May 17. From then on they were heard almost nightly and often in the daytime, until November 22. Mole crickets (*Gryllotalpa*) are rather common about the lake. Their burrows may be often seen in the sandy beaches. Their interesting musical note can often be heard, especially in August. Tree crickets were abundant, especially in low copses and thickets and, more than anything else except perhaps the katydids, made the autumn nights musical.

The following species of Orthoptera have been identified as occurring about Lake Maxinkuckee:

*Diapheromera femorata* Say
*Chorthippus curtipennis* Harr.
*Dissosteira carolina* Linn.
*Melanoplus atlanis* Riley
*Melanoplus bivittatus* Say
*Melanoplus differentialis* Thomas
*Melanoplus femur-rubrum* DeG.
*Melanoplus fasciatus* (Barnston-Walker)
*Scudderia curvicauda* DeG.
*Pterophylla camellifolia* Fabr.
*Neoconocephalus robustus* Scudd.
*Gryllus assimilis lactuosus* Serv.

## ORDER HEMIPTERA

### Bugs, Cicadas, Aphids, and Scale Insects

Of all the groups of insects found in the lake and in the immediate vicinity, the least attention was paid to the Hemiptera or bugs. In the course of seining, raking weeds, taking plankton, etc., various forms would attract the attention either because of form, color, habit or abundance, and these would be preserved for identification.

The Water Boatman, *Corisa* (*Arctocorisa*) *interrupta* Say, appears in our collection and was probably common in the lake. We have no special notes concerning it.

The Back Swimmers, Notonectidæ, are represented by *Notonecta undulata* Say, obtained November 25, 1904, in the outlet of Lost Lake, and *N. irrorata* Uhl., but we have no special notes.

The Water Scorpion, *Ranatra fusca* P. Beauvois, attracted attention by its commonness, and by the fact that it was usually in evidence while one was collecting minnows and darters out of the seine. The queer egg cases, laid in rows in bits of floating sticks or rushes, with the two long white setæ projecting, had aroused considerable curiosity which was not satisfied until a Ranatra was seen ovipositing in Lake Phalen, Minnesota, in 1907.

The Giant Water-bug or "Electric-light Bug" was occasionally seen. On December 7, 1906, one was observed creeping along on the under side of the clear ice, and on October 1, 1904, one was noted in the water near the Monninger cottage. Its smaller relative, *Belostoma flumineum* Say, was common in the lake and attracted attention through the habit of the male of carrying the eggs about on his back. It was obtained in various parts of the lake, in Aubeenaubee Bay, Aubeenaubee Creek, in Culver Inlet, and Lost Lake. On August 6, 1906, the young were observed hatching, the larvæ showing red eyes. These bugs as found in the lake are generally infested, sometimes pretty badly, with sac-like red objects attached to them, the young of one of the water-mites. On August 1, 1906, one was found in Lost Lake that had just moulted.

Peculiar toad-shaped bugs, *Gelostocoris oculatus*, were abundant along the sandy shore on the east side of the lake. Some were collected August 6, 1906.

The common water-strider *Gerris* (*Hygrotrechus*) *remigis* Say, was common in the creek in Overmeyer's woods and in various pools in the region about the lake.

The thread-legged bugs were represented by the long legged Emesa, *Emesa longipes*, which was very abundant in the Arlington waiting-room on one occasion, the insects looking a great deal like walking-sticks and presenting an odd appearance when in flight.

Individually by far the most abundant bug noted in the region was the Lace Bug, *Corythucha ciliata* Say, which was almost always present—both old and young—on the underside of the sycamore leaves. They ate the green color cells from the leaves, leaving them an unattractive sickly white in color. Under magnification these are the most attractive and dainty of the insects, the whole creature resembling a frosty lace.

Among the more common, homely bugs, the most abundant species was *Oncopeltus fasciatus* Dall, on the milkweed blossoms.

Cicadas, or harvest flies, were conspicuous by their absence. Throughout Indiana, as in other parts of the country, one of the characteristic sounds of summer is that of the Dog-day Locust or Harvest Fly. We have no record of hearing it at the lake. It is possible that it does not like the sandy soil.

An odd-shaped tree hopper, *Enchenopa binotata,* was noted in abundance laying white eggs in masses on twigs of the hop tree, *Ptelea trifoliata,* August 10, 1906, and examples were collected.

Plant lice were abundant on the pondweed leaves (*Potamogeton natans*) in Lost Lake, making a messy looking mass. They were also present, but in fewer numbers, on the water-lily leaves.

## ORDER TRICHOPTERA

### The Caddis-flies

The Caddis-flies are among the most interesting of our insects. Although about 150 species have been described from America, there are doubtless many remaining undescribed.

The adults are not well known to the general public, in spite of the fact that at times they appear in myriads. The larvæ, which are aquatic, are much better known. Every one who has spent any time along mountain streams, or even about other streams, or lakes, if at all observing, can not fail to have noticed the cleverly built, often beautiful, cases which these larvæ build of sand, brightly colored pebbles or bits of wood, held together by silken threads. As Professor Kellogg has well said:

> There is a great variety in the materials used and in the size and shape of the cases, each kind of Caddis-worm having a particular and constant style of housebuilding. Grains of sand may be fastened together to form tiny, smooth-walled, symmetrical cornucopias, or small stones to form larger, rough-walled, irregular cylinders. Small bits of twigs or pine-needles may be used; and these chips may be laid longitudinally or transversely and with projecting ends. Small snail shells or bits of leaves and grass serve for building materials. One kind of Caddis-worm makes a small, coiled case which so much resembles a snail shell that it has actually been described as a shell by conchologists. * * * An English student removed a Caddis-worm from its case, and provided it with small bits of clear mica, hoping it would build a case of transparent walls. This it really did, and inside its glass house the behavior of the Caddis-worm at home was observed.

Most Caddis-worm cases are free and can be carried about by the worm as it wishes, but many of them are fastened to rocks, stones or other objects in the bottom of the stream or lake. When a

Caddis-worm is ready to pupate, the pupa comes out from the submerged case, crawls up on some support above the water and there moults, the winged adult (imago) soon flying away. Some kinds, however, emerge in the water.

The Caddis-flies do not feed and are short-lived. They lay their eggs in or near the water where they hatch into Caddis-worms, thus completing the life cycle.

We find among our field notes the following:

October 29, 1900, collected a number of leathery caddis-cases at the Weedpatch. They were made of bits of shell fastened together. The larva sticks four legs out of the orifice and is able to crawl about freely. February 11, 1901, Caddis larvæ noted. June 10, Caddis-flies looking like small white moths, also lace flies, fluttering in the open woods, making a continuous hum through the night. June 11, noticed ovipositing in the lake; water full of larvæ casts, especially early in the morning; Caddis-flies very glaucous, looking like moths at a distance; they stay among the trees in the shady woods; collected a number and observed that their antennæ were very long. June 12, about 4 p.m., a strong southwest wind blew great myriads of Caddis-flies toward the lake; the swarm was thick and white and the appearance was that of a brisk snowstorm. June 13, while passing a maple tree on Long Point in the morning, an immense swarm of Caddis-flies came out of it, flying with a peculiar helpless, half-falling flight. June 14 to 17, many Caddis-flies and midges observed. June 22, caddis-flies laying in the water. October 18 to 29 (1904), Caddis cases (Helicopsyche?) like small snail shells, very abundant, attached to rocks and on bottom in Outlet Bay near Holbrunner's, and along the east side of Long Point. Also a number of empty chimney-shaped cases were seen, and several flattish ones moving about making burrows in the sandy bottom near Holbrunner's. October 5 and 10, many fine examples of Helicopsyche on stones, etc., in shallow water near shore. July 27, collected three of a scute-like kind while screening sand; put them in a saucer of water but they soon died. One species of Caddis-fly was abundant, a frail, glaucous, moth-like insect, the leathery cases of which were abundant on the stems of Potamogeton, Scirpus, etc., from midsummer until in the spring when (about June 10) they emerge in great numbers, and the next day are busy ovipositing. A peculiar case looking like a snail shell built of pebbles was found in numbers in the same place.

The caddis-cases that attracted the most interest were the flat

ones referred to above, found near shore in sandy bottom along the east shore of Long Point. Just as one species of Caddis-worm builds a case resembling a snail shell, the case of these bears some resemblance to a limpet, or to a marine genus of mollusks, Crepidula, showing how similar conditions of life lead to similarity of form. The caddis-case under discussion is very effectively concealed by its resemblance to the sand on which it is found; most were found while screening sand in the search for young mussels. The central portion of the shell—that is the first part built—is composed of very minute sand grains; around the margin, either because the larva has become stronger and can handle coarser material, or because they build up more rapidly, coarser bits are used. When the builder has chosen one sort of material it appears to make some effort to match it. In some cases the valves of the shells of a very small bivalve mollusk, Pisidium, were used around the margins and the cases thus built were especially attractive. The larva lived in a little arch or compartment below the roof of the case.

## ORDER COLEOPTERA

### The Beetles

No special attention was given to the beetles except a few species found in and about the water. No one could help noticing the tiger beetles which were present in considerable swarms on sandy beaches and were conspicuous on hot days, hopping or jumping before one walking along shore. There were two kinds present, a brown one and a bright, metallic green.

Whirligig beetles, *Dineutes*, were common about the edges of the lake. Some were seen swimming about as late as November 4.

The Predaceous Diving Beetles (*Dytiscus*) were not especially common in the lake. We obtained, however, an example of *D. hybridus*.

The water-scavenger, *Hydrophilus*, appeared more common in pools and ponds than in the lake itself. The egg cases were common on the under sides of the thallus of Riccia.

Small hemispherical or rather oval red beetles with black spots (*Melasoma interrupta*) were exceedingly abundant on the willows along shore early in the spring of 1901. The adults laid the eggs on the leaves of the willows and the young which soon hatched almost defoliated the trees, and the water of the lake was almost covered with the adult beetles.

The "water penny", the larva of *Psephenus lecontei*, was common under pebbles in the lake, its chiton-like form arousing con-

siderable interest. The most interesting of the beetles in the lake is a little creature belonging to the genus Stenelmis that lives in the masses of lime or marl or algæ which grow on the exposed ends of the freshwater mussels living in the lake. This growth or deposit is most marked on the shells of *Lampsilis luteola* which is the most abundant species of mussel in the lake. These mussels burrow more or less in the mud or sand, leaving usually one-tenth to one-fifth of the posterior end exposed to the water. Upon this exposed portion a mass of lime and algæ slowly accumulates and finally becomes one-fourth to one-half inch thick. In this mass the little beetle, recently described as new by Professor W. S. Blatchley from collections made by us and named by him *Stenelmis sulcatus*, is quite common; a collection of 20 to 30 mussels would furnish 50 to 100 examples of the species. Specimens have been found in similar masses on rocks in the lake, and it probably occurs on other species of mussels though we have found none on any except *Lampsilis luteola*.

Click-beetles, especially the large conspicuous eyed Elater, *Alaus oculatus*, were seen occasionally. The beautifully phosphorescent larva of one was obtained at night on Long Point June 28, 1901.

The fireflies or Lampyrids were exceedingly abundant in low grassy places, flashing everywhere at night. The phosphorescent larvæ were abundant in the grass along the Inlet.

A few stag-beetles were seen on Long Point.

Snout Beetles, especially acorn weevils, were common, and most acorns were attacked. One was seen on an acorn, and a snout-beetle was seen June 7, 1901, with patches of eggs, on the tip of a bulrush.

The only species of beetles represented in our collections are the following:

*Stenelmis sulcatus* Blatchley
*Dytiscus hybridus* Aubé.
*Ilybius biguttulus* Germ.
*Acilius fraternus* Harris
*Tropisternus glaber* Herbst.
*Photuris pennsylvanica* DeG.; larvæ.
*Dineutes sp;* larvæ.
*Psephenus lecontei* Lee
*Cicindella* sp.
*Melasoma interrupta*

## ORDER DIPTERA

### The Flies

The genera of dipterous insects found about the lake that possess most interest to us are Chironomus, Culex, and Anopheles. Of these the genus Chironomus is economically the most important. One species occurs at the lake in untold billions. Late in September and early in October, 1913, one large yellowish, mosquito-like species of Chironomus appeared in immense numbers. They were noted every evening at least from September 21 to October 5, filling the air at Long Point from near the surface to a height of 20 or 30 feet, and making it musical with their incessant humming. They were particularly abundant on the evening of October 5. They appeared in enormous numbers sometime before dark and continued late in the night. They literally filled the air; a person could not walk about without being annoyed by their striking him in the face. It was evidently their nuptial flight, and was kept up for about two weeks during warm quiet evenings. The flight would usually begin an hour or so before dusk and continue well into the night. They were in evidence in some numbers throughout the day, but the great flights always occurred late in the evening. Various species of birds were observed feeding upon these insects, among them nighthawks, yellow-billed cuckoos, red-headed woodpeckers, yellow-rumped warblers, and song sparrows. The cuckoos, warblers, swallows and sparrows would pick them from the limbs of trees, while the others took them on the wing.

At the same time, vast quantities of the cast-off skins of the larvæ of these insects were washed up on shore where they could be seen in great masses along the edge of the water. There they were fed upon by Wilson's snipes, sandpipers, rusty blackbirds and even red-winged blackbirds. They were also fed upon by various fishes such as straw-colored minnows, grayback, top-minnows and the like. The larvæ, known as red worms, are very abundant in all parts of the lake; they have been dredged up from even the deepest parts. They are choice food for the fishes and no doubt constitute an important part of the daily menu of the suckers, minnows, darters, sunfishes and the young of the basses and other spiny-rayed fishes. A 75-pound buffalo-fish contained almost a bucketful of Chironomus larvæ.

About the middle of August, 1906, a mass of eggs of a smaller species of Chironomus was found and placed in a saucer. The eggs hatched in a few days into little wrigglers which soon became worm-like and built for themselves little tubes in which they

stayed. The tubes varied greatly in size and were probably built up of the excreta of the wrigglers. These wrigglers would sometimes leave their tubes and swim about near the surface, and fed greedily upon Spirogyra which was put in the dish. Chironomus larvæ were observed to be abundant throughout the lake during the winter. They were easily obtained by dredging. They were either naked or enclosed in gray mud cases. When naked their bright colors made them very conspicuous. Some that were placed in a jar with some sticklebacks proved very attractive to the latter which snapped them up greedily. Some naked larvæ placed in a tumbler of dirty water over night encased themselves.

Another group of dipterous insects of importance is that of the mosquitoes. Fortunately for the summer cottagers, however, mosquitoes rarely appear in sufficient numbers about the lake to be much of a pest. While there are several marshy tracts near the lake which furnish favorable breeding grounds for mosquitoes, they are, in most instances, sufficiently remote from the cottages, or else the winds are favorable for keeping them away. They are, of course, more common in some seasons than in others. Our notes speak of them as common in certain places November 2, 1902 and 1903, July 3, 1904, September 12, 1907, and September 2, 1913. They are said to have been rather bad during the summer of 1913. Unfortunately, very little attention was given to preserving specimens of the various species of insects and our collection contains but three species of mosquitoes, viz: *Anopheles quadrimaculata*, *Culex stimulans* and *Culex excrucians*. Doubtless others occur.

Corethra larvæ are common in the lake, descending into the deeper waters; they are also common in the woodland ponds.

Following is a list of the species of Diptera represented in our collections from Lake Maxinkuckee:

*Psorophora ciliata* Fabr.
*Anopheles quadrimaculata* Say
*Culex stimulans* Walk.
*Culex excrucians* Walk.
*Tanypus monilis* Linn.
*Calliphora erythrocephala* Meig; larvæ.
*Chironomus meridionalis* Johan.
*Chironomus decorus* Johan.
*Chironomus cayugæ* Johan.
Tipulid, probably the genus Tipula.
*Tenytarsus dives.*
*Ablabesmyia monilis* Linn.

It is worthy of note that the deer-fly, *Chrysops,* which we found very annoying at Twin Lakes a few miles north, is not common at Lake Maxinkuckee. At Twin Lakes where the deer-flies were particularly pestiferous on one occasion a robber-fly came along and caught one just about to bite.

## ORDER LEPIDOPTERA

### Butterflies and Moths

Butterflies are abundant about the lake. The great diversity of soil, moisture, and vegetation, furnishes conditions very favorable to the development of this group of insects. The number of species is therefore large, and many of them are represented by numerous individuals during their season.

Perhaps the most conspicuous species and one that may be seen throughout the greatest number of months is the milkweed butterfly (*Danaus archippus*). Although not the first to appear in the spring it nevertheless appears quite early, and it is the species that may be seen in numbers quite late in the fall. Only a small amount of sunshine and warmth is sufficient to entice it to wing, and single individuals and often groups of three or more may be seen on almost any warm day until late in October or even in November. It is usually most in evidence, however, during the middle of summer (July and August) when the common milkweed (*Asclepias syriaca*) is in flower. Then about every clump of this showy plant, so abundant along the railroad and on the borders of woods, old fields and ill-kept fence rows, these large butterflies of rich brown and black may be seen in abundance. Late in the fall, even after the first biting frosts have changed the marshes and byways from their summer green to the somber browns and grays of late autumn, several of these butterflies may be seen by any one who goes afield on the still Indian summer days.

Sometimes remarkable flights of the Milkweed Butterfly occur. Such a flight was witnessed at noon on September 24, 1907, when several hundred were seen flying from the direction of the lake over Arlington station and into Green's woods. They flew against a strong wind but were able to make good headway. Some of them were much higher than the telegraph poles, others were lower down and sailed upward against the wind. At times only two or three would be in sight, then 20 to 30 would come flying close together. The flight continued for 15 or 20 minutes.

The common Cabbage Butterfly (*Pieris rapæ*) is, of course, an

abundant species. Our notes record it at various dates from April 27 to September 27. The larvæ are abundant and doubtless often drop or wash into the lake.

On October 9 and 10, 1907, the caterpillars of the Cabbage Butterfly were crawling thickly over the east side of a house on Long Point and pupating. Many were dead. They had apparently been stung by ichneumon flies, many of which were seen near the unaffected ones. Beside the dead caterpillars were clusters of golden silky cocoons, about 18 in number, probably of ichneumon-flies.

The Southern Cabbage Butterfly (*Pieris protodice*) is also common. It was noted throughout the season from June 11 to October 31.

The earliest species to appear in the spring is the beautiful Mourning Cloak (*Aglais antiopa*). As it hibernates through the winter it may be seen quite early in the spring when the first warm days revive and bring it forth. Our earliest record is for April 10, but it doubtless appears before then. Our latest record is on October 30, when one was seen hidden under a hollow log. On April 26, three were seen on flowers of Bebb's willow.

The Red Admiral (*Vanessa atalanta*) is another pretty species which appears early in the spring and remains until late in the fall. Our early and late dates are June 7 and October 29. This species is fairly common.

Hunter's butterfly (*Vanessa virginiensis*) is another beautiful but less common species which we have noted from May 3 to October 29.

The genus Polygonia is represented by at least two species (*Polygonia comma* and *Polygonia interrogationis*). These are also among the species which appear early in the spring and remain later in the fall. They are solitary in their habits; not often are more than one or two seen together. Our notes mention Polygonias at various times from April 4 to November 2.

Of the swallowtail butterflies perhaps the most common is the Black Swallowtail (*Papilio troilus*). Our records mention it on various dates from May 9 to September 27. The zebra or Ajax Swallowtail (*Papilio marcellus*) and the large yellow swallowtail (*Papilio glaucus f. turnus*) are apparently not common.

The following is a list of the species of butterflies noted at Lake Maxinkuckee:

1. *Papilio polyxenes* Fabr.
2. *Papilio troilus* Linn.
3. *Papilio marcellus* Cram.

4. *Pieris protodice* Bd.-Lec.
5. *Pieris rapæ* Linn.
6. *Eurymus philodice* Godt.
7. *Eurema euterpe* Men.
8. *Danaus archippus* Fabr.
9. *Cissa eurytus* Fabr.
10. *Satyrodes canthus* Linn.
11. *Cercyonis alope* Fabr.
12. *Cercyonis alope* Fabr. var.
13. *Cercyonis alope nephele* Kirby
14. *Argynnis cybele* Fabr.
15. *Brenthis myrina* Cram.
16. *Phyciodes tharos* Drury
17. *Polygonia interrogationis* Fabr.
18. *Polygonia comma* Harr.
19. *Aglais antiopa* Linn.
20. *Vanessa atalanta* Linn.
21. *Vanessa virginiensis* Drury
22. *Basilarchia archippus* Cram.
23. *Libythea bachmani* Kirt.
24. *Heodes hypophlæas* Boisd.
25. *Heodes theo* Boisd.
26. *Ereres comyntas* Godt.
27. *Lycænopsis pseudargiolus* Bd.-Lec.
28. *Epargyreus tityrus* Fabr.
29. *Cocceius pylades* Scud.
30. *Pyrgus tessellata* Scud.
31. *Thanaos persius* Scud.
32. *Ancyloxypha numitor* Fabr.
33. *Callosamia promethea* Drury (moth)
34. *Scepsis fulvicollis* Hubn. (moth)
35. *Eubaphe ferruginosa* Walk. (moth)
36. *Utetheisa bella* Linn. (moth)
37. *Xanthotype crocataria* Fabr. (moth)

## ORDER HYMENOPTERA

### The Bees

Our notes on the Hymenoptera are very few indeed. These, the most highly organized of insects, have the least to do with aquatic life.

Judging from the number and kinds of oak galls on the trees

about the lake, gall-wasps are abundant and represented by various species.

Of the Braconids, *Microgaster* is common, and the parasitized caterpillars that have fallen a prey to it have been frequently found about the lake.

Ants are not so common as to be a nuisance. There are, however, a few large dome-shaped ant hills along the border of the wet ground near Lost Lake and along its outlet down by Walley's woods.

The solitary wasps are represented by the potter-wasp, *Eumenes fraterna*, which builds its exquisite little clay vases on slender twigs down at the edges of the woods toward the south end of the lake.

Wasps and Yellowjackets are occasionally seen. Hornet's nests were rather rare. On November 2, 1902 a big hornet's nest was seen in a white oak in Walley's woods 30 feet up. It had been shot into. Another very large nest was found October 24, 1907 beside a lane west of the ice-houses near the tamarack swamp. It was built on some wild-cherry sprouts, the nest almost or quite touching the ground. Some one had torn away a part of one side. Tearing the nest open it was found that many of the grubs were just emerging and crawling about. A photo was taken of the nest. Dr. L. O. Howard says that this hatching in the fall is very unusual.

There is a current popular belief that if hornets build their nests high in the trees it is a sign of an open winter, while if they are built close to the ground the winter will be severe.

On October 11, 1913, a fine large nest was seen in a tulip tree in Overmeyer's woods, south of Farrar's. It was on the end of a limb about 20 feet from the ground.

Our notes have occasional references to both bumblebees and honey bees. There is little bee-keeping about the lake (we saw a few hives on the east side) though the country with its moist lowlands covered with blossoms from early spring to late autumn would furnish excellent opportunities.

# THE MOLLUSKS

## THE UNIONIDÆ

During the study of Lake Maxinkuckee considerable attention was given to the mollusks, particularly the freshwater mussels or Unionidæ. This was justified by the rapid and astonishing development of the pearl button industry in America which is dependent upon the shells of mussels for its raw material. The recent discovery by Lefevre and Curtis of methods whereby commercially valuable species of mussels are now successfully propagated artificially, adds special interest to these mollusks. Recent studies and discoveries relating to the formation and artificial production of pearls in freshwater mussels may also be mentioned as showing the importance of careful study of the taxonomy and life history of the Unionidæ.

### Lakes and Ponds as the Home of Mussels

Generally speaking, lakes and ponds are not so well suited to the growth and development of mussels as rivers are; the species of lake or pond mussels are comparatively few, and the individuals usually somewhat dwarfed. Of about 84 species of mussels reported for the State of Indiana, only about 24 are found in lakes, not all of these in any one lake, and several of them but rarely in any. Of the 24 species occasionally found in lakes, but five are reported only in lakes, and only three or four of the species common to both lakes and rivers seem to prefer lakes.

In rivers, the essential feature favorable to the development of mussels is the current; and in the rivers the mussel beds reach their best development in the riffles, where the current is strongest. The importance of the current to the well-being of the mussels is indicated by the position these mollusks naturally assume in the beds, the inhalent and exhalent apertures of the creatures being directed up-stream against the current. The importance of the current is not merely as a bringer of food; examinations show that the mussels of the plankton-rich lakes and ponds usually contain more food material than those of rivers. The current gives the river-mussels the advantage of a constant change of water, which means a more abundant supply of oxygen, and doubtless a more varied supply of mineral matter, from the various sorts of soil through which the river flows.

The current is also probably of considerable importance in assisting in the fertilization of mussels, one of its functions being

the conveyance of sperm from mussels in upper portions of the bed to other mussels below. In places where there is no current, fertilization must be more largely a matter of chance.

Although the majority of species of mussels prefer a river where there is a good current, some are more fitted to the quieter parts of streams, or to ponds. These are chiefly thin-shelled species with weakly developed or undeveloped hinge-teeth, best represented by the genus *Anodonta*. In some places Anodontas are known as pond-mussels, as distinguished from the heavier sorts or river-mussels.

The distinction between lakes and rivers is not constant in degree; we have all sorts of gradations from the extreme form of lake—isolated bodies without outlet—through lakes with relatively large, important outlets, to such lakes as are simply expansions of a river-bed, examples of the latter type being Lake Pepin, Minn., of the upper Mississippi, and the former English Lake in Indiana, an expansion of the Kankakee. As a usual thing, the more fluviatile a lake is, or the larger and more river-like its outlet, the more river-like will be its mussel fauna, both in abundance and species. In such lakes the mussels retain a vital continuity with the mussel beds of the river. In the less fluviatile lakes the mussels are more isolated, and there is more inbreeding. The large number (24) of lake-dwelling species recorded for Indiana is due to the fact that some of the lakes of Indiana are more or less fluviatile, and contain several species of river shells.

### Origin and Character of the Maxinkuckee Mussels

Lake Maxinkuckee, having a long, narrow, winding and relatively unimportant outlet, is a representative of one of the less fluviatile types of lakes, forming a pretty well marked contrast to the various lakes cited above, and bearing a pretty close resemblance to the neighboring lakes, such as Twin Lakes, Pretty Lake, Bass Lake, etc.

The Maxinkuckee mussels are doubtless derived from ancestors brought up the Outlet from the Tippecanoe River by ascending fishes. It is doubtful whether any have been introduced by the numerous plants of fish in the lake, though such a thing is possible. During the various times the lake was visited, a few Tippecanoe River mussels were planted in the thoroughfare between the lakes, and a few Yellow River and Kankakee mussels were planted in the main lake.

The Outlet of Lake Maxinkuckee is now a narrow, shallow winding stream, straightened in places by ditching, and bordered

on each side by a flat sedgy plain which indicates the former breadth and importance of the stream. The colonization of the lake with mussels was probably effected chiefly during the period when the Outlet was a broad and relatively important stream. The situation has been carefully considered and seems to show that the mussels of the river and lake are isolated from each other and that there is no longer any vital connection between them. The strongest indication of the independence of the lake and river mussel faunas is the appearance of the Maxinkuckee mussels themselves; these are lake-mussels, easily distinguished for the most part from river mussels of the same species, and many of them are ditinguishable also from the mussels of the neighboring lakes.

The Tippecanoe River is fairly well supplied with mussels. Although the number of species is considerably fewer, and the size of the individuals is generally smaller, than that of the Wabash into which it flows, it compares very favorably with rivers of its size. At Delong, Ind., a short distance above the mouth of the Outlet of Lake Maxinkuckee, were obtained in one bed specimens representing 24 species of mussels or about twice the number of kinds found in Lake Maxinkuckee.

Our knowledge of the extent and importance of migrations of fishes from the Tippecanoe River up to the lake and from the lake down to the river—a question which has a marked bearing upon the relationship of the mussel faunas—is not as complete as it should be, but indications are that they are not important or extensive. Inasmuch as the geographic distribution of a given species of mussel is coextensive with that of the species of fish which serves as its host, this question is worthy of careful consideration. There are several species of fishes of the Tippecanoe River (*Etheostoma camurum, Hadropterus evides, Hybopsis amblops,* etc.) which were not found either in the Outlet or in the lakes, and other species (*Hadropterus aspro, Ericymba buccata, Diplesion blennioides*) which have pushed halfway up the Outlet, but were found no further up.

In this connection, the mussel fauna of the Outlet is worthy of consideration, and on various occasions, but especially on a trip down the Outlet September 30, 1907, particular attention was paid to this feature.

The Outlet is not particularly well suited to the life and growth of mussels; the bottom is either a firm peaty soil or fine shifting sand; moreover, the course has been artificially changed in some places and the stream has naturally shortened its length in others by making cutoffs. In addition to this the mussel fauna of such

a narrow shallow stream would be the prey of muskrats, minks, etc., the entire length and width of the beds.

On the trip mentioned above, about a mile below Lost Lake a fine example of *Lampsilis iris* was found. This is the farthest up stream any species of mussel was obtained, and as this species is fairly common in both lakes and abundant in the Tippecanoe River, we have here the nearest approach to a continuous fauna. Some dead shells but no living examples of *Quadrula undulata* were found a little farther down. Farther down stream, from a quarter to half a mile, a short distance above the second cross-road south of the lake, was found a small mussel-bed of about 40 or 50 mussels, the great majority of which were *Quadrula undulata*. A few living *Lampsilis iris*, two dead *Symphynota compressa*, one living *Symphynota costata* (gravid), and a few dead shells of *Quadrula coccinea*, complete the list. Below this point no mussels were found until near where the Outlet joins the Tippecanoe. Here, a few rods up the Outlet, a fair bed of *Quadrula coccinea* was found. Of the five species of mussel found in the Outlet, only two, *L. iris* and *Q. coccinea*, are found in the lake, the latter but rarely. The form and general appearance of the *Q. undulata* of the Outlet is quite peculiar and they can be picked out at once in collections from the various rivers of the country. They are unusually elongate, in this respect representing some of the Tippecanoe mussels but differing from them in being thinner, and in having the furrows between the plicæ unusually deep and sharp. The costæ on the postero-dorsal slope are very marked, and the epidermis jet black. The umbones are considerably eroded.

## Distribution of Mussels in the Lake

In rivers, where there is a great variety of conditions, such as differences of current, bottom, etc., one finds the different species of mussels inhabiting different localities and different situations. In the lakes, where we have comparatively few species of mussels and not such important differences of environment, the distribution of the various species is much the same. The same conditions, such as rather shallow water and moderately firm bottom, are equally suitable for all. A few important exceptions may be noted; as for example, the less common species of the lake are often more or less local in distribution. The only well-marked bed of *Quadrula rubiginosa* in the lakes is in the Lost Lake mussel-bed below the Bardsley cottage, and this is the only place where *Lampsilis subrostrata* can be collected in any considerable numbers. *Lampsilis glans* has a marked preference for the shallow water at

the edge of the thoroughfare between the lakes; occasional examples can, however, be picked up almost anywhere along shore, and it appears to be increasing considerably along shore at Long Point. *Anodonta grandis footiana*, which can live in softer bottom than the other mussels, has a considerably wider distribution, and was dredged up in deeper water than any of the other mussels.

The mussels are to be found almost anywhere in water from 2 to 5 or 6 feet deep where the bottom is more or less sandy or marly. The beds are composed chiefly of the three principal species of the lake, *Lampsilis luteola*, *Unio gibbosus* and *Anodonta grandis footiana*, with the less common species sparsely interspersed. Especially good mussel beds occur at Long Point, along shore by Farrar's and McDonald's, by the Depot grounds, in Aubeenaubee Bay out from the Military Academy, and in the shallow water just beyond the mouth of Norris Inlet. Mussels are fairly well scattered from Long Point more or less continuously all the way southward to beyond Overmyer's hill, and from a little north of the ice-houses all the way around to the Military Academy. They are quite abundant in the neighborhood of Winfield's in shallow water, and occur scattered along the east side of the lake a little way out from shore. A good mussel bed is found in Lost Lake along the east shore, extending from a little south of the Bardsley cottage to where the bulrushes and water-lilies grow thickly in the soft black muck near shore.

*Movements:*—Closely connected with the question of distribution is that of movement. The greater number of mussels of the lake, especially in the deeper water, spend their lives in a state of quiescence. Young mussels appear to be more active than older ones. The mussels retain the power of locomotion during all their lives, but after they have got well settled down, they only occasionally use this power. The mussels of the shallow water near shore move out into deeper water at the approach of cold weather, in late autumn or early winter, and bury themselves more deeply in the sand. This movement is rather irregular and was not observed every year. It was strikingly manifest in the late autumn of 1913, when at one of the piers off Long Point a large number of furrows was observed heading straight into deep water with a mussel at the outer end of each. The return of the mussels to shore during the spring and summer was not observed. Many of them are probably washed shoreward by strong waves of the spring and summer storms, and some are carried shoreward by muskrats and dropped there. Occasional mussels were observed moving about in midwinter—even in rather deep water. During the

winter of 1900-1901 an example of *Lampsilis luteola*, in rather deep water in the vicinity of Winfield's, was observed to have moved about 18 inches within a few days. Its track could be distinctly seen through the clear ice.

As a result of the quiescence of the lake mussels, the posterior half or $\frac{1}{3}$ of the shell, which projects up from the lake bottom, is usually covered by a thick marly concretion which appears to be a mixture of minute algæ and lime. This marly concretion grows concentrically, forming rounded nodules, its development increasing with the age and size of the shell. This concretion, though most abundant on shells, is not confined entirely to them, but grows also on rocks that have lain undisturbed on the bottom. When growing on shells, it adheres to them very closely; and upon being pried loose sometimes separates from them much as the matrix separates from a fossil, and leaves the epidermis of the mussel clean. In other cases it adheres more firmly and is difficult to scrape off clean. On this marly growth, colonies of Ophrydium, much the size, color, and general appearance of grapes with the skins removed, are often found growing, and in the cavities and interstices of the marl, a handsome little water-beetle, *Stenelmis undulatus* Blatchley, and its peculiar elongate black larvæ, live in considerable numbers but apparently have nothing to do with the mussels. Various species of hydrachnids, one of them strikingly handsome with its green body sprinkled with bright red dots, also live in the cavities of the marl, and offer some suggestion as to how the parasitic mite *Atax* went a step farther and took up its habitation within the mussel itself.

*Food and feeding:*—An examination of the stomach and intestinal contents of the various species of mussels of the lake showed no noticeable differences between the food of the different species. Enough of the bottom mud is generally present to give the food mass the color of the bottom on which the mussels are found; thus the stomach-contents of the mussels found in the black bottom of Lost Lake was usually blackish, while that of those found in the lighter bottom at Long Point was grayish. Intermixed, however, with the whole mass was always enough algæ to give it a somewhat greenish tinge, this green being usually intermixed more or less in the form of flakes. A striking contrast between the stomach contents of mussels inhabiting lakes and those found in rivers is the much greater preponderance of organic matter in the food of the lake mussels. The stomach contents of river-mussels is generally chiefly mud, with a few diatoms, desmids, *Scenedesmus* and *Pediastrum* intermixed, as said above. Those of

the lake mussels are almost always full enough of algæ to be more or less flecked with green and sometimes the whole mass is decidedly greenish. On being placed in a vial of preserving fluid (3% formalin was generally used) and shaken, the material from the river mussels always retains the uniform appearance of mud; that from the lake mussels separates, the mud settling to the bottom and the organic material settling as a light flocculent mass above the more solid portion. This top layer is composed of the various plankton elements of the lake, and was found to vary considerably in different lakes. In the Lake Maxinkuckee mussels it was found to consist chiefly of such species as *Microcystis aeruginosa, Botryococcus braunii, Coelosphaerium kuetzingianum*, various diatoms, such as species of *Navicula, Rhoicosphenia, Gomphonema, Cyclotella*, and *Cocconema*, various forms of desmids, especially *Cosmarium* and *Staurastrum*, various forms of *Scenedesmus*, considerable *Peridinium tabulatum*, and short filaments of *Lyngbya*. *Pediastrum*, both *boryanum* and *duplex* are here, as almost everywhere, rather common objects encountered in the intestines of mussels. Casts of the rotifier *Anuræa cochlearis*, and of the small entomostracan Chydorus, were occasionally encountered. In one of the Lost Lake mussels, *Dinobryon*, an exceedingly frequent element of the mussel-food in Lake Amelia, Minn., but rare here, was found.

No opportunities were had to study the stomach contents during the winter, the mussel work having not been taken up to any great extent during the earlier part of the survey. Mussels obtained quite late in the autumn contained much the same material as in summer. The open and apparently active inhalent and exhalent apertures noted throughout the winter in some individuals would indicate that the mussels—at least some of them—do not hibernate, but carry on life processes more or less actively the year round. The presence of pretty well marked growth-rings would indicate, however, annual rest periods. As diatoms appear to be much more abundant in the water during the winter, it is probable that they enter more plentifully into the mussel's bill-of-fare during the late autumn, winter and early spring than during the summer. In consideration of the mussels as feeders on plankton elements, it is worth while to investigate whether these are not of benefit to the lake as the reducers of excessive amounts of such undesirable elements as *Lyngbya, Anabaena* and *Microcystis*, and whether a considerable increase in the mussel population by means of artificial propagation would not clear up the lake to a considerable extent. The following studies of stomach contents and table

of mussel food are by no means exhaustive, but represent hurried examinations and a record of the more easily recognized forms out of a mass of doubtful material. They are intended to be simply suggestive.

Closely connected with the question of food and nutrition is that of the size of mussels. A marked feature of the mussels of Lake Maxinkuckee as well as of the neighboring lakes, is the dwarfing of many of the species, and this is rather difficult to explain, when one considers the large amount of organic material they ingest. The mussels of a few northern lakes examined were thick-shelled and large, so this dwarfness may not be necessarily associated with lake conditions, that is, absence of current. A possible explanation is that of close inbreeding, there being no admixture of new blood with other distant colonies, such as is possible where the lake is in close connection with a large river and its mussel beds.

*Breeding habits, reproduction, etc.:*—The reference to inbreeding above leads to a consideration of breeding and breeding habits. At first glance it would appear that lakes, having no or only feeble currents would make fertilization of the ova of the female mussels largely a question of chance. It is not possible, with the data at hand, to make precise comparisons between number of gravid females of the mussels of lakes and rivers during the proper seasons; but the general impression gained from having examined the mussels of numerous lakes and rivers through the different seasons is that there are fewer of the mussels of the lake that succeed in having their ova fertilized. Gravid mussels are indeed not rare in the lake at the proper seasons, but they seem to be much fewer than one might expect. On October 17, 1907, for example, of 252 *Lampsilis luteola* examined, 41 were of the characteristic female form but only 25 were gravid. Likewise of 18 Anodontas examined on the same date, only 2 were gravid. This is a considerably lower percentage than one would expect in rivers at that date. There are other indications that the functions of reproduction are much less prominent in the lake than in rivers. In the height of the spawning season certain species of mussels, especially *Lampsilis ventricosa* and *L. multiradiata*, exhibit, in the neighboring rivers, a very striking appearance, due to the excessive development and high coloration of portions of the mantle near the inhalent aperture. Though both these species are found in the lake, none was observed in this condition. In some rivers in densely crowded beds, moreover, one frequently encounters precocious individuals; small shells, usually apparently only two or three years old but gravid and with the characteristic female contour markedly de-

veloped. This is possibly related to opportunities of fertilization of ova, and is most frequently observed in *L. ventricosa* and *L. luteola;* no such precociously developed mussels were found in the lakes.

A large and well developed female *Lampsilis ventricosa* was transplanted from Yellow River into Lake Maxinkuckee. On being examined two years later in the autumn when this species is usually gravid, it was found to be sterile.

The natural infection of fishes of the lake with the glochidia of the mussels does not appear to be common. The gills of an immense number of fishes were examined for parasites, but no glochidia were noted. Some young bluegill and redeye, exposed to glochidia of *L. luteola* in the autumn of 1912, took very readily.

Very young mussels were either few, or very difficult to find. Diligent search was made for them, especially in the sandy bottom near Long Point, the sand being scooped up and sieved through fine-meshed sieves. Numerous and varied forms of life were thus obtained, such as *Sphaerium*, *Pisidium*, caddis-cases, etc., and rather small but by no means minute examples of *L. luteola*. These young shells were remarkably brightly rayed. Half-grown *Q. rubiginosa* were fairly common in the beds of Lost Lake.

*Proportion of various species in the lake:*—Of a collection of 340 living mussels collected October 17, 1907, at Long Point, 252 were *Lampsilis luteola*, 41 *L. ventricosa*, 21 *Unio gibbosus*, 18 *Anodonta grandis footiana*, 5 *Strophitus edentulus* and 3 *Lampsilis subrostrata*. In deep water *U. gibbosus* and *Anodonta* would have given a higher percentage, and in the Lost Lake beds *Quadrula rubiginosa* would be present in considerable relative abundance.

*Parasites, enemies, and diseases:*—As a general rule the mussels of lakes, ponds and bayous are more heavily infested with parasites than those of swiftly flowing rivers, the probable reason being that in still waters the parasites can migrate more easily from one mussel to another than where there is a swift current. The mussels of the lake are not nearly so badly parasitized as those of the sloughs of the Mississippi, the dead water in the Maumee above the dams, or those of Twin Lakes a few miles to the north. The parasites will be taken up more fully in consideration of the various species of mussels. *Cotylaspis insignis* and several species of *Atax* are the most common parasites. Unlike the mussels of most of our rivers, the mussels of the lakes are comparatively exempt from the ravages of man. A few are killed and used for bait, and now and then a mild case of pearl fever ap-

pears at the lake but is soon cured by the examination of a bushel or two of mussels. On September 22, 1907, a man was seen at the south end of the lake with about a peck of shells which he had opened in a vain search for pearls; on October 8 of the same year a pile of about a half bushel of shells, which had evidently been opened by pearlers, was found in Overmyer's woods. Another pearler was seen in 1907 who had collected a few slugs of almost no value. One of the citizens of Culver, in 1906, submitted a small vial of lake baroques for valuation, but they had no worth whatever. The greatest enemy of the lake mussels is the muskrat, and its depredations are for the most part confined to mussels near shore. The muskrat does not usually begin its mussel diet until rather late autumn, when much of the succulent vegetation upon which it feeds has been cut down by frost. Some autumns, however, they begin much earlier than others; a scarcity of vegetation or an abundance of old muskrats may have much to do with this. The rodent usually chooses for its feeding grounds some object projecting out above the water, such as a pier or the top of a fallen tree. Near or under such objects one occasionally finds large piles of shells. The muskrat apparently has no especial preference for one species of mussel above another, but naturally subsists most freely on the most abundant species. These shell piles are excellent places to search for the rarer shells of the lake.

On September 24, 1907, about a bushel of shells, recently cleaned out by muskrats, was found at Long Point where a pier had been removed not long before. The shells were all of rather small size and were in about 18 inches of water. About half were taken and examined. Of these shells 358 were *Lampsilis luteola*, 167 *Unio gibbosus*, 6 *Lampsilis iris*, and 1 *Lampsilis multiradiata*. In the autumn of 1913 freshly opened shells of *Lampsilis glans* were common along shore at Long Point. The first shells killed are rather small and are probably killed by young muskrats.

In the winter after the lake is frozen, great cracks through the ice extend out from shore in various directions, and this enables the muskrat to extend his depredations some distance from shore in definite limited directions. During the winter of 1904 a muskrat was observed feeding on mussels along the broad ice-crack that extended from the end of Long Point northeastward across the lake. The muskrat was about 500 feet from shore. It repeatedly dived from the edge of the ice-crack, and reappeared with a mussel in its mouth. Upon reaching the surface with its catch, it sat down on its haunches at the edge of the creek, and, holding the mussel in its front feet, pried the valves apart with its teeth and

scooped or licked out the contents of the shell. Some of the larger mussels were too strong for it to open, and a part of these were left lying on the ice. The bottom of the lake near Long Point, and also over by Norris's, is well paved with shells that have been killed by muskrats. Muskrats do not seem to relish the gills of gravid mussels; these parts are occasionally found untouched where the animal had been feeding.

## LIST OF SPECIES

### 1. FLAT NIGGERHEAD

**QUADRULA COCCINEA** (Conrad)

Rare at the lake; this is a river rather than a lake shell and would be expected in abundance only in fluviatile lakes, or lakes with broad short outlets and vital connection with river faunas. The few living mussels of this species found in the lake probably represent a vanishing remnant of a fauna introduced when the lake had a broader outlet than at present and communication with the river below was more active. A few dead shells were found along the north shore of the lake at various times. On October 25, 1907, a shell 1.75 inches long was found near the railroad bridge at Culver, and in 1909 another small shell was found on the shore at Aubeenaubee Bay. Some fine large examples brought up from the Tippecanoe were planted in the Thoroughfare below the railroad bridge, but they have probably been covered and suffocated by sand.

### 2. WABASH PIG-TOE

**QUADRULA RUBIGINOSA** (Lea)

More common in Lake Maxinkuckee than *Q. coccinea*, but nevertheless rather rare, only a few dwarfed shells having been found. In Lost Lake below the Bardsley cottage it was a fairly common species. None of the shells found was of large size, but all were well-formed and handsome. The older shells are almost jet black and peculiarly elongate, with the umbones markedly anterior in position. They look considerably unlike those of either the Tippecanoe or Yellow River, but a form much like the Lost Lake shells was found in the lower course of the Kankakee. No gravid examples were found in the lake. Half grown examples are rather common in Lost Lake beds, but as they are usually buried considerably deeper in the sand than the older shells, they are harder to find. These half-grown shells are of a peculiarly beautiful golden yellow color with a satiny epidermis, and are of the same shape as those found in the neighboring rivers—

that is, the normal or usual shape of the species. The peculiar elongate form of the adult is therefore evidently the product of local influences. The young shells are very iridescent and translucent--much more so than those found in rivers.

*Q. rubiginosa* is at its best a very fair button shell, but the lake shells are too small to work up well. This species appears to be rather rare in lakes. The only lake examples of this species with which the Lost Lake shells were compared were some obtained in Lake Erie. The Lake Erie shells were much more dwarfed, but very solid.

*Food:*—The following is the result of an examination of the material found in the intestines of *Q. rubiginosa* from Lost Lake:

Sample 1. August 2, 1908. Mass fine flocculent rather brownish green material, cohering somewhat in cylinders. Looks as if chiefly organic; not gritty to touch. Organisms present: *Scenedesmus, Fragilaria, Tetraëdron, Navicula, Peridinium tabulatum, Anuraea,* and *Botryococcus braunii.*

Sample 2. August 20, 1908. A large amount of material; appearance in vial, bottom black, top a fine flocculent sediment. In the top material are *Teraëdron, Scenedesmus, Microcystis aeruginosa,* and many disassociated minute cells. Black bottom composed of *Anuraea, Lyngbya aestuarii,* a long filament; *Scenedesmus,* many, *Peridinium tabulatum, Tetraëdron, Epithemia turgida, Merismopedia,* cast of *Cyclops, Melosira crenulata, Gloeocapsa, Staurastrum, Pediastrum boryanum, Gomphonema, Chaetophora, Cosmarium,* sponge spicule, *Gomphosphaeria aponina,* and *Botryococcus braunii.*

Sample 3. August 20, 1908. A small amount of flocculent brownish material.

*Microcystis aeruginosa, Peridinium tabulatum* many and a good many empty cuirasses, *Chydorus, Eudorina* a few, *Scenedesmus* common; Diatoms, *Pediastrum duplex.*

Sample 4. August 20, 1908. Fine blue-green flocculent material. *Lyngbya aestuarii,* several filaments; *Microcystis aeruginosa,* common; *Coelosphaerium kuetzingianum, Peridinium tabulatum,* very abundant; *Chydorus, Anuraea, Botryococcus braunii, Coelastrum, Staurastrum* 1, small, *Naracula,* several.

Sample 5. August 20, 1908. Fine bluish-green material. *Peridinium tabulatum,* abundant; *Cymbella cymbiformis, Navicula,* a few; *Anuraea cochlearis, Microcystis aeruginosa, Chydorus* 1 entire, and other fragments; *Pediastrum duplex, Coelosphaerium kuetzingianum; Cosmarium, Coscinodiscus, Scenedesmus,* very common; *Merismopedia glauca.*

Sample 6. August 20, 1908. A small amount of flocculent grayish material.

*Peridinium tabulatum,* abundant, agglutinated in masses; *Microcystis aeruginosa,* very common; *Navicula, Staurastrum, Cosmarium,* several; *Chydorus,* fragment; *Scenedesmus,* small forms, common; *Pediastrum boryanum, Cymbella cymbiformis, Tetraëdron,* common; various diatoms; Rotifer, an elongate species; *Merismopedia glauca; Coelastrum,* desmids.

Sample 7. August 21, 1908. A small amount of rather coherent fine flocculent greenish material.

*Peridinium tabulatum,* very common; *Anuraea cochlearis,* a few; *Microcystis aeruginosa,* frequent; *Lyngbya aestuarii,* short filament; *Pediastrum boryanum,* diatoms (*Cymbella cymbiformis; Cymatopleura; Epithemia argus, Gomphonema, Synedra*) *Tetraëdron, Scenedesmus,* occasional; *Dinobryon, Staurastrum,* rather slender form.

Sample 8. August 20, 1908. A small amount of flocculent bluish-gray material.

*Peridinium tabulatum,* most abundant; *Coelosphaerium kuetzingianum; Pediastrum duplex; Microcystis aeruginosa, Anuraea cochlearis,* sponge spicule, diatoms (*Navicula, Cymbella,* etc.). *Scenedesmus.*

Sample 9. August 20, 1908; a fair amount of flocculent grayish-brown material with a greenish cast.

*Peridinium tabulatum,* most abundant; *Microcystis aeruginosa, Anuraea cochlearis, Staurastrum, Pediastrum duplex, Botryococcus braunii; Tetraëdron minimum, Coelosphaerium kuetzingianum; Pediastrumi boryanum, Chydorus, Lyngbya aestuarii, Gloeocapsa,* diatoms—*Cymbella cymbiformis, Navicula.*

### 3. SPIKE

#### UNIO GIBBOSUS Barnes

This mussel, known among clammers as the "spike" or "lady-finger" is, next to *Lampsilis luteola,* the most abundant shell in the lake. It is found wherever the other mussels are; that is, in sandy or somewhat marly bottom in rather shallow water most of the way around the lake, and in the shell-bed in Lost Lake below Bardsley's. In Lake Maxinkuckee one of the best beds is at Long Point. It is abundant also at Norris Inlet, and by McDonald's and Farrar's.

No very young of this species were found in the lake; they are, however, hard to find in numbers anywhere, even in rivers where

the species is abundant, except in cases where portions of the river go almost dry, and this of course never happens to the beds in the lake. The half-grown examples are solid, rather cylindrical shells, the same neat form that is known as the "spike" among the clammers. The old shells develop into a peculiar form, being flattened, arcuate along the ventral border and very thin posteriorly, so that they usually crack badly in drying; they represent the form described by Simpson as var. *delicata*. In general outline they remind one somewhat of *Margaritana monodonta*. This form is not strictly confined to the lake; some similar shells were collected in the Wabash near Terre Haute.

As found in the lake, *Unio gibbosus* is very constant in its characters, the only noteworthy difference between individuals being the change in shape already referred to as being due to age. In rivers this shell exhibits considerable variation in shape, size, color of nacre, etc., but the shells of the lake are quite constant in almost every respect. The nacre is a deep purple, never varying to pink or white as it frequently does in rivers.

Like *Lampsilis luteola* this species is frequently preyed upon by muskrats and the cleaned out shells are common where these rodents have had their feasts.

Although *U. gibbosus* of the Tippecanoe River near the mouth of the Outlet is very commonly infested with a distomid parasite along the hinge-line which brings about the formation of irregular baroques, this parasite does not occur in the lake so far as known. Small species of *Atax* are common parasites of this species in the lake, and in 1909 one was found affected by the large *Atax ingens*.

Even the large strong river shells of *Unio gibbosus* have no value in the manufacture of buttoms because of their purple color and lack of luster. (The white-nacred shells are sometimes used.)

The only other lake examples with which the Lake Maxinkuckee specimens of this species have been compared, are some collected in Lake Erie at Put-in-Bay. The Lake Erie shells are much unlike the Maxinkuckee specimens, being short, humped and remarkably solid and heavy. Similar shells to those of Lake Erie are found in some of the small southern rivers.

We have no notes referring to gravid examples in the lake. This was probably because the most active work in collecting and examining mussels was carried on in the autumn, and the breeding period of this species is in early summer.

#### 4. ALASMIDONTA CALCEOLUS (Lea)

Judging from the dead shells found scattered along shore, this is not a particularly rare species in the lake. The shells were found most abundantly along the north shore of the lake, although they were also found along the east and southeast portion and were not infrequent between Arlington and Long Point. No living examples were found. On account of its small size and its habits this is a rather difficult species to find, even where common, except under favorable conditions such as exceptionally low water, when the mussels move about more or less. Nothing was therefore learned of its habits in the lake. In the Tippecanoe River near Delong, Ind., this species was rather common in stiff blue clay near shore, and it is fairly abundant in Yellow River at Plymouth. Here, although the dead shells were common, the living examples were difficult to find until, during a period of very low water, they began actively moving about and could be tracked down. The species, which reaches an unusually large size in Yellow River, was there found gravid in autumn (September and October). The glochidia are of the Anodonta type, chestnut-shaped or rounded-triangular in outline, with large hooks at the ventral tips of the valves.

### 5. FLOATER

#### ANODONTA GRANDIS FOOTIANA Lea

Although the genus *Anodonta* is generally regarded as the "Pond-mussel" *par excellence,* the species of which might naturally be expected to be at home in lakes and ponds and thrive in such places even better than in rivers, the Anodontas of Lake Maxinkuckee show, along with the river-species proper, the dwarfing influence of the lake. Moreover, *Anodonta* is not, as one might naturally expect, the most abundant mussel in the lake, but is outnumbered in some beds at least, by both *Lampsilis luteola* and *Unio gibbosus.* Its relative scarcity in some of the shore beds is in part made up by its wider distribution in the deeper waters of the lake than the others reach, and on its presence on the isolated bars, where it was occasionally taken up by the dredge.

On account of the great variability of *Anodonta grandis* and the difficulty in distinguishing the various forms, particular attention was paid to this species as found in the lake, and the lake specimens were compared with numerous examples from the neighboring lakes and river. No Anodontas were found in the Tippecanoe River near Lake Maxinkuckee Outlet, and we were therefore

unable to compare our lake specimens with the form that would be most interesting in this connection.

The mussels of Tippecanoe Lake at the head of Tippecanoe River were examined in this connection. Blatchley (Indiana Geological Report for 1900, p. 190) has reported *Anodonta grandis* as common, and the subspecies *footiana* as frequent in Tippecanoe Lake. The Anodontas of that lake differ markedly both in the size and shape of the individuals from those of Lake Maxinkuckee. The difference in size can be easily explained by the more favorable conditions in Tippecanoe Lake. This body of water is more fluviatile than Lake Maxinkuckee, being directly connected with the Tippecanoe River, which is already a fairly large stream when it leaves the lake, and the mussel beds of the lake and river are continuous. The upper part of Tippecanoe Lake is exceptionally favorable for Anodontas; the living mussels are large and abundant, and the dead shells almost pave the bottom near shore, several dead shells often being telescoped within each other. Some of the shells reached a size not often surpassed in the neighboring rivers, one example measuring 172.5 mm. long, 95 mm. high and 65 mm. in diameter. A few were thickened with a tendency to form half pearls, but most were thin. A number of the shells approached *Anodonta corpulenta* in general form, and one flattened, rounded shell resembled *A. suborbiculata*. The Anodontas from other lakes of the Tippecanoe River system, such as Center Lake and Eagle Lake near Warsaw, resembled those of Lake Maxinkuckee, but were generally smaller and shorter.

The Anodontas of Lake Maxinkuckee were also compared with those of Yellow River a few miles to the north, and with the various lakes of the Kankakee system, including Upper Fish Lake, Lake of the Woods (Marshall Co), Pretty Lake, Twin Lakes, Bass Lake and Cedar Lake. Some of the Yellow River Anodontas were normal, oval shells such as are common in the rivers of northern Indiana; a few were exceptionally thin and exceedingly inflated, resembling *A. corpulenta*. Those of Upper Fish Lake—originally a fluviatile lake containing other fluviatile shells such as *Q. undulata*—were large shells like those of Tippecanoe Lake. The Anodontas of each of the other lakes differed more or less from those of the others, though all probably had a common origin. The only lake of this group, the Anodontas of which closely resembled those of Lake Maxinkuckee, is Bass Lake, and even here the shells were somewhat different, being smaller and with the epidermis more deeply stained. Even the Anodontas of Lost Lake differ slightly from those of Lake Maxinkuckee, being somewhat more inflated

and with the epidermis rather green than brown, and in having the shell usually somewhat thinner. Some of the shells near the outlet of Lost Lake are exceedingly thin, some of them so much so that ordinary print can easily be read through them; they are so fragile that it is almost impossible to keep them.

Of the collection from Lake Maxinkuckee, mostly from Long Point, 26 examples were carefully compared. The smallest measured 68 mm. long, 38 mm. high and 24.6 mm. in diameter, and the largest 93.5 mm. long, 50 mm. high and 37 mm. in diameter. Among variant forms was one female, gravid when collected, which was unusually elongate, its measurements being 86 mm. long, 43.5 mm. high and 32.5 mm. in diameter. In outline this shell closely resembled *Anodontoides ferussacianus subcylindraceus.*

Some of the larger specimens are rather humped and arcuate, the ventral margin of one being somewhat concave. This is a variation which is quite likely to occur in old shells of any species.

Although gravid Anodontas were found rather frequently during the late autumn, no infected fishes were seen, and no young were found.

The Anodontas of the lake are fairly free from parasites, a few *Atax* and *Cotylaspis* and occasionally a few distomids on the mantle next to the umbonal cavity being the only ones present in any numbers. In some of the other lakes the Anodontas were very badly infested; a colony found in one of the Twin Lakes being infested to a remarkable degree by a distomid which formed cysts in the margin of the mantle.

*Food and Parasites of various examples:*—The following is the result of the examination of various examples of Anodontas from the lake.

Sample 10. Vial containing intestinal contents of *Anodonta grandis footiana*, Lost Lake, Sept. 7, 1908. The vial contains a considerable amount of material (in formalin) which was separated into black fine mud below and fine flocculent light green above. Upper portion—*Microcystis aeruginosa* most common; *Peridinium tabulatum* some; *Pediastrum boryanum; Melosira crenulata*, a few filaments; *Coelastrum microporum, Botryococcus braunii* and *Scenedesmus.* Bottom layer—*Lyngbya aestuarii, Microcystis aeruginosa* very common; *Peridinium tabulatum, Anuraea cochlearis, Cymbella cymbiformis* and *Navicula.*

Sample 11. Food of *Anodonta grandis footiana*, Lake Maxinkuckee, near Norris Inlet, Aug. 20, 1908. A good mass of flocculent fine green material; no mud.

*Microcystis aeruginosa* most common, *Melosira* filament, *Oscillatoria*, short filament; *Anuraea cochlearis* several; *Cymbella cymbiformis; Gomphosphaeria aponina; Peridinium tabulatum; Coelosphaerium kuetzingianum, Lyngbya aestuarii, Epithemia argus, Chydorus*, and what appears to be fragments of *Ceratium hirundinella*.

Sample 12. *Anodonta grandis footiana*, near Norris Inlet, Lake Maxinkuckee, Aug. 20, 1908; a small mass of flocculent blue material.

*Microcystis aeruginosa* most abundant; *Lyngbya aestuarii, Melosira, Epithemia, Anuraea cochlearis, Pediastrum boryanum, Cosmarium intermedium* and a few others, *Staurastrum, Spirulina* and *Pediastrum duplex*.

Sample 13. *Anodonta grandis footiana*, 97 mm. long. Edge of Lake Maxinkuckee east of Norris Inlet, Aug. 29, 1908.

Parasites, 9 Atax, free among gills. Mussels gravid, with anterior end of shell indented and with some brown spots on the nacre. Food mass fine golden brown, abundant in quantity, containing *Anuraea cochlearis* many; *Microcystis aeruginosa* most abundant element; *Lyngbya aestuarii* frequent; *Scenedesmus*, a few; *Botryococcus braunii* frequent, *Cymbella cymbiformis; Staurastrum, Navicula; Fragilaria; Chydorus*, a few; *Coelosphaerium kuetzingianum;* the diatoms are not abundant.

Sample 14. *Anodonta grandis footiana* apparently old, 90 mm. long, near Norris Inlet, Lake Maxinkuckee, Ind., Aug. 29, 1908, the shell stained somewhat brown inside, with one steel-blue stain on the right valve anteriorly.

Parasites; Atax 7, large, full of eggs, one small, one very small, these all free among the gills; *Cotylaspis insignis* 1, in axil of gill.

Food abundant; *Microcystis aeruginosa* abundant, *Lyngbya aestuarii* common, *Pediastrum duplex, Botryococcus braunii*, a few; *Cosmarium; Anuraea cochlearis* several; *Scenedesmus; Ankistrodesmus*, and many diatoms, among which are *Cocconeis pediculus, Melosira, Gomphonema, Navicula, Epithemia turgida*, etc.

Sample 15. *Anodonta grandis footiana*, 101 mm. long, Lake Maxinkuckee, near shore, by Norris Inlet, Aug. 29, 1908.

Parasites, 5 *Atax*, free in gills, some full of eggs, 2 smaller in size, larval *Atax* (black) scattered in gills. *Cotylaspis insignis* 2, axil of inner gill.

A large amount of food material in intestines, very fine, of a yellowish-brown color.

*Microcystis aeruginosa, Anuraea cochlearis, Lyngbya aestuarii, Botryococcus braunii, Coelosphaerium kuetzingianum, Cosmarium,*

*Navicula*, an elongate form, *Cymbella cymbiformis, Pediastrum duplex, P. boryanum;* red cysts apparently of *Peridinium.*

Sample 16. *Anodonta grandis footiana*, 90 mm. long, sandy bottom of Lake Maxinkuckee near Norris Inlet. Aug. 29, 1908. Mussel gravid. Parasites, *Atax*, 3, free among gills, *Atax* embryos scattered through gills.

Food material scarce, fine golden brown in mass, consisting of *Microcystis aeruginosa* abundant; *Coelosphaerium kuetzingianum* abundant, *Lyngbya aestuarii*, a few filaments; *Anuraea cochlearis* and another rotifer; *Botryococcus braunii; Sorastrum, Coelastrum, Scenedesmus, Pediastrum duplex, Navicula* several, *Melosira tabulata, Synedra, Epithemia turgida, Cymbella cymbiformis;* other small diatoms rather numerous; *Cosmarium*, a few.

Sample 17. *Anodonta grandis footiana*, 93 mm. long. Sandy bottom of Lake Maxinkuckee near Norris Inlet, Aug. 28, 1908. Mussel gravid. Parasites, 1 *Atax*, free among gills. Intestines almost empty. *Microcystis aeruginosa* one of most abundant elements, *Lyngbya aestuarii, Coelosphaerium kuetzingianum, Botryococcus braunii; Cosmarium, Pediastrum, Cocconeis pediculus, Epithemia turgida; Navicula*, (1 actively moving) *Gomphonema, Melosira tabulata, Anuraea cochlearis, Chydorus.*

Sample 18. *Anodonta grandis footiana*, 95 mm. long, Lake Maxinkuckee near Norris Inlet, Aug. 29, 1908. Mussel gravid. Parasites, 6 Atax free among gills, one a minute red species. Many young Atax embryos in inner side of mantle, not in gills.

Food material golden brown with some green intermixed, very fine. *Microcystis aeruginosa*, common; *Lyngbya aestuarii*, a few filaments; *Coelosphaerium kuetzingianum; Botryococcus braunii; Pediastrum duplex; Anuraea cochlearis* a few; *Epithemia turgida; Navicula*, common; *Cymbella cymbiformis; Cocconeis pediculus*, several; *Cosmarium; Chydorus.*

Sample 19. *Anodonta grandis footiana*, Lake Maxinkuckee, near Winfield's. Mussel gravid. Parasites, young Atax in gills; distomids on mantle; (a slug pearl near hinge.)

Food: *Botryococcus braunii; Microcystis aeruginosa; Lyngbya aestuarii, Coelosphaerium kuetzingianum, Pediastrum duplex, Navicula, Cymbella cymbiformis.*

Sample 20. *Anodonta grandis footiana*, Lost Lake. Young transparent shell, gravid; length 77 mm., height 41 mm., diameter 30 mm.; live weight 1 oz., shell $\frac{1}{4}$ oz. Parasites, several *Cotylaspis insignis* in axil of gills. Food chiefly *Microcystis aeruginosa;* considerable *Botryococcus braunii.*

Sample 21. *Anodonta grandis footiana*, Lost Lake. Parasites,

1 young Atax in gill; *Cotylaspis insignis* in axil of gill. Food chiefly *Microcystis aeruginosa*, a little *Botryococcus braunii*, *Lyngbya aestuarii* and *Pediastrum boryanum*.

### 6. PAPER-SHELL

#### ANODONTA IMBECILLIS Say

A single specimen.

### 7. SQUAWFOOT

#### STROPHITUS EDENTULUS (Say)

Not very common in the lake. Occasional shells can be picked up along shore, especially between Long Point and Arlington, and along the north shore. Living examples were also taken in small numbers from the mussel bed at the mouth of Norris Inlet, and at Long Point. In a collection of about 300 living mussels collected at the latter place in the autumn of 1907, only 3 were of this species.

As found in the various rivers of the country, this is one of the most variable of shells, and the exact limits of the species and its various forms are not yet well worked out. The lake examples, though differing considerably from those of the neighboring rivers and from river shells in general, do not exhibit a very large range of variation. They are all markedly dwarfed, the average length being about 2½ inches or 63.5 mm. long. All have a well-developed rounded posterior ridge. The epidermis is deeply stained, that of the exposed portion of the shell being a rich yellowish brown, while the anterior portion—in the living shell buried in the soil of the bottom—is a deep, shining, brown black. The anterior margin is not nearly so heavy and produced as one frequently finds it in river examples. The beaks of the lake shells are not so angular as they usually are in river shells, and the high wavy ridges are more numerous and pronounced. In the Maxinkuckee shells, also, a number of fine hair-like lines or ridges, much like growth lines, extend along the posterior border of the umbone, parallel with the posterior ridge of the earlier stages of the shell.

The nacre of the lake shells is a rich rosy salmon. Unlike the salmon color of "*Anodonta salmonia*" this is a natural color, not due to diseased conditions; the nacre surface is very smooth and the color extends deeply into the shell. In some cases the inner nacreous surface appears to be a secondary thickening of the shell, laid on the older portions like an enamel. Below this extra nacreous deposit the growth lines are very distinct on the

inner surface of the shell. The rest periods are distinct black lines, often plainly visible through the translucent shell when held up to the light. Rays are always invisible by reflected light in the lake shells, but in some examples they were visible by transmitted light. The animal has orange-colored flesh. The few living examples examined indicate that parasites are common: one contained three old *Atax ypsilophorus*, and several young.

One gravid example was found, October 17, 1907. The youngest example found was 42 mm. long and exhibited four rest periods.

#### 8. LAMPSILIS GLANS (Lea)

Fairly common in the main lake; dead shells are often found along shore, and occasionally the living mussels are to be seen in shallow water at the various mussel beds in the lake. It is quite abundant along the edges of the thoroughfare joining the lakes, and is common in Lost Lake. The examples found in the thoroughfare and Lost Lake were of unusually large size; this is one of the few species of mussels which are as large or larger in the lake than in the neighboring rivers. *L. glans* appears to prefer shallow water along shore. A good number of shells recently cleaned out by muskrats was found near the water's edge at Long Point in the late autumn of 1913.

In the Tippecanoe River at Delong this was a very abundant species in the greasy whitish blue clay along shore, and was here one of the favorite morsels of the muskrat. With the exception of *Micromya fabalis* this is the smallest species of mussel found in the lake. It can be easily recognized by its black epidermis, small size and purple nacre.

### 9. RAINBOW-SHELL

#### LAMPSILIS IRIS (Lea)

Rather common in the lake in shallow water near shore, found scattered among the other species in the various shell-beds. There is a good colony in the Lost Lake bed, and it is fairly abundant off the depot grounds, by Kruetzberger's pier, at Long Point, and at the bed near the mouth of Norris Inlet.

The lake shells differ markedly from those of the neighboring rivers, so much so that it is easy to separate the lake and river shells at a glance. The lake shells are considerably more elongate, and the epidermis is stained a deep brown, mostly concealing the rays; when these are visible they are brownish rather than green, and the umbones are rather eroded. The shells, indeed, resemble

somewhat the males of *L. subrostrata*, with which they are associated. The lake shells exhibit a tendency to have their posterior margin somewhat broader than that of the river shells, and the shells are flatter at the posterior tip, becoming somewhat produced. The river shells are more solid and heavy.

*Lampsilis iris* is one of the few species of mussels which does not show a marked decrease of size in the lake; indeed, some of the larger lake examples run actually larger than those from the neighboring rivers. Some of the largest lake shells examined have the following dimensions:

| No. | Length mm. | Alt. mm. | Diam. mm. |
|---|---|---|---|
| 1 | 69.6 | 37.3 | 21 |
| 2 | 65.9 | 34.9 | 21 |
| 3 | 68.0 | 34.6 | 22 |
| 4 | 64.9 | 35.8 | 22.7 |
| 5 | 67.0 | 36.8 | 20.9 |
| 6 | 67.7 | 33.8 | 21.5 |

No young shells were found, even the smallest appear rather old. The smallest three measure:

| Length mm. | Alt. mm. | Diam. mm. |
|---|---|---|
| 41.4 | 21.2 | 12.5 |
| 38.9 | 21.5 | 12.5 |
| 37.0 | 20.0 | 12.3 |

For comparison with the lake shells, the dimensions are given of the largest two shells found in Yellow River:

| No. | Length mm. | Alt. mm. | Diam. mm. |
|---|---|---|---|
| 1 | 67.0 | 34.5 | 22.9 |
| 2 | 64.0 | 33.5 | 21.0 |

Only one gravid example was found; this was obtained at Lost Lake bed Sept. 7, 1908.

Of all the species of mussels in the lake, *L. iris* has the best connection, through scattered individuals along the Outlet, with the shells of the Tippecanoe River, a few shells having been found almost through the whole length of the Outlet. The outlet shells, like those of the rivers, are brightly rayed. The species is abundant in the Tippecanoe River at Delong. A number of examples were noted in spawning condition there in late August and early September in 1908. Observations in the Maumee River would indicate that these species, *L. parva* and *L. multiradiata*, do not have exactly the same breeding season as many other species of *Lampsilis* (*luteola, recta, ligamentina*, etc.) but are sometimes fertilized in July, spawning in August and September. Being small and

an early developing species, it is probable that they have somewhat different habits: indeed it is possible that they have more breeding seasons per year than the other species.

The Tippecanoe mussels of this species were a favorite food of the muskrat, and were killed in great numbers every autumn, the dead shells being thickly strewn along the bank, or piled in heaps at the bases of rocks which the rodent had used as a feeding place.

*Lampsilis iris* has a well marked tendency in the lakes and Outlet to produce pearls and baroques, but these are too small to be of any value.

#### 10. LAMPSILIS SUBROSTRATA (Say)

*Lampsilis subrostrata* reaches its best development along the muddy shores of lagoons, not being perfectly at home either in swiftly flowing streams or in perfectly quiet lakes, although occasional examples may be found in either. It is considerably more abundant in Lake Tippecanoe and Upper Fish Lake than in any other Indiana lakes examined. Along the edges of the Mississippi sloughs it is fairly common and reaches a large size, often distinguished with difficulty from *Lampsilis fallaciosa* except for the thinness of the shell and the black epidermis. It is rare in Lake Maxinkuckee, only a few examples having been obtained from the mussel bed near Norris Inlet. It is much more common in Lost Lake in the large bed along shore south of the Bardsley cottage. Mr. Blatchley, in a short report on the mollusks of the lake, (25th annual report, Department of Geology and Natural Resources of Indiana, 1900, p. 250), says of this species: "Not common in the main lake; more so in the muck and mud along the margins of Lost Lake, where a well-marked variety, with a larger and broader beak, was taken. A specimen of this was sent, among others, to Mr. Chas. T. Simpson, of the Smithsonian Institution, for verification. In his reply he says: 'The variety of *subrostratus* which you send is, so far as I know, confined to northern Indiana. It is quite remarkable, and would seem to be almost a distinct species. I have seen quite a number of specimens of it, and at first thought it a variety of *U. nasutus*, but there seem to be intermediate forms connecting it with *U. subrostratus*.'"

With the exception of the differences due to sex, all the Maxinkuckee and Lost Lake shells are very uniform in appearance, much more so than *L. luteola*, and are hardly distinguishable from examples from Lake Tippecanoe, Upper Fish Lake, or a specimen collected in the Wabash River at Terre Haute by Dr. J. T. Scovell.

They are dark brown in color with very faint rays. The species appears to be rare in the Tippecanoe River at Delong. One example was obtained there, which is somewhat shorter and stouter than those of the lake, and not so badly stained; it shows faint rays posteriorly. The Lost Lake shells are somewhat larger than those found at the other lakes. No young were found, the smallest shell obtained being a half-grown example. One gravid specimen was found at Lost Lake Sept. 7, 1908. The marsupium closely resembles that of *L. iris*, being a kidney-shaped mass filling the hinder portion of the outer gill, this mass being marked into segments by rather deep radiating furrows. The very edge of the marsupium is white beyond the dusky submarginal area, the white making a chain-like area at the edge of the gill. Like *L. iris*, this species has a tendency to form pearls, but they are too small to be of any value.

*Food of indiriduals:*—The following is the result of the examination of the contents of the intestines of *L. subrostrata* from Lost Lake at various dates.

Sample 22, August 20, 1908. A small amount of flocculent bluish-gray material.

*Peridinium tabulatum* abundant; *Microcystis aeruginosa* abundant; *Anuraca cochlearis; Pediastrum boryanum;* Diatoms—*Synedra, Cymbella cymbiformis.*

Sample 23, August 20, 1908. A very small amount of flocculent grayish material.

*Peridinium tabulatum* a few; *Microcystis aeruginosa* a little; *Pediastrum boryanum; Cosmarium, Tetraëdron minimum, Scenedesmus, Euglyphia alveolata; Peridinium,* a small, sharp-spined form. Diatoms make up the greater part, including *Cymbella cymbiformis, Naricula, Fragilaria, Coscinodiscus,* and *Epithemia.*

Sample 24, September 7. A large amount of material, black mud below, greenish flocculent material above. The upper portion contains chiefly *Botryococcus braunii* and *Microcystis aeruginosa.* Bottom portion—*Microcystis aeruginosa* common; *Botryococcus braunii; Peridinium tabulatum, Peridinium,* a small spined species; *Scenedesmus,* frequent. *Staurastrum, Pediastrum duplex; Coelastrum* a few; *Anuraca cochlearis, Tetraëdron, Docidium, Coelosphaerium kuetzingianum,* sponge spicule, *Lyngbya aestuarii.* Diatoms,—*Synedra, Naricula, Gomphonema, etc.*

### 11. FAT MUCKET

#### LAMPSILIS LUTEOLA (Lamarck)

*Lampsilis luteola* is the most widely distributed of the American Unionidæ, its range extending over nearly all of North America east of the Rocky Mountains. It lives and thrives under a great variety of conditions, being frequent in both lakes and rivers.

In Lake Maxinkuckee this is the most common mussel, being found almost everywhere in water from 2 to 5 or 6 feet deep where the bottom is suitable. It prefers a rather solid bottom with some admixture of sand or gravel, but occurs also even where the bottom is of a rather firm peaty nature as in some places in Outlet Bay. It is, however, rather scarce and widely scattered in such localities. The best beds are found at Long Point, at Farrar's, in front of McDonald's, by the old Kruetzberger pier, and in Aubeenaubee Bay off from the Military Academy. In Lost Lake it was abundant in the large mussel bed below the Bardsley cottage, and a few shells were found in the north end of the lake.

The Lake Maxinkuckee shells are smaller and thinner than those of the rivers; they closely resemble those of most of the neighboring lakes with which they were compared, such as Twin Lakes, Pretty Lake, Bass Lake, etc. The *L. luteola* of Upper Fish Lake are much larger and more like river shells. Compared with specimens of more remote lakes, those of Lake Erie are much smaller, more solid and not stained, the rays being quite distinct. The *L. luteola* of Lake Pokegama, Minn., are unlike any of those above cited, being large, thick and heavy, furnishing excellent button material.

*Lampsilis luteola* is represented in Lake Maxinkuckee and Lost Lake by 2 forms; although these forms are well connected by intergrades the extremes are pretty markedly distinct.

The colony in Lost Lake is composed of compressed, elongate shells, almost as large as those found in rivers, but considerably thinner. It is in the females of this group, and only in part of them, that the greatest variation occurs. The males are not much unlike the ordinary well-known form of the neighboring rivers. The most strongly aberrant females are markedly compressed, and flare out broadly in the post-basal region. The umbones are far forward and they remind one somewhat in contour of the marine species, *Modiola plicatula*. Some of them closely resemble *Lampsilis radiata* of the Atlantic drainage. The Lost Lake mussels of this species are stained a peculiar attractive ash-gray which does not greatly obscure the rays. They are not so heavily encrusted

with marl as are those in the Lake Maxinkuckee beds. Typical Lake Maxinkuckee specimens are dwarfed and stained a deep brown, which obscures the rays. Most of them are thickly coated posteriorly with incrustations of marl. It is principally this species which has associated with it the little water-beetle, *Stenelmis undulatus* Blatchley. At Long Point, where *L. luteola* is the most common mussel, examples of the peculiar Lost Lake form are rather frequent. In comparing sets of shells from the various mussel beds of the lake—Long Point, Farrar's and the Norris Inlet beds—it was noted that the mussels of each bed, as one approached the upper portions of the lake, averaged somewhat smaller.

As regards food, movements, reproduction, etc., *L. luteola* does not differ greatly from the other mussels of the lake with the exception that it appears to be considerably the most active species in the lake. A few were observed moving about during the winter of 1900-1901. The deep water individuals rarely move about at all. In the autumn of 1913 the migration of those near shore into deep water was strikingly shown by a series of numerous furrows, with a mussel at the deep water end and extending from shore outward near Long Point.

As with the other mussels of the lake, reproduction is a rather inconspicuous phenomenon, not attended with the marked display common in the larger river examples. Of 252 examples collected at Long Point Oct. 17, 1907, 25 contained glochidia in the gills, some being very full and much distended. One was found gravid May 24, 1901, and on August 22, 1906, some in Lost Lake appeared to be about ready to spawn.

The young of this species were found rather frequently in the lake, much more frequently, indeed, than any other kind. The smallest examples were obtained while sieving sand for Sphaeriums at Long Point. These young mussels live buried in the fine sand near shore. Specimens up to about a half inch long are very crinkly, being covered with narrow elevated parallel ridges, generally 5 in number, each consisting of 2 open loops placed end to end, the sides of the loops being roughly parallel with the ventral margin of the shell; the ends where they join form a sharp curve upward toward the umbone. These double loops are followed by a number of broken irregular ridges. The markings just described persist on the umbones of the older shells until eroded away. The half grown shells are beautifully rayed with green on a whitish background. As the shells grow older they become gradually stained a deep uniform brown, obscuring the rays.

Most of the mussels of the lake are slightly parasitized, none abundantly; they contain a few examples of a small reddish *Atax*, and a few *Cotylaspis insignis*. A small round-worm, somewhat like a vinegar eel, was found very active in the intestine of one specimen; it was probably parasitic.

Small irregular pearls or slugs are produced but they are of no value. In some rivers this species produces an abundance of small round pearls. Some of the pearl-bearing river specimens were planted in the lake in 1912 to see if they would infect the lake shells. The *Lampsilis luteola* of the rivers is a fair button shell, but the Lake Maxinkuckee shells are too small and thin to have much value. It is a remarkable fact that in Lake Pokegama, Minn., *L. luteola* grows abundantly in shallow bottom among the weeds, and there produces a handsome thick heavy shell, one indeed concerning which the pearl button manufacturers are very enthusiastic, so much so that the shells at that distant point from the market brought $22.00 per ton; in the summer of 1912, two carloads of these shells were shipped to Europe.

Just why the Lake Maxinkuckee shells are not like the excellent ones of Lake Pokegama remains as yet unanswered, but seems to be largely a question of breed. It would certainly be worth while to introduce the Lake Pokegama breed into Lake Maxinkuckee.

Following is the result of the examination of various individuals of the Maxinkuckee and Lost Lake shells:

Sample 25. *L. luteola*. Lost Lake, Sept. 7, 1908. Mussel gravid. Length 100 mm., altitude 62 mm.; diameter 33 mm. Live weight 3½ oz.; shell 1¾ oz. Parasites—7 free *Atax* among gills, young *Atax* in gills and numerous Atax eggs on interior surface of mantle. Food chiefly *Microcystis aeruginosa*, *Botryococcus braunii*, *Lyngbya aestuarii*, *Melosira*, *Navicula*.

Sample 26. *L. luteola*, Lost Lake, Sept. 7, 1908; mussel gravid; length 95 mm., alt., 60 mm., diam., 38 mm.; live weight 3¾ oz.; shell 1¾ oz. Parasites, 7 free *Atax* in gills, and *Atax* eggs in the mantle. Food—chiefly *Microcystis aeruginosa*, also *Botryococcus braunii*, *Navicula*, *Lyngbya aestuarii* and *Anuraea cochlearis*.

Sample 27. *L. luteola*, Lost Lake by Bardsley's, Sept. 7, 1908; live weight 3¼ oz.; shell 1½ oz.; length 97 mm., alt. 54 mm., diam. 33 mm. Parasites—7 free *Atax* among gills; many small red eggs of *Atax* on inner surface of mantle. Food chiefly *Microcystis aeruginosa*, *Botryococcus braunii* and *Navicula*.

Sample 28. *Lampsilis luteola*, Lost Lake, Sept. 7, 1908. Live

weight 3¾ oz.; length 104 mm., alt. 54 mm., diameter 33 mm. Parasites, *Atax* 6, free among gills, eggs of Atax on inner side of mantle, young in pits on side of foot. Food, *Microcystis aeruginosa* most common. *Lyngbya aestuarii*, *Navicula*, *Melosira*, *Anuraea* and *Cymbella*.

Intestinal contents of two examples of *L. luteola* obtained in Lake Maxinkuckee Aug. 27, 1908, near the shore just north of the ice-office gave the following results:

Sample 29. *Microcystis aeruginosa*, main mass; *Anuraea cochlearis* a few; *Botryococcus braunii* rather common; *Cymbella cymbiformis*, one; *Lyngbya aesturaii*, 1 filament; *Navicula*, 2 examples; *Synedra*, a few.

Sample 30. *Microcystis aeruginosa* main mass; *Botryococcus braunii*, very common; *Lyngbya aesturarii*, several filaments; *Anuraea cochlearis* a few; *Synedra* some; *Navicula* one example, very lively; *Cosmarium* one round worm like vinegar eel, very lively.

Sample 31. Lost Lake, 1908. A good mass of material, blackish below, flocculent greenish above.

*Lyngbya aesturarii*, a few filaments; *Microcystis aeruginosa*, quite abundant; *Anuraea cochlearis;* sponge spicule, *Pediastrum duplex*, *Staurastrum*, *Botryococcus braunii*, *Peridinium tabulatum*, a few; *Peridinium*, a small spiny species 1; *Pediastrum boryanum;* several diatoms—*Navicula*, *Coscinodiscus*, *Melosira*, *Cymbella cymbiformis; Microcystis* is the most abundant element, *Peridinium* is rather scarce.

Sample 32. Lake Maxinkuckee, Aug. 27, 1908. A small amount of brownish green flocculent material.

*Anuraea cochlearis*, quite frequent; *Lyngbya aestuarii*, short filament; *Peridinium tabulatum*, a few; *Coelastrum microporum; Coelosphaerium kuetzingianum; Pediastrum boryanum; Scenedesmus*, very few; *Chydorus* fragment. Diatoms,—*Epithemia turgida*, *Navicula*, *Cymbella cymbiformis*, *Gomphonema*, *Coscinodiscus*.

Sample 33. Lake Maxinkuckee, Aug. 27, 1908. A fair amount of brownish green material, muddy below, flocculent green above. The green top material consisting chiefly of *Microcystis aeruginosa;* with some *Anuraea cochlearis; Lyngbya aestuarii; Microcystis aeruginosa; Bulbochaete* bristle; *Coelastrum microporum; Merismopedia glauca; Pediastrum boryanum;* diatoms—*Navicula*, *Coscinodiscus*, etc.

*Measurements:*—The following is a series of measurements of Lost Lake examples:

| No. | Date, 1908 | MEASUREMENTS IN MM | | | Remarks |
|---|---|---|---|---|---|
| | | Length | Alt. | Diam. | |
| 1189 | August 20 | 85 | 54 | 32 | Fanshaped female. |
| 1260 | September 7 | 97 4 | 55 | 31 | Fanshaped female, gravid |
| 1215 | August 20 | 87 | 46 | 35 6 | Fanshaped female |
| 1224 | August 20 | 98 | 56 | 26 | Fanshaped female. |
| 1245 | August 20 | 90 | 51 | 32 8 | Fanshaped female. |
| 1235 | August 20 | 98 | 48 9 | 36 3 | Male. |
| 1188 | August 20 | 102 | 53 | 36 | Male. |
| 1221 | August 20 | 100 | 51 | 37 | Male. |
| 1223 | August 20 | 96 | 51 4 | 34 8 | Male. |
| 1228 | August 20 | 102 3 | 53 7 | 33 | Male. |

Most of these shells blistered posteriorly.

The males are fairly like those of river; the females are more fanshaped. Weight of the 10 shells, 15 oz. only a few are rayed.

## 12. POCKETBOOK

### LAMPSILIS VENTRICOSA (Barnes)

Rather common at the Long Point mussel bed; a few found in the bed by Farrar's and a few in Lost Lake. The species as found in the lake is markedly dwarfed and quite different in appearance from the usual river form. There are two types in the Long Point bed. One consisting of females, having the post basal inflation of the shell characteristic of that sex, not exactly as in the river form, however, but somewhat more restricted; this feature, along with a peculiar stain of the epidermis which conceals the normal coloring of the shell, causes them to very closely resemble a short female *L. luteola*. The other type, an oval shell without the post-basal inflation, was at first taken to represent the males, but some of them were found to contain glochidia. These, too, bear a marked resemblance to *L. luteola*, and the only way to distinguish the two species, as they occur in the lake, is by an examination of the umbonal sculpture. This in *ventricosa* consists of a few coarse parallel ridges; in *luteola* the sculpture is of numerous fine wavy lines.

The lake *L. ventricosa* was so markedly different from the species as usually known that it was compared with a large series of both lake and river forms. Of river shells only a few from the central part of the Maumee, where for some reason the shells are markedly dwarfed, bore any close resemblance to it. None was found in any of the neighboring lakes with which to compare them. In some of the small lakes of Michigan where Dr. Robert E. Coker collected, he experienced a similar difficulty in distinguishing *L. ventricosa* and *L. luteola*. He sent sets of criti-

cal specimens to Mr. Bryant Walker of Detroit, Mich., who identified the shells with a few coarse straight undulations on the beaks as *Lampsilis ventricosa canadensis* and the others as *L. luteola.*

The Maxinkuckee specimens were also compared with *L. ventricosa* from Lake Champlain, and were found to be much like them. The Champlain examples which were free from staining of the epidermis more closely resembled in color the *ventricosa* of the rivers.

The specimens of *L. ventricosa* differed considerably in the different beds. Lost Lake examples are usually rather small, and are stained a peculiar ashy-gray. Those from the near Farrar's are mostly small and apparently young and are rather well rayed; they resemble river forms more closely than any others in the lake.

The large oval *L. ventricosa* of Long Point are the heaviest shells of the lake. A peculiarity of several of these shells is a conspicuous rib-like thickening on the inside, extending from near the umbonal cavity postero-ventrally. The nacre is soft satiny in luster, and not very iridescent. This oval form of *ventricosa* found at Long Point furnishes the only shell in the lake that could be used to any advantage in the manufacture of buttons, and even it produces rather inferior material. Some of these shells were sent to a button factory at Davenport and buttons were made of them. The following is a set of measurements of these large shells:

| No. | Date, 1907 | Length mm. | Alt. mm. | Diam. mm. | Remarks |
|---|---|---|---|---|---|
| 1 | September 24 | 114 | 74.8 | 53 | Female gravid. |
| 2 | October 30 | 107 6 | 65 5 | 54 8 | |
| 3 | October 2 | 105 2 | 63.7 | 52 5 | |
| 4 | October 30 | 92 5 | 60.4 | 53 7 | Female gravid. |
| 5 | October 30 | 103 7 | 67.3 | 49 3 | Dorsal baroques. |
| 6 | October 17 | 98 6 | 60 2 | 55 5 | Arcuate; baroque found. |
| 7 | October 20 | 101 7 | 63 6 | 52.2 | |
| 8 | October 30 | 94 6 | 58 4 | 53 2 | Nacre diseased and blistered. |
| 9 | October 17 | 95 6 | 55 7 | 49 | |
| 10 | October 17 | 91 5 | 60.4 | 49 5 | |

Although the reproductive phase of *L. ventricosa* of the lake is much less conspicuous than in the river mussels, most of them apparently succeed in reproducing themselves. Most of the females found later in autumn have more or less numerous glochidia in the gills. No infected fishes or very young mussels of this species were seen.

The most common parasite is Atax, and it is not particularly abundant. Of six examples collected near Farrar's July 24, 1909,

the first contained 9 of the mites, the second 4, the third 15, with *Atax* eggs in the mantle and body, the fourth 12 *Atax* and numerous eggs of the mite on the inner surface of the mantle, the fifth 3 *Atax* with eggs and the sixth 7 *Atax* with eggs and egg scars. No other parasites were noted. No pearls were found, only a few irregular slugs.

In 1906 some of the immense *L. rectricosa* of Yellow River were planted in the lake near shore not far from the old ice office. A few died shortly after planting but near the same place 2 years later some of the mussels were found alive and apparently thriving. Two of the large females were killed and examined. Altho this was at a time when this species is usually gravid, one of these individuals was sterile, apparently having failed to become impregnated. The influence of its residence in the lake was marked by a dark stain which covered the exposed portion of the shell. The other had a few eggs in the gills, and numerous marginal cysts in the mantle. About 10 Atax among the gills, and numerous distomids on the outside surface of the mantle in the umbonal cavity.

#### 13. LAMPSILIS MULTIRADIATA (Lea)

Not abundant in the lake; occasional shells are found along shore, and now and then they are encountered in the piles of shells where muskrats have been feeding. A few living examples were found in the mussel bed near the mouth of Norris Inlet and a few at Long Point bed. In all hardly a dozen living examples were secured; of 563 shells taken from a pile left by a muskrat at Long Point in 1907, only 1 was of this species. This mussel, as it occurs in the lake, is not nearly so attractive as river specimens, being dwarfed and so deeply stained that the rays are inconspicuous, being usually black or dull brown instead of green.

This species was found in unusual abundance in the Tippecanoe River at Delong, and a considerable number was observed spawning during the autumn of 1908. While spawning, this mussel is a very conspicuous spectacle. It lies either on its back, or more usually with the posterior end directly upward, and the showy edges of the mantle, which are of a yellowish brown color, and cross-barred with narrow lines which are continuous with the fine rays of the epidermis, look a good deal like a small darter lying on the bottom. Long waving pennant-like flaps, with a showy black spot at the base of each are developed, and this portion of the mussel is made still more conspicuous by reason of periodic violent spasmodic contractions.

At the Tippecanoe River this is one of the favorite foods of the muskrat, and it must be difficult for them to hold their own against that rodent.

14. MICROMYA FABALIS (Lea)

Rare; previous to 1913 only one shell had been found; this was picked up on the north shore of the lake in 1907. In 1913 several shells, recently cleaned out by some animal, probably a muskrat, were found at the wagon bridge. This species is fairly common in Tippecanoe Lake and frequent in the Tippecanoe River at Delong where it was collected in shallow water near shore in rather stiff blue clay. It is the smallest of our Unionidæ. The white or bluish white nacre has an exceedingly brilliant luster.

Several other species of mussels have been recorded for the lake, among them *Quadrula lachrymosa* (Lea), *Alasmodonta marginata* Say, *Symphynota compressa* Lea, *Anodontoides ferussacianus* (Lea), *Ptychobranchus phascolus* (Hildreth), *Obovaria circulus* Lea, *Lampsilis parva* (Barnes), and *Lampsilis gracilis* (Barnes). We have seen representatives of none of these species from the lake, and while some, such as *A. ferussacianus*, are very probably present, others are very improbable.

## MOLLUSKS OTHER THAN UNIONIDÆ

About 116 species of mollusks in addition to the Unionidæ are known to occur in Lake Maxinkuckee or its immediate vicinity. Specimens of nearly all of these species were collected during our investigations; others were collected by the late L. E. Daniels. These collections were referred to Dr. Paul Bartsch of the United States National Museum for study and report. Other duties have prevented Dr. Bartsch from completing his full report on these mollusks. He has, however, supplied the following list of his identifications. This shows that the Lake Maxinkuckee molluscous fauna is a remarkably rich one, the total number of species, including the Unionidæ, being not fewer than 130.

### FRESHWATER MOLLUSKS

1. *Lymnæa palustris* (Müller)
2. *Lymnæa obrussa exigua* (Lea)
3. *Lymnæa danielsi* Baker
4. *Lymnæa dalli* Baker
5. *Lymnæa humilis* (Say)
6. *Lymnæa desidiosa* (Say)
7. *Planorbis bicarinatus* Say

8. *Planorbis trivolvis* Say
9. *Planorbis campanulatus* Say
10. *Planorbis parvus* Say
11. *Planorbis exacutus* Say
12. *Planorbis albus* Müller
13. *Segmentina armigera* (Say)
14. *Physa integra* Haldeman
15. *Physa heterostropha* Say
16. *Ancylus tardus* Say
17. *Ancylus shimekii* Pilsbry
18. *Ancylus rivularis* Say
19. *Ancylus kirklandi* Walker
20. *Viciparus contectoides* W. G. Binney
21. *Viviparus intertextus* (Say)
22. *Campeloma decisa* (Say)
23. *Valvata tricarinata* (Say)
24. *Valvata sincera simplex* Gould
25. *Amnicola limosa* (Say)
26. *Amnicola limosa porata* (Say)
27. *Amnicola lustrica* Pilsbry
28. *Amnicola walkeri* Pilsbry
29. *Angitrema armigera* (Say)
30. *Pleurocera subulare* (Lea)
31. *Pleurocera subulare intensum* (Reeve)
32. *Pleurocera canaliculatum* (Say)
33. *Pleurocera undulatum* (Say)
34. *Pleurocera moniliferum* (Lea)
35. *Goniobasis louisvillensis* Lea
36. *Goniobasis depygis* (Say)
37. *Goniobasis livescens* (Menke)
38. *Goniobasis pulchella* (Anthony)
39. *Sphærium flavum* (Prime)
40. *Sphærium occidentale* Prime
41. *Sphærium rhomboideum* (Say)
42. *Sphærium simile* (Say)
43. *Sphærium solidum* (Prime)
44. *Sphærium stamineum* (Conrad)
45. *Sphærium striatinum* (Lamarck)
46. *Sphærium sulcatum* (Lamarck)
47. *Sphærium tenuis* Sterki
48. *Sphærium tumidulum* Sterki
49. *Sphærium walkeri* Sterki
50. *Musculium rosaceum* (Prime)

51. *Musculium rykholti* (Sterki)
52. *Musculium securis* (Prime)
53. *Musculium transversum* (Say)
54. *Musculium truncatum* (Linsley)
55. *Pisidium mainense* Sterki
56. *Pisidium medianum* Sterki
57. *Pisidium milium* Haldeman
58. *Pisidium nove-boracense* Prime
59. *Pisidium pauperculum* Sterki
60. *Pisidium pauperculum crystalense* Sterki
61. *Pisidium sargenti* Sterki
62. *Pisidium scutellatum* Sterki
63. *Pisidium splendidulum* Sterki
64. *Pisidium strengii* Sterki
65. *Pisidium tenuissimum* Sterki
66. *Pisidium walkeri* Sterki
67. *Pisidium abditum* Haldeman
68. *Pisidium affine* Sterki
69. *Pisidium compressum* Prime
70. *Pisidium compressum lævigatus* Sterki
71. *Pisidium idahoense* Sterki
72. *Pisidium indianense* Sterki
73. *Pisidium lacustrinum* Sterki
74. *Pisidium virginicum* Bourginat
75. *Pisidium rotundatum* Prime
76. *Pisidium variabile* Prime
77. *Pisidium politum* Sterki
78. *Pisidium vesiculare* Sterki
79. *Pisidium subrotundatum* Sterki

LAND MOLLUSKS

80. *Polygyra hirsuta* (Say)
81. *Polygyra fraterna* (Say)
82. *Polygyra monodon* (Rackett)
83. *Polygyra thyroides* (Say)
84. *Polygyra thyroides bucculenta* (Gould)
85. *Polygyra elevata* (Say)
86. *Polygyra zaleta* (Binney)
87. *Polygyra profunda* (Say)
88. *Polygyra multilineata* (Say)
89. *Polygyra multilineata algonquinensis* Nason
90. *Pyramidula alternata* (Say)
91. *Pyramidula cronkhitei anthonyi* Pilsbry & Ferriss

92. *Pyramidula perspectiva* (Say)
93. *Helicodiscus parallelus* (Say)
94. *Zonitoides arboreus* (Say)
95. *Zonitoides nitidus* (Müller)
96. *Zonitoides minusculus* (Binney)
97. *Euconulus fulvus* (Müller)
98. *Polita hammonis* (Ström)
99. *Polita indentata* (Say)
100. *Vallonia pulchella* (Müller)
101. *Vallonia costata* (Müller)
102. *Coehlicopa lubrica* (Müller)
103. *Strobilops labyrinthica* (Say)
104. *Strobilops virgo* Pilsbry
105. *Strobilops affinis* Pilsbry
106. *Pupoides marginatus* (Say)
107. *Pupilla muscorum* (Linnæus)
108. *Gastrocopta armifera* (Say)
109. *Gastrocopta contracta* (Say)
110. *Gastrocopta tappaniana* (Adams)
111. *Vertigo morsei* Sterki
112. *Carychium exile* H. C. Lea
113. *Carychium exiguum* (Say)
114. *Succinea retusa* Lea
115. *Succinea obliqua* Say
116. *Succinea avara* Say

## THE CRUSTACEANS

A comprehensive study of the Plankton was made by Professor Chancey Juday now of the University of Wisconsin. A similar thorough study of the Parasitic Copepods was made by Dr. Charles B. Wilson whose report is made part of this paper.

Except during the summer of 1899 and 1900 the field work on Lake Maxinkuckee was nearly all done by one or two investigators only. This made it impossible to pay equal attention to all the groups of animals and plants; indeed, many groups could receive scarcely more than passing notice, while others had to be wholly neglected. Among those which received but slight attention are the worms, polyzoans, protozoans, smaller crustaceans, insects, and the like. Although considerable collections were made in some of these groups, insurmountable difficulty was experienced in finding specialists to work them up. Our reports on several of those groups are therefore necessarily brief and general in character.

Occasional notes and memoranda were made regarding various species which we did not have opportunity to observe regularly or methodically. Such of these as seem to possess some value or interest are given in the following pages.

The list of species contained in the Plankton collections of 1899 and 1900 and a discussion of their abundance, distribution and habits will be found in Professor Juday's report. A few additional species were later obtained in the small ponds about the lake.

Of the individual species not much can be said; our studies were too general for that purpose.

It may be stated, however, that plankton species of crustaceans constitute a large part, probably nearly all, of the first food of young fishes, and much of the food of some species of fishes throughout their entire lives. The little Stickleback (*Eucalia inconstans*), for example, may be mentioned as one of such species. Examples of this species kept in an aquarium fed eagerly on any and all plankton crustaceans which we placed in the aquarium with them. We observed also that these small crustaceans are captured and eaten freely by those curious carnivorous plants, the bladderworts.

Of the whole group, it can be said that they are present throughout the year in greater or less abundance. The abundance varies greatly, however, from time to time, as shown by Juday. On September 6 (1906), peculiar ripples were observed on the surface of the otherwise smooth lake. Upon cautiously approaching the spot it was found that the disturbance was caused by large schools of very young black bass, circling about and feeding voraciously. Upon drawing a towing-net through the place great quantities of several species of plankton crustaceans were obtained.

On many occasions the lake surface in large areas was seen to be covered with a thin scum which, on examination, was found to consist chiefly of the cast-off skins of minute crustaceans.

On November 5 (1906), Entomostraca were present in such remarkable abundance at and near the surface of the lake that the water had the appearance and consistency of thick soup, the little animals actually crowding each other in the water. The next day great windrows of these crustaceans were found washed up on the shore at Long Point. Two days later they were again observed forming dense clouds at and near the surface of the lake off the Morris boathouse. A 4-drachm vial was simply dipped into the water and about 100 of the creatures were secured.

A quantity of plankton collected July 7 (1909), and examined qualitatively by Professor A. A. Doolittle of the department of

biology, Washington, D. C., high schools, gave the following results:

| Species. | Per cent. |
|---|---|
| *Diaptomus oregonensis* Lilljeborg | 0.38 |
| *Cyclops leuckarti* Claus; (*edax* Forbes) | 4.11 |
| *Diaphanosoma leuchtenbergianum* Fischer | 0.40 |
| *Daphnia retrocurva* Forbes, var | 1.06 |
| *Daphnia hyalina* Leydig | 84.02 |
| | 99.97 |

*The Copepods* (free-swimming species) frequently bear attached Protozoa, sometimes in such numbers as to make them appear bristly. They seem to be more abundant in winter when the lake is covered with ice. Whenever holes are cut through the ice these crustaceans often come crowding to the light and air.

*The Cladocera* are, generally speaking, the larger and more showy element of the crustacean plankton. Their stomach contents, which at times forms conspicuous masses, was found to be composed largely of phyto-plankton elements, especially *Botryococcus braunii* which, because of its color, was easily recognizable. One of the smaller Cladocera, Chydorus, was found to constitute an important part of the food of the Unionidæ or mussels of the lake, as it also does of the small fishes.

One of the most notable species of the Zoo-plankton was *Leptodora hyalina*. This is usually a deep-water species, but on September 2 (1906), it was taken in quantities in a surface tow-net in Outlet Bay. Though one of the largest of the plankton crustaceans, this species is so transparent as to be quite invisible except by its movements among the associated individuals of Lyngbya.

Two other species of Entotomostraca not usually classed as plankton, were noted, namely, the fairy shrimps. One, *Branchipus serratus*, was found dead in large numbers floating on the surface in deep water July 11 (1899). Later in the same day, considerable numbers were seined in shallow water off Norris Inlet. Again on August 21 and 31, a few were seen floating.

Another species, *Branchipus vernalis*, was found abundantly in small temporary ponds west and south of the lake in the spring of 1901.

A school of these curious crustaceans of delicate structure and pearly appearance, apparently usually swimming on their backs, their numerous gill-feet moving rapidly in the water, makes a very pretty sight.

*The Parasitic Copepods* are reported on by Dr. Wilson (pp. 79-82). It may be here remarked that, as compared with other bodies

of water, these forms are comparatively rare in Lake Maxinkuckee. In certain rivers which we have examined, particularly the Kankakee, Maumee, and the sloughs along the Mississippi, certain large species of Lernæa are so abundant during the summer and fall that they infest most of the rock bass, crappies, and bluegills. They seemed to be worst on the rock bass, nearly every one of which was bleeding in one or more places where these parasites had fastened in their skin. At this season these fishes are said to be "wormy" and are rejected by anglers and others who chance to catch them.

*The Isopods* or *Sowbugs* are represented at the lake by two aquatic species, one in the lake proper, the other (*Porcellio scaber*), in the woodland ponds and in damp places. The lake species is abundant all the year round among the Chara, especially in Outlet Bay. It is one of the most important foods, particularly of rock bass and bluegills. It sometimes forms the greater part of the food of those species. Little or nothing was learned of the habits of the pond species. There are, of course, several land species of these curious crustaceans.

*The Amphipods* are represented by several species in the lake and the neighboring ponds. A large species was found near shore, and smaller forms farther out in the lake among the aquatic plants. The Hornwort (*Ceratophyllum demersum*) was one of their favorite haunts. Some of our herbarium specimens of this plant were found full of these beach fleas. Many specimens were obtained from the plants raked up from various depths. The Amphipods could be obtained by washing the plants in a tub or bucket of water. A few were taken at night in the towing-net. Some were found in stomachs of fishes seined August 3 (1906), south of Arlington station.

The freshwater shrimp (*Palaemonetes exilipes*) was not common in or about the lake. Only a few were obtained, one on August 2 (1899), one on September 6 (1899), and one on October 23 (1900), all in the Outlet. Two were secured in Lost Lake, one on August 1, the other September 1 (1900). Another was taken November 27 (1900), upon a mass of aquatic plants dredged some distance from shore in the lake. This species therefore appears to be rather rare at this lake. In Little River near Aboite, Allen Co., Indiana, immense numbers of this shrimp were found in masses of *Ceratophyllum* from which the transparent creatures jumped with great alacrity when hauled up out of the water. They were found in great abundance also in Chester River, near Chester, Md.

## THE COPEPOD PARASITES

By Charles B. Wilson, Professor of Biology, State Normal School, Westfield, Mass.

Three species of *Argulus*, two of *Ergasilus*, and one of *Achtheres* were found upon the fish of the lake. The species of *Argulus* have all been described elsewhere (Proc. U. S. Nat. Mus., XXV, pp. 709, 715, 718). The life history of one species, *A. maculosus*, was obtained in full, and a brief account was published in 1907 (Proc. U. S. Nat. Mus., XXXII, p. 416). Of the two species of *Ergasilus*, one (*E. centrarchidarum*) has been described by Wright*. This species is common everywhere on all fishes of the perch family. The other species was new to science; it was named *E. versicolor*, and a full description with figures was published in 1911 (Proc. U. S. Nat. Mus., XXXIX, p. 341: pl. 45).

The single species of *Achtheres, A. ambloplitis*, has also been described by Wright, Kellicott, and others, but several details were here supplied that had hitherto been lacking.

The complete life-history was also worked out for both genera; that of *Achtheres* had been partially described before by Claus and Kellicott, while not a single detail had ever been published for *Ergasilus*.

#### 1. ARGULUS CATOSTOMI Dana & Herrick

Found in the gill-cavity of the white sucker, *Catostomus commersonii*. The discovery of this species in Indiana, together with those recorded from Lake Champlain and the rivers of Massachusetts, Connecticut, and New York, shows the distribution of this parasite to be identical with that of the host it infests. The specimens here obtained and those from Lake Champlain include males, the first of that sex to be recorded for this species.

#### 2. ARGULUS AMERICANUS Wilson

Found on the outside surface of the Dogfish or Bowfin (*Amia calva*). This species does not appear to be very common at Lake Maxinkuckee, but possibly an examination of a larger number of fish would show different results. This is the first instance of the species having been obtained from fish in their native haunts.

#### 3. ARGULUS MACULOSUS Wilson

Found on the outside surface of the Common Bullhead (*Ameiurus nebulosus*), the Yellow Catfish (*Ameiurus natalis*), and the

*Proc. Canadian Institute (N. S.), I, p. 243.

Rock Bass or Redeye (*Ambloplites rupestris*). Only two females were found on the Redeye; both were full of ripe eggs; evidently they were hunting for a suitable place to deposit them, and were only using the Redeye as a temporary host.

The Yellow Cat is the true host of this *Argulus* and nearly half the fish of that species that were examined yielded specimens of this parasite.

#### 4. ERGASILUS CENTRARCHIDARUM Wright

Found on the gill-filaments of the Calico Bass (*Pomoxis sparoides*), the Redeye (*Ambloplites rupestris*), the Warmouth (*Chaenobryttus gulosus*), the Bluegill (*Lepomis pallidus*), the Small-mouthed Black Bass (*Micropterus dolomieu*), the Large-mouthed Black Bass (*M. salmoides*), the Yellow Perch (*Perca flavescens*), and the Walleyed Pike (*Stizostedion vitreum*), and would have been found almost certainly upon the different sunfishes, had there been an opportunity to examine them.

As its name rightly implies, it is a family rather than a specific parasite, and is very widely distributed, as are the hosts upon which it lives.

#### 5. ERGASILUS VERSICOLOR Wilson

Found only on the two species of Catfish (*Ameiurus nebulosus* and *A. natalis*), the latter of which was the more badly infested. This species was not found upon any other fish in the lake although many hundreds of them were searched for it, nor was *Ergasilus centrarchidarum*, so common on the other fish, ever found on these catfishes.

*E. versicolor* has since been obtained from the Channel Cat (*Ictalurus punctatus*), and the Eel Cat (*Ictalurus anguilla*), in the Mississippi River.

The species is thus distinctively a Catfish parasite in sharp contrast to *E. centrarchidarum*, which is a Perch parasite.

The life history of *Ergasilus* worked out upon these two Maxinkuckee species, was published in vol. 39, Proc. U. S. Nat. Mus., pp. 313-326, and still stands as the only contribution to the ontogeny of the entire family.

#### 6. ACHTHERES AMBLOPLITIS Kellicott

Found on the gill-arches of the Redeye (*Ambloplites rupestris*), the Bluegill (*Lepomis pallidus*), the Small-mouthed Black Bass (*Micropterus dolomieu*), the Large-mouthed Black Bass (*M. salmoides*), and the Walleyed Pike (*Stizostedion vitreum*). It was

particularly common on the Redeye and the Small-mouthed Black Bass, two-thirds of the specimens examined being infested with this parasite. Like the first species of *Ergasilus* mentioned above, it is a family rather than a specifis parasite, as its name implies. This species is as typically American as *A. percarum* is European, and is fully as widely distributed.

The life history of this species appeared in vol. 39, Proc. U. S. Nat. Mus., pp. 194-224, pls. 29-36.

Female Achtheres with ripe eggs were found toward the last of August, and that may be designated as one of the breeding seasons of the species.* The nauplius and metanauplius stages are passed wholly inside the egg and the emerging larva is a fully developed copepodid larva with an elliptical cephalothorax, three free thorax segments, a two-jointed abdomen, and two pairs of swimming legs.

The most striking characteristic of this copepodid larva is its attachment filament, which can be plainly seen inside the anterior end of the body. This filament appears at the very beginning of the nauplius stage; at first it consists of a large mushroom-shaped body (the future button or disc) which is situated close to the integument at the very anterior margin of the head, and a straight stalk or filament passing directly backward from the center of the disc. This filament is about one-fifth the diameter of the disc, and its posterior end is slightly enlarged and fastened into the tissue of the nauplius's body just back of the disc. As development progresses the filament increases in length and begins to coil so that just before the nauplius transforms into a metanauplius it consists of two circular coils, one lying inside the other, the outer one twice the diameter of the disc. In the free swimming copepodid stage there are three large coils instead of two.

This larva shows only traces of a digestive canal, even under the magnification, and the center of the body is still filled with large yolk cells of different sizes. It swims about actively with a motion like that of an adult Caligus, and at once seeks a host. Like its European relative (*A. percarum*) it infests the Centrarchidæ, and fishermen are well acquainted with the fact that our game fishes belonging to that family are in the habit of catching their food at or near the surface of the water. This is just where the parasite larva is waiting for its host, and the two thus come together. All the larva needs is a chance to get inside the fish's mouth without being swallowed, and such an opportunity is af-

* For full account and figures see Proc. U. S. Nat. Mus., Vol. 39, pp. 189-226; pls. 29-36.

forded in the ordinary act of breathing. Once inside the mouth and swept against the gill-arches by the out-current of water, the larva secures a firm hold by means of its powerful maxillipeds.

It is noticeable in this connection that those of the Centrarchidæ which feed most persistently at the surface are the ones infested by this parasite. Even in the hottest weather the redeye frequents the shallow water along the shore, at least at night. As a result, its gills are practically certain to yield a goodly number of Achtheres, and the same is true of the two kinds of black bass, particularly the small-mouthed.

On the other hand, a fish like the walleye, which frequents deeper water, does not present as favorable an opportunity and most of them are free from this parasite.

Once fastened to the gill-arches, the parasite remains there for life, so that the only chance its enemies have to kill it are while it is swimming about freely at the surface.

This free swimming period is much shorter than that of the Ergasilus and Argulus larvæ, but the Achtheres larva is larger than the other two and so offers a more tempting bait. It is a significant fact that so many of them were found in the stomachs of the few minnows and darters that were examined.

In this way they are kept within due bounds and prevented from multiplying in sufficient numbers to become dangerous to the larger fish.

#### 7. ACHTHERES MICROPTERI Wright

Found on the gills of *Micropterus salmoides* and *M. dolomieu*. This species is not at all common, and for a long time all the specimens obtained from the two basses were supposed to belong to the species *ambloplitis*. The female of this species, however, may be distinguished from *ambloplitis* by the large abdomen with its basal lobes and more distinct segmentation, and by the much smaller egg-tubes. This distinction may then be confirmed by the details of the mouth-parts.

The male may be distinguished by its much larger size, and by the chelæ on the tips of the second maxillæ.

## THE CRAWFISHES

By WILLIAM PERRY HAY, Head of the Department of Biology and Chemistry, Washington, D. C., High Schools

Crawfishes are quite common in Lake Maxinkuckee and in Lost Lake; on the land about the lakes they are less frequent. The truly aquatic species are found chiefly in the shallower depths, hiding under rocks, sticks, and among Chara and other aquatic vegetation. But even at their best, not as many will be taken in the seine as will be secured in similar collecting in sluggish streams. The greatest number taken in one haul of the seine in Lake Maxinkuckee was twenty-two.

In the collections turned over to me for identification and study, four species are represented, namely: *Cambarus blandingi acutus, C. diogenes, C. propinquus*, and *C. immunis spinirostris;* or, using English names instead of Latin combinations, we may designate these four species as the Pond Crawfish, the Solitary Crawfish, the Gray Rock Crawfish, and the Rock Crawfish respectively. Of these, the first three have long been known to occur in northern Indiana, but *C. immunis spinirostris* has not heretofore been known north of Terre Haute. One or two other species probably occur in the Maxinkuckee region. *C. argillicola* Faxon, has been reported from several localities north, east and south of Lake Maxinkuckee, and *C. rusticus* Hagen, has been taken near Mt. Etna, Huntington Co., Ind.

Beyond doubt, the crawfish fauna of this lake, or of any other, will repay careful study. The habits and economic importance of these animals are only poorly known, but it must be that, as a source of food supply for other animals, or as scavengers, they fill a field of usefulness.

As the present account is for the general public rather than for the zoologist, it will be unnecessary to give more concerning the structural characters of these animals than is absolutely required for their recognition. The male crawfish may be distinguished from the female by the presence of two pairs of rigid appendages which are attached to the first two joints of the abdomen or tail, and which, projecting nearly straight forward, lie in a sort of groove between the basis of the walking legs. In the female the abdomen is broader than in the male, and the appendages of the first two joints are slender and flexible like those which follow. The rostrum is the beak-like projection of the shell (or carapace) above the eyes.

### 1. POND CRAWFISH

CAMBARUS BLANDINGI ACUTUS (Girard)

This species may be at once distinguished by the fact that in the males the third and fourth pairs of walking legs bear a hook on the third joint from the base. The rostrum is long and approximately triangular, with a pair of small teeth quite close to the tip. The large pincers and the legs which bear them are long, slender, and roughly granular.

This crawfish is represented in the collection by 2 males and 7 females from Aubeenaubee Creek, one male and one female from Culver Inlet, 8 males and 2 females from Spangler Creek, and by 2 males and 1 young female from Bruce Lake.

This is the pond crawfish of the region, its home being in woodland ponds. Individuals were seen from time to time but they usually escaped under the leaves. Several dead ones were found in ponds. Generally speaking, it is not a very abundant species anywhere. It is occasionally met with in the sloughs of the Mississippi.

### 2. THE SOLITARY CRAWFISH

CAMBARUS DIOGENES Girard

This crawfish is an inhabitant of the lake at certain times only. It visits the water early in the spring for the purpose of producing its young, but during the remainder of the year each individual lives alone in a burrow over which it constructs a chimney of mud pellets. This habit is so peculiar, being shared by only one other Indiana species, that it alone should be almost enough to distinguish the solitary crawfish; but as some of our readers may wish to know what the animal is like the following description is given: The body is high and compressed; the rostrum is short, thick-edged, and without teeth near the tip; the two longitudinal, curved lines on the back run together throughout the whole part of their length so that only small triangular spaces are left between them in front and behind. The color is quite brilliant for a crawfish, the claws, rostrum, and the elevations on the shell being more or less marked with crimson and yellow. Represented by 1 large female and 7 young from Aubeenaubee Creek. Other examples were noted in 1901, as follows:

March 31, a good sized female caught in a pool at the birch swamp; April 1, one dead, in ditch east of railroad, in Green's marsh; April 2, remains of several seen in the Outlet; April 3, remains of one found in Green's marsh; April 4, two caught, copu-

lating east of the railroad, in Green's marsh, and one caught in the marsh north of Lost Lake; April 9, three living ones seen, 2 caught, and remains of great numbers at the drained lake; April 11, one big one caught at mouth of Farrar's Creek, and one at mouth of Aubeenaubee Creek; April 15, several seen in creek at south end of the lake, 2 caught; April 17, a female with eggs caught on west side of lake; April 19, a large one dead at water's edge just east of the depot; May 3, chimneys abundant east of Lost Lake outlet; May 17, one caught at edge of Lake Maxinkuckee at Long Point, with small young attached to it.

This is a large "meaty" species with heavy pincers, and except where its natural habitat gives it a muddy flavor, makes an excellent food.

### 3. THE GRAY ROCK CRAWFISH

#### CAMBARUS PROPINQUUS Girard

This species may be recognized at once by the fact that the upper surface of the rostrum has a low median longitudinal ridge. This is too low to be visible, but may be detected by passing the tip of one's finger across from side to side, when the elevated portion may easily be felt. The species is usually an inhabitant of running water and will probably be found to occur most abundantly about the inlets and outlets of the lake. It is represented by 15 males and 29 females from Aubeenaubee Creek, 9 males and 5 females from Lake Maxinkuckee, 7 males and 10 females from Culver Inlet, 1 male and 1 female from Outlet, and 4 males and 7 females from East Inlet.

This is the common crawfish of the lake. It is found in considerable abundance everywhere among rocks and in the Chara. The lake form is brownish gray in color. It is too small to be of much use as human food. This species is also found in Yellow River, near Plymouth, and appears to be the most common species of the region. They do not burrow, but hide under rocks or bits of board or stick under which they may make small excavations. Of many notes taken the following may be given here:

April 27, 1901, several seen in the bottom, one bluish in color; two copulating; June 3, a large shed carapace in Outlet Bay; June 7, several caught, they hide under boards; one very small one with its mother; June 12, many caught, more seen, almost every blunt-nosed minnow's nest is watched by one or two; June 13, a good many at minnows' nests; June 16, some caught at minnows' nests; June 22, still at minnows' nests. In 1904, October 19, a common content of fish stomachs. Fisherman reports that they are "the

best bait now." One angler caught 6 black bass with crawfish and one with a minnow. October 3, many at the head of the Outlet, about 8 seen in a small space. One was eating at a dead grass pike; it stayed there a good while. October 31, one still eating in the morning at the pike. Very little of the pike eaten. November 2, still eating at the pike. November 14, one near shore east of Long Point eating a minnow. November 22, two caught while copulating. November 25, two caught copulating, east of Long Point. January 1, 1905, three seen together, 2 smallish, copulating, and a big one near by.

From numerous observations of the crawfishes of the lake the following conclusion may be drawn:

There appears to be no special time for mating, and no special breeding period was observed; nor again, any special time for moulting. It is probable that in the fairly uniform temperature of the lake the lives of the crawfishes are not so markedly divided into seasons as they are in the river crawfishes. Generally, in rivers heavily populated with crawfishes, one can find immense numbers of moulted shells at certain periods, usually about the beginning of July, but in Lake Maxinkuckee, only occasional and scattered cast-off skins can be found.

The nature of the food was not easily discovered by examination of stomach contents, as the material was too finely comminuted. A few were seen eating dead fishes as mentioned above. They are usually found in the vicinity of minnow nests, and probably devour fish eggs to some extent. Various fishes, especially walleye and bass, eat them at times, and they are one of the principal foods of the soft-shelled turtle. The lake species are rarely used for bait, perhaps because of the difficulty of obtaining soft-shells or "peelers" in the lake; river crawfishes are sometimes used.

The crawfishes of the lake often have protozoa attached to the gills, but this probably does not seriously inconvenience them.

### 4. THE ROCK CRAWFISH

#### CAMBARUS IMMUNIS SPINIROSTRIS Faxon

In general form and appearance this species is somewhat like the last, but it lacks the longitudinal ridge on the rostrum. The teeth of the rostrum are apt to be very small and, in the males, the tips of the first abdominal appendages are slender, blade-like, and recurved.

Represented by 9 males and 8 females from Aubeenaubee Creek, 1 male from Culver Inlet, and 12 young females from Norris Inlet.

## THE LEECHES

By J. Percy Moore, Professor of Zoology, University of Pennsylvania

The leeches form a fairly conspicuous part of the lake fauna. Although quite abundant, the particular forms which attack human beings do not seem to be common, and bathers are never troubled with them. In Winona Lake, near Warsaw, Indiana, which has a good deal of muddy bottom, there are places where one can not enter the water and remain long without being attacked by numerous leeches, the bites of which cause severe itching for days. This condition was not noted at Lake Maxinkuckee except near the Norris Inlet, where on one occasion (Aug. 1, 1906) the leeches proved very voracious and troublesome.

There are probably several species present besides those listed in this paper. The long dark leech with yellowish stripes along the sides, which is usually found in soft mud, was found in Green's marsh and in the pond near the elevator. A good many fish-leeches were obtained from various fishes during the summer of 1906, and appear to be different from those to be found on turtles.

Economically considered, the fish-leeches are perhaps the most important in the lake. They are especially common on catfishes, and most catfishes caught have red sore spots on the chin where the leeches have been attached. They do not appear to be abundant or do much harm, a single fish rarely harboring more than two or three at a time.

The animals most severely troubled by leeches are the turtles, almost every one of which has one to several leeches attached. The turtle-infecting leeches are broad flat animals and "play 'possum" when disturbed. The turtles which are at liberty appear to be able to keep from being badly enough infected to do them serious injury. A snapping turtle kept in a livebox, however, was found to be badly attacked. It was fairly clean when placed in the livebox, but when taken out ten days later had a great bunch of leeches—53 in number—attached to the neck. These leeches occasionally attack mussels, especially Anodontas, and are now and then found inside the mussel shell, between the mantle and the foot. A number of recently killed shells found near Norris Inlet were covered with them; they were probably feeding upon mucus. Small leeches are probably great enemies of snails, some small examples of Planorbis were found to be swarming with them. The leeches of all sorts spend a good deal of time under boards. One found June 6, 1901, under a board had a good number of round,

rather large, yellow eggs under her, and on June 8 one was found under a board covering a number of minute young. On June 11, a number of very small red ones were found attached to the mother.

The swimming leech of the lake, *Dina fervida*, is often found under boards or rocks. When frightened it swims off with great rapidity, apparently swimming on its side with rapid dorso-ventral flexions of the body. It is pink in color and bears considerable resemblance to a fish worm in general appearance, but is flat and has no ring about the body. It does not appear to be parasitic but is a scavenger, often being found in considerable numbers on dead animals (coot, duck, shrews) found at the water's edge. They are eaten by water-dogs and probably by fishes and appear to be the principal food of the Wilson Snipe which haunt the stretches of shore during its autumnal migrations. A prominent citizen of Culver reported that leeches make the best sort of bait he ever tried. He had found this out one summer when other sorts of bait were scarce. All sorts of fish took them eagerly—bass, bluegill, sunfish, etc. They were "as tough as India rubber so the fishes could not take them off the hook—often two or three fish could be caught on the same leech."

The leeches of Lake Maxinkuckee are evidently incompletely made known herein and further explorations may be expected to demonstrate the occurrence of at least five or six additional species. The collections upon which this report is based comprise 11 species. These are apportioned among three families, as follows: Glossiphonidæ, seven; Hirudinidæ, one; and Erpobdellidæ, three. No specimens of the Ichthyobdellidæ are included, although it is certain that one and probably two, or perhaps even three, species of the true fish-leeches occur parasitically upon the skin and fins or within the gill-chambers of the small fishes of the lake. The Glossiphonidæ, as the most accessible and easily collected of leeches, are probably nearly completely represented in the collection. The same is true of the Erpobdellidæ, also. Of the Hirudinidæ one or two additional species of Hæmopis may be expected to occur and the true blood-sucking leech, *Macrobdella decora*, so ubiquitous throughout the greater part of the North American continent, should occur in the plant-grown shallows of the lake, where warm-blooded animals come to drink or where frogs deposit their eggs in the spring.

For full descriptions and figures of the several species mentioned in this report, as well as for the synonymy and literature references, the following papers may be consulted: Castle, Some

North American Fresh-water Rhynchobdellidæ, Bulletin Museum of Comparative Zoology, Vol. XXXVI (1901), pp. 16-64; Moore, The Hirudinea of Illinois, Bulletin Illinois State Laboratory of Natural History, Vol. V (1901), pp. 479-547; Nachtrieb, Hemingway & Moore, The Leeches of Minnesota, Geological and Natural History Survey of Minnesota, Zoological Series, No. V, 1912, especially Part III, Classification of the Leeches of Minnesota.

For the determination of the species herein listed the following Key will serve:

A. Mouth a small pore through which the slender exertile pharyngeal proboscis may be protruded; complete somites usually composed of three rings, one or more of which may be partially subdivided. *Glossiphonidæ*

B. Eyes all simple, one to three pairs, those of the two sides usually distinct; form slightly or moderately depressed; cutaneous papillæ few and mostly small or obsolete; gastric cæca small and simple or little branched, sometimes reduced or absent; no compact pharyngeal glands. *Glossiphonia*

C. Eyes one pair, widely separated; genital orifices separated by one annulus; gastric cæca more or less reduced, size small. (Subgenus *Helobdella.*)

1. A brown or yellow cuticular nuchal plate and underlying gland on dorsum of somite VII; color pale pink, gray, brownish or greenish; gastric cæca three to six pairs, the first two or three pairs always small; usual length 10 to 15 mm.; slender. *G. stagnalis*

2. No nuchal plate or gland in adult; more or less heavily pigmented with brown in longitudinal lines with metameric white spots on middle annulus of complete segments; generally three longitudinal series of papillæ conspicuously pigmented with dark brown or black; gastric cæca five or six pairs ; length of *G. stagnalis* but stouter and more depressed. *G. fusca*

CC. Eyes three pairs; genital orifices separated by two annuli; gastric cæca not reduced, six or seven pairs. (*Glossiphonia ss.*)

3. Eyes in regular longitudinal series; a pair of dark longitudinal paramedian lines above and below; opaque; length 15 to 25 mm.; robust. *G. complanata*

4. Eyes grouped in twos at the angles of a triangle; translucent and little pigmented, no dark longitudinal lines; length 6 to 12 mm.; broadest and most depressed of genus. *G. heteroclita*

BB. A single pair of compound eyes, often united into a common pigment mass and rarely followed by several pairs of simple eyes; form moderately or greatly depressed; cutaneous papillæ usually numerous and conspicuous; gastric cæca seven pairs, large and more or less complexly branched; a pair of compact pharyngeal glands in addition to the diffuse salivary glands. *Placobdella*

D. Somites I-V much widened to form a distinct head; form little depressed.

5. Dorsum bearing three prominent papillated keels; color usually green or olive; length rarely exceeds 20 mm. *P. montifera*

DD. No distinct enlargement of anterior segments to form a head; form greatly depressed, foliaceous.

6. Integuments rather opaque; colors in a bold pattern of yellow and olive green or brown; dorsal papillæ low and smooth; length up to 3 inches. *P. parasitica*

7. Integuments translucent; colors a much broken pattern of mixed yellow, brown and green; dorsal papillæ very numerous, elevated and rough; length up to $2^1/_2$ inches. *P. rugosa*

AA. Mouth large; pharynx without protrusible proboscis; complete somites usually of five annuli, some of which may be subdivided.

E. Pharynx usually provided with three distinct toothed jaws; testes several metameric pairs; eyes five pairs in as many segments. *Hirudinidæ*

8. 12-16 pairs of coarse teeth on each jaw; genital orifices separated by five annuli, penis filiform; color usually a mottled pattern of black or brown and gray, sometimes plain dark green or yellow; usual length 3-5 inches. *Hæmopis marmoratus*

EE. Pharynx provided with three longitudinal muscular folds but no toothed jaws; testes numerous and minute, not metameric; eyes usually three or four pairs in two groups. *Erpobdellidæ*

F. Last annulus (*b 6*) of each somite not obviously enlarged or subdivided. *Erpobdella*

9. Genital orifices separated by two rings; eyes three pairs; color usually two or four dark longitudinal stripes separated by paler bands; loops of vasa deferentia reaching to ganglion XI; length about 2-3 inches. *E. punctata*

FF. Annulus *b 6* obviously enlarged and subdivided. *Dina*

10. Genital orifices separated by two rings; eyes three or sometimes four pairs; pigmentless or dorsum marked with irregular scattered spots; vasa deferentia not reaching ganglion XI; length 1 to $1^1/_2$ inches. *D. fervida*

11. Genital orifices separated by three and one-half (sometimes three) rings; eyes four pairs; pigmentless or more usually with numerous small, often confluent, dark spots, sometimes forming a median stripe; vasa deferentia as in 9; length seldom in excess of 1 inch. *D. parva*

## GLOSSIPHONIDÆ

### 1. GLOSSIPHONIA STAGNALIS (Linnæus)

This almost cosmopolitan and usually very abundant species is very poorly represented in the collection by twenty-two specimens from three localities. In the small meadow ponds and shallow lakes that abound throughout the northeastern United States and contiguous portions of Canada this species occurs in great numbers. It also occurs in the warm shallow waters of creeks and rivers, especially in quiet bays overgrown by aquatic vegetation. These leeches shun the bright light and congregate in great numbers under stones and the ensheathing foot-stalks of the leaves of rushes, Sagittariæ, etc.

The most usual food consists of small annelids, insects and mollusks but blood will be taken from abraded surfaces of all kinds of living and dead animals whenever opportunity offers, and for this purpose vast numbers of these little leeches gather about fishing stations where the bloody offal is thrown into the water. In turn they form no inconsiderable part of the food of certain of the larger leeches and of small carnivorous fishes, and, along the shores of tidal rivers, of snipe and sandpipers.

Like other species of the same family this leech carries its eggs and young attached to the ventral surface of the parental body, the margins of which are inrolled, especially when disturbed, to make a crude sort of temporary brood chamber. Before hatching, the eggs are enclosed in groups in small mucoid sacs, of which each leech may bear from eight to fifteen.

The following are the labels attached to the Lake Maxinkuckee specimens: "Long Point, under stones, Dec. 7, 1904," 1 specimen with *G. complanata;* "E. side knee-deep, Sept. 17, 1906," 20 with *G. fusca*; "19-I-III," one with *G. complanata*, *G. fusca* and *G. heteroclita*.

### 2. GLOSSIPHONIA FUSCA Castle

This pretty little gray leech was taken at a greater number of stations and is probably more plentiful in Lake Maxinkuckee than the last. This might have been anticipated as it is generally more partial to colder and clearer waters than is *G. stagnalis*. It is a true snail-leech and, being much more sluggish than *G. stagnalis*, confines its attacks almost exclusively to the smaller aquatic species of these mollusks. In breeding habits this species resembles the next to be described.

"E. Long Pt., by Holbrunner's, Oct. 29, '04", 1 specimen with *G. complanata* and a small *Placobdella rugosa;* "Long Pt. Nov. 1, '04," one small example; "Long Pt. Dec. 7, '04, under stones," one with seven *G. complanata;* "E. side knee-deep, Sept. 17, 1906," 2 with twenty *G. stagnalis;* "19-I-III," one with *G. complanata* and *G. heteroclita*.

### 3. GLOSSIPHONIA COMPLANATA (Linnæus)

This well-known species is widely distributed throughout Europe, Asia and North America and is very constantly characterized everywhere by the arrangement of the eyes and the pair of longitudinal dark lines above and below. In the Lake Maxinkuckee collections it is the most generally represented of its genus.

The common name of snail-leech given to this species in England is equally applicable here as its principal food consists of

small water snails which its great relative strength enables it to overcome with ease. Small worms and aquatic insect larvæ are also eaten but it rarely or never partakes of the blood of vertebrates. Notwithstanding its great strength and activity when once aroused this is naturally a sluggish leech and is much more likely than other related species to roll itself into a tight ball and so remain quiescent for considerable periods of time. The breeding habits closely resemble those of the last species, especially in the fact that only a small number of capsules, each containing a large number of eggs, are produced. The length of the breeding season is also unusually long.

"Aug. 18, '00, B. W. E.," 1 specimen; "Long Pt. Sept. 1, '00, with five other sorts," one unusually large example; "E. Long Point, by Holbrunner's Oct. 29, '04," three specimens with the brown lines broken into series of dashes, with one *G. fusca* and one *P. rugosa;* "Long Pt., Dec. 7, '04, with others," four small examples; "Long Pt. Dec. 7, '04," 8 small specimens with *G. fusca* and *G. stagnalis;* "E. side knee-deep, Oct. 17, '06." 4 specimens one of which is coarsely mottled on the dorsum; "19-I-III," 1 specimen with one each of *G. stagnalis, G. fusca* and *H. heteroclita.*

#### 4. GLOSSIPHONIA HETEROCLITA (Linnæus)

This is a small leech of very distinctive characteristics which occurs in Europe and the northern United States. Nowhere in this country is it plentiful though it is probable that it is frequently overlooked because of its small size and inconspicuous coloration. Little is known of its habits. It is found in the same situations as *G. stagnalis* and is very sluggish. Its usual food appears to be the juices and mucus of aquatic snails. Unlike the remaining species of the genus, the eggs are attached singly to the ventral surface, more as in *Placobdella.*

But one specimen occurs in this collection, "19-I-III" with one each of *G. stagnalis, G. fusca* and *G. complanata.*

#### 5. PLACOBDELLA PARASITICA (Say)

This strikingly handsome leech of interesting habits is not only one of the most abundant but one of the largest and best known of our North American species.

It is familiar chiefly as a temporary blood-sucking parasite of the snapping turtle but occurs more rarely upon other species of aquatic turtles, and also lives during part of its life a free existence during which it feeds on aquatic worms and other small invertebrates. The method of fertilization by means of spermatophores

attached to the skin, and the habit of carrying the eggs and young are very interesting but have been frequently described. This is the largest of the Glossiphonids of the United States, the giants of the species attaining a length of four inches and a width of one inch.

Abundantly represented in the collection from the following stations:

"July 18, '00, B. W. E.," one specimen; "Nov. 30, '00, picked from a snapping turtle," numerous specimens presenting much variation in color pattern, some of them bearing young or attached spermatophores;" "musk turtles, April 10, '01," two small; "Outlet Bay, under board, June 12, '01," four specimens with *P. rugosa;* "Outlet Bay, Nov. 26, 1904 (13-2)," 1 specimen; "on painted turtle, between Lakes Lagoon, Dec. 19, '04," five specimens, one of which bears young; "near Inlet, in Chara, 4-5 ft., Dec. 24, 1904," 1 specimen; "back of snapping turtle, Aug. 28, 1906," one large and three smaller examples; "Outlet, Aug. 10, 1906," one; "Oct. 29, 1906", three specimens "on shore on dead turtle and shrew."

### 6. PLACOBDELLA RUGOSA (Verrill)

This large species is readily distinguished in its ordinary phases from the preceding by its very rough and translucent integuments and its much broken, mixed color pattern in which brown usually predominates. Although sometimes associated with *P. parasitica* on turtles it is usually free-living and inhabits the muddy shallows of warm streams and ponds where it is found abundantly attached to the under surface of driftwood or stones. The ordinary food consists of worms, insect larvæ and other aquatic invertebrates but blood will also be freely taken. The eggs are carried in early spring in a layer attached to the underside of the leech and covered by a delicate membrane. When with eggs the parent usually attaches itself firmly by both suckers to the under surface of a stone or other firm object and resists removal vigorously. When removed the eggs will frequently be found adhering to the foreign object.

"Nov. 30, '00," four specimens; "Outlet Bay, under board, June 12, '01", four specimens with *P. parasitica;* "leeches from *Kinosternon odoratum*, Apr. 19, 1901," 2 small; "E. Long Pt., by Holbrunner's Oct. 29, '04," one small specimen with *G. fusca* and *G. complanata;* "Long Pt., Nov. 1, 1904", three with attached spermatophores; "snapping turtle's back, July 28, 1906", two small specimens; "III, 1 H. W. C. 19," one; "III, 1 H. W. C. 19-7," 2 small.

7. PLACOBDELLA MONTIFERA Moore

This species is easily distinguished among the present assemblage by the enlarged head disc and strongly keeled back. It is a solitary leech whose habits are still imperfectly known. Although often found under stones and among plants in shallow brooks and ponds it is a voracious blood sucker and in pursuit of its food attaches itself frequently to frogs, toads, mussels and snails.

A single small specimen from Long Pt., Dec. 7, 1904, under stone.

## HIRUDINIDÆ

8. HÆMOPIS MARMORATIS (Say)

Along with *P. parasitica* this was one of the first leeches to be described from North America by Thomas Say. It is widely known as the horse leech from its habit of living in the mud of pasture drinking holes and attacking horses and cattle that come to its haunts to slake their thirst. It also occurs along the shores of rivers and lakes where it burrows in the mud in search of earthworms, smaller leeches, insect larvæ, various small mollusks, etc., which constitute its usual food. Its eggs are laid in a mass of albuminous mucus enclosed in a horny capsule and deposited in the mud.

This, the only species of Hirudinidæ represented in the collection, was taken at two points only: "Long Pt. June 2, '01." one specimen; "Green's flat, Apr. 3, '01," two small.

## ERPOBDELLIDÆ

9. ERPOBDELLA PUNCTATA (Leidy)

A generally very abundant species of fairly wide distribution, well known for its variability, its activity and its ferocity. It feeds upon all kinds of small aquatic invertebrates, not excepting leeches of its own and smaller species, sucks the blood of vertebrates whenever opportunity offers, and is a great scavenger, collecting in great numbers wherever waste from slaughter houses is deposited in streams, and on the shores of ponds upon which the prevailing winds drive dead fishes and other animals. The egg capsules are well-known chitinoid flattened capsules attached to the under surface of stones, etc.

"July 5, '99," one unspotted pale specimen; "Outlet Bay, 1901," one small; "Long Pt., Nov. 1, '04, with others," several with *D. parva* and *D. fervida*.

10. DINA FERVIDA (Verrill)

A species mainly characteristic of the lake region of the northern United States and southern Canada, represented in the collection from several points. The habits so far as known are essentially similar to those of *E. punctata*.

"Nov. 30, '00," eleven specimens; "Long Pt., Nov. 1, '04," several with *D. parva* and *E. punctata*, two have four pairs of eyes like Verrill's type; "near Outlet, Dec. 13, 1904," two specimens; "near Inlet, in Chara, 4-5 ft., Dec. 24, 1904," two specimens; "near Inlet, Dec., 1904", two.

11. DINA PARVA Moore

Little is known of this species, which was first taken in Minnesota and appears to be abundant in Lake Maxinkuckee. Nothing is known of its habits.

"Long Pt., Nov. 1, '04, with others," many specimens with *D. fervida* and *E. punctata;* "Long Pt., Dec. 7, 1904," a large number, most of which are pigmented; "on shore on dead turtle and shrew, Oct. 29, 1906," numerous small specimens.

## THE PROTOZOANS AND CŒLENTERATES

No special attention was paid to the Protozoa of the lake; only those forms were noted which thrust themselves upon our notice.

The protozoan life of the lake is not conspicuous except for a few forms which are found in such abundance as to attract attention.

The list of species identified is a short one, not because these organisms are rare at the lake, but because no one of the party engaged in the study of the lake was especially interested in or familiar with them. An attempt was made to collect and preserve all forms that attracted the attention, but these were naturally only a small proportion of the species present. It so happened that the plankton, which should have contained a number of these organisms, was submitted to two different experts, one interested in Algæ, the other in Crustacea, with the result that such Protozoa as there were went by default.

Forms of doubtful affinity, by some placed among Algæ and by others as animals, such as Peridinium, Ceratium and Volvox, are included, Volvox especially exhibiting characters which strongly suggest a position in the animal series.

Following are our notes upon the few species identified:

1. ARCELLA VULGARIS Ehrenberg

Upon examining the stomachs of a number of tadpoles caught at the edge of Aubeenaubee Bay in August, 1906, a goodly number of *Arcella vulgaris* were obtained. The tadpoles when caught were busy sucking the surface of weeds and sticks, as is their habit, and from these they probably obtained the Protozoa. It is probable that Protozoa form an important part of the food of young tadpoles. On other occasions we have seen them taking in large numbers of Paramœcium.

*Arcella vulgaris* was abundant September 3, 1906, with other material (Paramœcium) forming a scum over water in a tumbler where some duckweeds were kept. It was also present in hand-gathered material obtained at the dam in the Outlet, October 30, of the same year.

2. CENTROPYXIS ACULEATA Stein

Taken occasionally in the summer and autumn of 1906 in gatherings in shallow water near shore.

3. EUGLYPHA ALVEOLATA Dujardin

Obtained in collections near shore, summer and autumn of 1906.

4. DINOBRYON sp.

Found occasionally near shore in Lost Lake, but not abundant. In the small lakes about St. Paul, Minn., where it is very abundant, it furnishes an important item in the food of the fresh-water mussels.

5. EUGLENA VIRIDIS Ehrenberg

Some found in a scum in pools in Green's marsh. The great amount of vegetation makes the water almost as rich as an infusion. Obtained August 22, 1906. Euglena formed a bright green scum over the small pools.

6. VOLVOX AUREUS Ehrenberg

Not found by us at all in the lake, but exceedingly abundant in Farrar's pond and a pond east of the lake in the spring of 1901, large swarms being seen there, a single dip of a common dipper always containing several examples. A large number of examples obtained from a small pond near the lake April 24, 1901. Its favorite habitat is shallow pools, easily warmed throughout and containing in the bottom an abundance of dead leaves or similar fertilizing matter. This species was exceedingly abundant in the shallow well-fertilized carp ponds at Washington, D. C., in the spring of 1906.

7. PERIDINIUM TABULATUM Ehrenberg

Taken rather less frequently in the vertical hauls than its relative, *Ceratium macroceras*, and apparently not very common. One might naturally expect it to be more common near shore. It was not noted often in surface hauls. It is a species of world-wide distribution, and probably is abundant where conditions are favorable.

There is very little difference between the genera *Ceratium* and *Peridinium*, the horns or projections, which are the distinguishing characteristics, occurring in all degrees of development.

8. CERATIUM MACROCERAS Schrenk

Common in the vertical plankton hauls, occurring in the great majority of hauls, but not common in the surface towings. A similar form, *C. tripos*, was collected in towing near shore at Eagle Lake. The long horns or projections of this species are developed perhaps as much to give buoyancy to the form as for protection. The Peridinales, represented by this and the 2 preceding species, are claimed by both botanists and zoologists.

9. STENTOR CŒRULEUS Ehrenberg

While raking up weeds through a hole in the ice at the Weed-patch, January 15, 1901, it was noted that the water dripping from the plants turned the snow a vivid green. The snow thus colored was taken home and examined and the green color was found to be due to multitudes of green stentors. These were kept in a vessel for some time. On January 6, they began to gather on sticks, on snail shells, on the sides of the vessel, and on the under surface of the water, assuming a globular form. The species was probably *cœruleus*.

On February 7, on looking through the ice on Outlet Bay, it seemed full of a reddish fine material like stirred up mud. Examination revealed the presence of small diatoms and many green stentors.

10. STENTOR sp.

Among our notes mention is made of another Stentor, larger than the green one, brownish and with a large, flat, peristomal disc, circular, with a side cleft like a water-lily leaf.

On October 14, 1907, it was noted that brown stentors were attached to the under side of lily-pads in Hawk's marsh.

11. VORTICELLA CHLOROSTIGMA Ehrenberg

On June 26, 1901, white, fluffy little globules which shrank to minute size when touched, and which proved upon examination

to be composed of colonies of Vorticella, were found very abundant on the submersed tips of Ceratophyllum leaves at the Inlet. Late in the autumn of 1904 (October 31, November 2 and 16), the same objects were noted, but in considerably longer and larger patches, on various weeds, such as Myriophyllum, etc., in the vicinity of Winfield's. Again, in the autumn of 1906, they were exceedingly abundant in various weeds, especially dying leaves of Vallisneria, in Outlet Bay. So far as we have observed, these organisms seem to increase greatly during the autumn. Both white and green colonies were found, alike in everything except color, and it is probable that they were the same species under different conditions. The green forms showed distinctly against the dead Vallisneria leaves, which had faded to a papery white. It may be it was common during the summer, but concealed by its green substratum. June 22, 1906, it was plentiful on the weeds in Lost Lake.

In a note of June 26, concerning this species occurs the remark: "This is a larger sort; there are also other smaller isolated ones present." On July 25, and previously, it was common in both lakes in weedy, stagnant places, forming a white halo along stems, not in balls. In addition to these there are minute green Vorticella-like organisms attached to the parasitic copepods on the gills of fishes, and on August 28, 1908, a number of minute clear Vorticellas were found on the body of a Cyclops. A species of Vorticella was abundant July 31, 1906, on Anabæna in plankton scum. Small Vorticellas are found in myriads on objects in Hawk's marsh. They can be found there more abundantly than anywhere else about the lake.

#### 12. EPISTYLIS sp.

A species of *Epistylis*, probably *plicatilis* Ehrenberg, was observed forming a dense growth on the shells of a small Planorbis, March 25, 1901, near Chadwick's pier.

The copepods of the same region at that time presented a very fuzzy appearance, and upon examination were found to be thickly overgrown with the same or a similar protozoan.

#### 13. OPERCULARIA IRRITABILIS Hempel

Abundant during the summer and autumn of 1906, upon the lower surface of the shell (plastron) and also on the skin of various turtles, especially the painted and snapping turtles, making a close, short, brown, fuzzy growth. The turtles were botanic gardens above and zoological gardens below. The organisms seemed to do

them no injury, and were gotten rid of when the turtles shed their scutes. It sometimes forms a halo about the heads of small turtles, in which case it was at first mistaken for Saprolegnia. It is usually the head of the Musk Turtle that is affected. In this case it appears to do no harm, as the turtles are quite lively.

Something very like this, probably the same thing, was observed abundantly (August 6, 1907) on the shoulders of a dragonfly larva.

#### 14. VAGINICOLA sp.

A species of *Vaginicola*, perhaps *gigantea*, was rather common along the shore of the lake by Overmyer's hill, attached to algæ, October 28, 1906. There were at least 6 examples on one small bunch of algæ. The sheath was brownish and transparent. When jarred, the animal retracted into the sheath, usually doubling up somewhat into a sigmoid curve.

#### 15. TOKOPHRYA QUADRIPARTATA (Ceparede & Lachmann)

Common, intermixed with *Opercularia irritabilis*, on the ventral scutes of a Musk Turtle, September 12, 1906. It was also found to some extent of the back.

#### 16. OPHRYDIUM sp.

By far the most abundant and conspicuous protozoan in the lake was a species of Ophrydium which formed large blue-green gelatinous colonies about the size of a hazelnut, or larger. These semitransparent blue-green balls remain in about the same condition the year round. They are found abundantly wherever the carpet chara grows, and are usually attached to it or to pebbles; or, quite frequently, to mussel shells either alive or dead. Clear colonies, remarkable for their unusual transparency, were found on submerged pieces of tile, August and September, 1907. At certain times, as August 1, 1906, and August 1 and October 12, 1907, great quantities are washed ashore. The colonies are sometimes hollow, as were many of those washed ashore August 1, 1907.

#### 17. HYDRA OLIGACTIS Pallas

Not frequently encountered in the lake. On October 31, 1906, however, multitudes were found under leaves at the water's edge on the east side, and on November 13 more were found in a similar position. November 18 one was found attached to floating Wolffiella in Norris Inlet.

## THE WORMS

Our notes on this group are few and very unsatisfactory. We give here only such of them as may possess some value.

The attention we were able to give to these forms was so little that we are unable to say much regarding their relative or actual abundance, their distribution, or their relation to the biology of the lake.

Flat-worms or Planarians, small, soft, flat objects, gray above, white below, and oval in outline, were common on rocks and among weeds in the lake. In certain material (Vorticella, etc.) obtained near Norris Inlet, they were quite common. They were often abundant on Ceratophyllum also. They were so soft that they often pulled apart when attempts were made to remove them from the rocks.

Small pinkish parasites (probably a species of Distomum), resembling minute leeches, were found quite common in the stomachs of fishes, particularly the Straw Bass (*Micropterus salmoides*) and the Skipjack (*Labidesthes sicculus*). Usually during the winter the stomachs of these fishes contained little or no food, but in most cases from one to several of these parasites were found in each.

Round-worms, resembling Ascaris, are frequent intestinal parasites of the snakes of this region, and one small form was found in the intestine of a mussel.

Tapeworms were almost invariably present in the several shrews (*Blarina brevicauda*) examined. They were also common in the yellow perch and walleyed pike, and practically every dogfish (*Amia calva*) examined was heavily loaded with them. Many duck stomachs examined, especially those of the ruddy duck, contained from a few to many tapeworms.

Angleworms or fishworms are not abundant in this region. The country about the lake is chiefly sandy, a soil not favorable to angleworms. At the edges of ditches, marshes and woodland ponds, where the soil is a black loam with some admixture of clay and decaying vegetation, a rather small species of Lumbricus is fairly abundant. Fishermen who know these places are usually able to secure all they need for bait. The farmers and farmers' boys and the boys of the village are the ones who make most use of fishworms in their angling.

On December 7 (1904), worms which resembled angleworms were observed in considerable numbers coiled up under a submerged water-soaked board at Long Point, where they evidently were passing the winter. These worms, however, possessed no

annular ring. In alcohol they display a fine opalescent iridescence in reflected light. One seemed to be dividing by a constriction near the middle.

Some very small worms, resembling fishworms in general appearance when alive, were seen at the mouth of a ditch April 19 (1901).

*Cotylaspis insignis* Leidy is a common parasite of the mussels of Lake Maxinkuckee and Lost Lake. To the naked eye this parasite looks like a minute yellowish leech. Its position in the mussel is close up in the axils of the gills. It was found in *Lampsilis luteola* and also in *Anodonta grandis footiana*, from one to several being found in nearly every example of these species examined August 23 (1906). It was also found in mussels taken on September 28 following, in Little River near Fort Wayne.

The so-called Horsehair Snake or worm (*Gordius* sp.) is very abundant in and about Lake Maxinkuckee. According to anglers, many of the grasshoppers used by them for bait are infested with this parasite. On August 2 (1906), large numbers were seen writhing about in mud among snails along the Outlet where it had been suddenly lowered by a dam at the railroad bridge. We suspect that they may be parasitic in this snail also. They were frequently found in fishes, either free in the lower intestine or coiled up and encysted in some of the internal organs. The bluegill appears to be especially liable to infection by Gordius. It may be that the fish become infected through the grasshoppers they devour. On August 6 (1906), these worms were noted in considerable numbers in shallow water on the east side of the lake.

A long slender brownish worm, probably a species of Tubifex, was found in considerable numbers projecting up into the shallow water from the soft mud bottom of Lost Lake. These were first observed June 8 (1901), when the bottom near the shore was seen to be covered with small whitish mounds about the size of buckshot, which gave a peculiar mottled or dappled appearance. When some of this mud was dipped up and examined the small mounds were seen to be small sand tubes in which the worms were and from which they waved about in graceful undulations. They were observed again at the same place on June 15. On June 18, many were seen in the creek under the railroad bridge and on June 25, some were noted at the south end of Lake Maxinkuckee. And finally, on November 4 (1904), numerous burrows were seen in shallow water near shore in Lost Lake.

Thorn-head worms (Acanthocephali) were found to be common intestinal parasites of various fishes and turtles. Among fishes

the redeye appeared to be most affected. The carnivorous turtles such as the soft-shelled and the snapper were especially subject to them while the herbivorous species, particularly the painted turtle, were comparatively free.

Record may here be made of a Bryozoan, *Plumatella polymorpha*, possibly related to the Gephyrean worms. *Plumatella polymorpha* is a compound animal, many individuals budding off from one another, as in plants. The moss-like colonies of this species were very common in the lake among the Chara and other plants. They were noted in the Chara near the depot pier, off Long Point, near Winfield's, and at the south end near the Farrar cottage. Indeed, it appears to be distributed generally through the lake wherever there are patches of vegetation. Among the Charas it forms a brown upright bushy growth. In the Weedpatch it was common on the leaves of *Potamogeton amplifolius*. On October 23 (1900), it was found to be abundant on Ceratophyllum in rather deep water. A week later (October 29) a good deal was gotten on Myriophyllum. Early in the spring (March 1, 1901), it was seen growing on *Potamogeton robbinsii*, and a little later it was found in abundance in front of Arlington station. It was often found on Chara and other aquatic plants dredged at various times. It was also found growing on tile piles September 1 (1906).

During the autumn of 1900, the statoblasts were frequent in plankton scum along shore, often being present in great abundance. They somewhat resemble floating sand grains but are lighter in weight, being minute circular brown discs uniform in shape and size. Under magnification they show series of facets like the compound eye of insects.

On October 18 (1900), one of the buoys which had been for some time anchored out in the lake was found to be covered with a flat creeping growth of this species.

As *Plumatella polymorpha* occurs in this lake it is highly worthy of its specific name, as it shows great variation in form and general appearance.

The leaves upon which it grows are often eaten by fishes, probably for the sake of the Plumatella. The yellow perch and bluegill are the species in whose stomachs we found it most abundantly. The stomach of a bluegill caught at the Weedpatch October 26 (1904), was full of statoblasts. During the autumn of 1904 it was noted as exceedingly abundant.

So far as we know *Plumatella polymorpha* is the only Bryozoan in this lake.

## THE SPONGES

Sponges are not especially abundant in the lake. In some of the not far distant lakes, as Winona Lake, they frequently form a thick coating around the submerged portions of bulrushes growing out in the water, but at Lake Maxinkuckee this was not observed. They are not common on the rocks. On September 9, 1906, some were found forming a coating on submerged rocks on the east side and some of these were collected a few days later. On November 5, 1906, some flat ones found on rocks on the east side were apparently being eaten by insect larvæ. On September 22, 1907, Prof. U. O. Cox of the Indiana State Normal, found some flat sponges covering a rock where the lake enters the Outlet at the wagon bridge, and there were more on a rock farther down between the wagon and railroad bridges. This completes the record for the flat sponges.

A long, green string-like form found hanging among the weeds at the lake, especially at the Weedpatch, was much more common. This was observed quite frequently and often obtained when collecting aquatic plants. Occasionally, these long strings were washed up near shore. On October 27, 1900, these sponges were observed forming statoblasts on the weeds in Lost Lake.

Occasionally, the sponges form small, blue-green, spherical masses, like bullets, around the stems of Chara. On January 22, 1901, some of these spherical sponges were observed on carpet chara about 5 feet out from the Arlington Hotel.

Sponges are quite common in creeks and ponds near the lake. The long form is common in Twin Lakes. There are long, finger-like forms in Yellow River, and they were abundant in the Outlet about the bridge below Walley's.

The sponges were submitted for identification to the late Mr. Edward Potts, of Media, Pa., who in a letter dated May 24, 1905, wrote so interestingly regarding the material that we here quote his letter in full:

Yours with package of material was received by first mail yesterday A. M.; and having nothing important on hand, I examined the vials at once, with the following results:

First, I must express my pleasure in finding that you had sent only *Sponges;* that is, remembering that frequently even workers in other lines of science are utterly unfamiliar with these forms, and hence send one gelatinous and otherwise incongruous articles, I was glad to learn that you know a sponge when you see

it. The only possible exception is in your No. 5, which as you supposed, is not a sponge but only a puzzle, which may perhaps be explained by considering the fibres to be a form of alga, or more probably, the stems or stipes (as the "Micrographic Dictionary" calls them) of some, possibly all, those Diatoms now found at the outer surface of the sub-spheres. I have frequently found Diatoms so growing.

No. 1 is *Carterius tubisperma* Mills, and is, I am sorry to say, the only sponge in satisfactory condition for safe determination. Nos. 2 and 4 are, I fully believe, of the same species as No. 1, and they have plenty of gemmules or statoblasts; but these are so far from maturity that, if the same species, the chitinous coat is extremely thin and it apparently has not yet developed the foraminal tubules, the granular crust, and protective bisotulate spicules which should be the determining points. I do not understand why this should be so with the date given (Nov. 15 and later); but I suppose it possible that cold spring water or its unusual depth may have retarded development to a date later than that with which I have been familiar. This is further suggested by No. 3 in which I have failed to find any gemmules and which reminds me of the appearance and condition of forms that I have sometimes called perennial or evergreen sponges, which apparently continue their growth all through the winter, at least in deep water.[2]

No. 3 is clearly a different sponge from the others, as shown by its shorter and more robust spicules (skeletal) which, as you will see, are covered with very minute spines. I should have been much pleased to find the statoblasts of this sponge. The skeleton spicules suggest *Meyenia leidyi* Carter, although in that species they are rarely microscopical. You may meet with it again under more favorable circumstances.[3]

Although I fear they are too soft for safe transportation, I propose to pack with the vials returned, two trial slides, No. 1, showing *Carterius tubisperma* in which you may see the foraminal tubules before mentioned and the armature of radial birotulate spicules, beside the skeleton and dermals; and No. 2, showing separated spicules of the same.

[2] See my Monograph, pp. 245, 246.

[3] See fig. 1, plate X, of my Monograph.

## THE PLANKTON

By CHANCEY JUDAY, University of Wisconsin

Between the 2nd and the 29th of August, 1899, some observations were made on the plankton of Lake Maxinkuckee as a part of the field investigations of the U. S. Fish Commission at that lake.

The net used in making the observations had an opening of 471.5 sq. cm. The filtering cone was made of Dufour's No. 20 bolting cloth. The area of the cone was 3,910 sq. cm., thus making the ratio of the opening of the net to filtering area 1 to 8.2. Lack of time prevented experiments for the determination of the coefficient of the net, as the plankton work was only one of several duties assigned the writer.

Three main stations were selected. No. I was located just north of the center of the lake in the deepest part. No. II was in the southwestern part in a small basin called the Kettlehole. This basin has a maximum depth of 43 feet (12.8 m.) and is separated from the main basin of the lake by a considerable area where the water scarcely exceeds 10 feet (3 m.) in depth. During the time of these observations, the bottom temperature in the Kettlehole was lower than the bottom temperature in the deepest part of the lake. This was selected for the purpose of determining whether these local peculiarities would have any marked effect on the quantity of plankton. No. III was about midway between the other two stations in water only 20 feet (6 m.) deep. For purposes of comparison in horizontal distribution, one series of hauls was made at each of five other stations.

In making the hauls, the net was lowered to the desired depth and then raised to the surface with a velocity as nearly uniform as possible. The material was washed into the bucket of the net and then transferred to 95 per cent. alcohol.

Because of the small amount of time available for this work, the centrifuge method was used in measuring the quantity of plankton. This method, however, is open to the serious objection that the material is treated as if it were a homogeneous mass, and this is obviously not the case. This same objection applies equally to the gravity method, in which the material is allowed to settle a certain number of hours. Both must be supplemented by the counting method in order to show the part played by each species in the plankton life of a body of water. In settling the material, the centrifuge was given a speed of 3,000 revolutions per minute and this speed was continued for a period of one minute.

In all, 128 hauls were made at the principal stations. Not all of them are included in the following tables, however, as some hauls were made at depths not regularly included in each set of observations. Their omission does not affect the conclusions in any way. The tables show the quantity of plankton in cubic centimeters under each square meter of surface and to the depth indicated, exclusive of a correction for the coefficient of the net. That is, they show the total quantity taken in each haul multiplied by $21.2(\frac{1000}{471.5})$.

In the results given for Station I, those for the first, second, and fourth weeks are averages of three to five sets of observations per week but only one set was made the third week. At Station II, only one series of hauls was made each week. At Station III, no hauls were made the first week and only one set each during the second and third weeks. The result for the fourth week is the average of ten sets of hauls.

STATION I

| Depth | First week | Second week | Third week | Fourth week |
|---|---|---|---|---|
| 0—1 m. | 34.55 | 23.85 | 22.26 | 18.65 |
| 0—3 m. | 43.88 | 37.73 | 30.21 | 27.77 |
| 0—5 m. | 49.50 | 47.27 | 38.70 | 31.67 |
| 0—8 m. | 65.49 | 56.18 | 50.35 | 39.58 |

STATION II

| Depth | First week | Second week | Third week | Fourth week |
|---|---|---|---|---|
| 0—1 m. | 29.68 | 22.26 | 19.08 | 15.90 |
| 0—3 m. | 37.10 | 34.45 | 25.44 | 23.32 |
| 0—5 m. | 50.88 | 41.34 | 30.21 | 32.33 |
| 0—8 m. | 56.18 | 54.58 | 34.98 | 31.80 |

STATION III

| Depth | First week | Second week | Third week | Fourth week |
|---|---|---|---|---|
| 0—1 m. | | 32.86 | 23.85 | 18.65 |
| 0—3 m. | | 37.10 | 38.16 | 26.15 |
| 0—5 m. | | | 39.22 | 32.65 |

*Decrease*:—The above tables show that there was a pronounced decrease in the quantity of plankton during the four weeks. This was due to the decline of the phytoplankton. The maximum decrease, 16 per cent., was found in the 0-1 meter stratum where the phytoplankton was most abundant. The hauls from greater depths showed a minimum decrease of 36 per cent. Most of the crustacea were found below one meter and a slight increase of them partially compensated for the decrease of phytoplankton.

*Horizontal distribution:*—A comparison of the tables for stations I and II shows that, with two exceptions, the quantity of plankton obtained at Station II was smaller than that obtained the same week and from similar depths at Station I. The differences, however, are comparatively small, which shows that the local peculiarities at the former had relatively little effect on the plankton.

The hauls made at the five stations in the main basin of the lake, besides the two regular ones, showed that the plankton was very evenly distributed.

*Vertical distribution:*—The plankton was confined almost wholly to the upper 12 meters. This included the thermocline which extended from 9 to 12 meters. Undoubtedly the region below this depth remained almost tenantless because of the chemical condition of the water. Only Corethra larvæ were found regularly below the thermocline.

A little more than 48 per cent. of the entire quantity of plankton was found in the 0-1 meter layer. As might be expected, this was preeminently the region for phytoplankton. The crustacea were represented by a few Cyclops and a considerable number of nauplii. The 0-3 meter stratum contained 68 per cent. of the entire quantity. *Ceriodaphnia lacustris* and *Diaphanosoma brachyurum* were found mainly in the 1-3 meter stratum. *Diaptomus minutus* and *Daphnia retrocurva* seemed to prefer the region between 3 and 12 meters. *Daphnia pulicaria* was most abundant in the region of the thermocline, or between 9 and 12 meters. Cyclops and nauplii appeared more or less abundantly throughout the upper 12 meters.

Only one set of observations was made at night. The quantity of plankton obtained from the 0-1 meter stratum at night was smaller than that obtained during the previous afternoon but there was a marked increase in the crustacea. *Epischura lacustris, Leptodora hyalina* and adult *Daphnia retrocurva* were found in this stratum at night but never in the day catches. Also there was a larger number of adult Cyclops than was usually found in the daytime.

I am indebted to Prof. C. Dwight Marsh for the following list of Copepoda:

*Cyclops leuckarti* Claus; *Cyclops prasinus* Fischer; *Diaptomus minutus* Lilljeborg; and *Epischura lacustris* Forbes.

The following Cladocera were collected: *Daphnia pulex pulicaria* Forbes, *Daphnia retrocurva* Forbes, *Ceriodaphnia lacustris* Birge, *Sida crystallina* (O. F. Müller), *Acroperus harpæ* Baird, *Pleuroxus procurvatus* Birge, *Diaphanosoma brachyurum* (Lieven)

*Ilyocryptus spinifer* Herrick, *Alona guttata* Sars, and *Leptodora hyalina* Lilljeborg.

During the summer of 1900, plankton work on the lake was continued under the immediate direction of Mr. Leonard Young, along the same lines and with the same apparatus used in the previous summer. The work extended from the middle of July until the first of September.

Hauls were made from four stations. Three of these (Nos. I, II, and IV) were the stations of the previous summer's work. A fourth (No. III) was located on a line between Nos. I and II in 40 feet of water and on the rim of the deep basin of the northern part of the lake in which No. I was located. No. III is separated from No. II by a ridge (10 feet of water). At these stations hauls were made from 3, 9, 15, 25, 40, and 80 feet, according to the depth of the water. Random hauls were made along the shores near the patches of bulrushes and among them, and also on the Sugarloaf. The Sugarloaf is a small area of shallow water on the northwest side of the deep basin of Station No. I. It is about 80 feet in diameter, in water with a minimum depth of 8 to 9 feet, but surrounded by much deeper water. On the surface of the mound are beds of Potamogeton, Chara, Nitella, etc.

The temperature of the water at Station No. I was taken at intervals of 5 feet at the time of each observation, except those made during the night. The temperature of No. II in the Kettle-hole was taken occasionally for comparison. The temperature of the bottom was found to be slightly higher (1°-2°) than in the deeper basin, although it was somewhat lower the summer before. Hauls were made at various times during daylight hours, and also at night, both before and after midnight.

The plankton was examined from time to time in order to determine the prevailing forms composing it. The plant forms noted were: Rivularia, Lyngbya, Anabæna, Pediastrum, Protococcus forms, Œdogonium, Spirogyra, Draparnaldia, and Raphidium. The animal forms were Daphnia, Cyclops, Diaptomus, Rotifera, Vorticella, and other unknown Protozoa and Crustacea.

In the upper layers of the water in the open lake, the plankton consisted almost entirely of plant forms. At a depth of about 25 feet a number of entomostracans were found,—a species of Daphnia being the most abundant. These remained at that depth until they disappeared later in the season. In the hauls made near the shore and among the rushes, the animal forms were much more numerous than in the surface water in the open lake and were present in greater abundance. The plant forms here were in

greater variety than in the open lake and were often present in much greater quantity. The latter seems to have been due to the prevailing wind at the time.

In the hauls made in daylight the greater portion of the plankton was found in the upper 10 feet of water, with most of it in the first three feet. In the hauls made during the night the vertical distribution was somewhat different. There seemed to be a downward migration of the surface plankton, so that while the total quantity remained about the same, less of it was in the first 3 feet than during the daylight. During the earlier hours of daylight it resumed its former distribution. Since the greater portion of the plankton consisted of plant forms, the absence of the photosynthetic processes may have been the cause for this downward migration.

The total quantity of plankton reached its maximum the last of July and the first of August. During the last of August the quantity decreased very considerably, and the water became quite clear.

During July and the first half of August the prevailing plant form was a species of Rivularia. A species of Anabæna was also in abundance. During the latter part of August a species of Lyngbya was the most abundant plant form. Until about the tenth of August a number of entomostracans were found at a depth of about 25 feet in the open lake, but at this time they disappeared and could not be found in either deeper or shallower water.

No uniform difference in the vertical distribution and the total quantity of the plankton at the various stations in the deeper water was detected, except that at Station No. IV in 25 feet of water, the entomostracans mentioned above were not found. The entomostracans were not so abundant on the Sugarloaf as in water of equal depth near the shore among the bulrushes. In the shallow water, near the shore, there was often a greater quantity of plant forms and always a greater quantity of animal forms than in deeper water. The greater quantity of plant forms was due to drifting by the wind.

The quantity of plankton during this summer was less than half that of the previous summer. The greater portion consisted of plants during both seasons, but the prevailing form in 1899 was Lyngbya, while in 1900 it was Rivularia. No plankton observations were made in other lakes during this summer, but in doing some sounding in Bass Lake, it was noticed that there was very much more minute vegetation in Bass Lake than in Lake Max-

inkuckee. The coefficient of the net has not been determined, so that the total quantity of plankton has not been calculated.

As almost the entire volume of plankton was above the thermocline, which is about 35 feet deep, no relation between the vertical distribution and the change in temperature was noted.

## THE PLANKTON SCUM OR WASSERBLUETHE

In addition to the plankton studies carried on at the lake by Professor Juday in 1899, and by Mr. Young in 1900, reported on by them in the preceding pages, some attention was given to the subject by Mr. Clark and Dr. Evermann whenever opportunity afforded. Some of their observations are here recorded.

Almost every dweller in a region where lakes abound is familiar with the annual collection of green scum over the surface or parts of the surface of the lakes. This phenomenon is known the world over wherever lakes are found. It is known in Germany as "Wasserbluethe" and in parts of England as the "Flowering of the meres." About Lake Maxinkuckee it is spoken of as "the lake cleaning itself." It is, indeed, the same phenomenon as may be observed everywhere, wherever there is a stagnant pool or dead stretch of river.

*Time of appearance:*—The plankton scum does not appear general over the lake until late summer or early autumn. The prime condition for its appearance, in addition to proper temperature and favorable environment for the rapid development of the low forms which compose it, is an unruffled water surface. It accordingly makes its first appearance in quiet sheltered bays. The following are brief notes as to dates of occurrence:

September 30, 1900. Air dead calm; flecks of foam scattered over the lake, slowly drift shoreward, and are colored green.

October 3. Green scum, mixed in with insect exuviæ noted near shore.

October 5. No scum, though the water is full of diffused Anabæna near the Deephole.

October 15. At noon, considerable green coating of water near shore in front of Arlington Hotel.

October 17. Morning calm, with considerable scum; by noon nearly as dense as yet seen.

November 2. Some scum on the east side and some on the surface of the deep water, but none at shore. The lake was calm, and gave an opportunity to observe the formation of the scum. The observation was made near the Deephole from a boat. The water was full of diffused algæ (principally Anabæna and

Lyngbya), which have a lower specific gravity than water and rise slowly, at an angle, to the surface. The Lyngbya is heavier than the Anabæna, and comes up more slowly and not in such large quantities.

November 3. Clear and smooth; a large amount of Anabæna and Lyngbya on top arranged in fine parallel lines on the water surface, the lines being quite near each other and running southeast and northwest.

December 1. Some Anabæna and statoblasts near shore about noon.

December 8. Considerable foam tinged green with Anabæna by the icehouses and in the Outlet.

December 10. Some green plankton scum on cast-up foam. No more scum was seen during the winter or the next spring, until June 12, when the first plankton scum of the year was seen.

In 1904, from October 17 to the end of the year when the lake was under observation, no scum was noted.

In 1906, the first scum was observed July 31, and it was noted every calm day thereafter as long as the lake was under observation.

August 6, the scum was very abundant along the northeast shore near the Military Academy, forming a perceptible scum on the lake.

August 8, abundant among rushes off the Assembly grounds.

August 15, much scum, composed of Anabæna and insect exuviæ in streaks on the water surface. A great scum of Anabæna, insect exuviæ and Vallisneria blossoms in Outlet Bay soon forming a putrescent mass.

August 16, a little scum, and considerable diffused Anabæna.

August 28, no scum in the morning but much diffused Anabæna in clumps rising to the surface and collecting near shore.

August 31, some scum on Twin Lakes, Anabæna and Lyngbya.

September 4, a good lot of scum, chiefly Anabæna, on Zechiel's pond.

November 15, some green free plankton scum under the ice south of Winfield's.

In 1908, the lake was visited for only a short time and but few observations could be made on the plankton. On the morning of August 22, the following organisms were observed in surface plankton: Lyngbya, most common, many empty sheaths; Rivularia, a few colonies; Vallisneria flowers, abundant; *Anabæna flos-aquæ*, a few colonies; Cyclops, a few; Moina, a few; Cypris, a few; Vorticella, a minute greenish species usually two at the

end of a slender stalk, attached to detritus; insect larvæ and larvæ casts, and a few small snails. On August 31, a fisherman remarked that the lake began "cleaning itself" four weeks ago and that there was then a much thicker scum than at present. He said neither he nor any of the residents had seen it act so ("clean itself") so early for 15 years. He remarked that fishes bite well before and after the process of "cleaning" but not during that time.

*Constitution, significance, etc., of plankton scum:*—The plankton scum of different lakes differs considerably in its elements. In all lakes it is principally vegetable, such inert animal products as exuviæ of insect larvæ and the statoblasts of bryozoa sometimes being included in considerable quantities. It is best collected by skimming or by simply holding the mouth of the collecting bottle below the surface of the scum and allowing it to run in. Not precisely the same elements are obtained by drawing a towing net through the scum, as many of the finer elements readily sieve through, and crustacea in the water near the scum, but not a part of the scum, are captured.

In Lake Maxinkuckee the principal elements of the plankton scum are *Lyngbya æstuarii*, *Anabæna flos-aquæ*, *Botryococcus braunii*, *Cœlosphærium kuetzingianum*, statoblasts of Plumatella, and the staminate blossoms of Vallisneria. Occasionally Vorticella was associated with the Anabæna, but this was only a temporary association. The most abundant element is *Anabæna flos-aquæ;* indeed, it is so predominant that the history of the plankton scum is essentially the history of it. The plankton scum of some of the surrounding lakes, such as the Twin Lakes north of Hibbard, and Lake-of-the-Woods northeast of Plymouth, is also Anabæna, but it is worthy of note that that of some of the neighboring lakes is somewhat different. The principal plankton elements of Winona Lake appear to be *Lyngbya æstuarii* and *Microcystis æruginosa*. Chapman Lake, Kosciusko County, and Bass Lake, Knox County, have at times a scum composed of *Rivularia echinulata* colonies. While in one of the Twin Lakes and in Winona or Eagle Lake some of the quiet lagoons and adjacent parts of the lake are so thickly overgrown with the little duckweed, Wolffia, that this might properly be referred to as plankton scum. In some of the lakes of the upper Mississippi, the principal plankton scum element is *Aphanizomenon flos-aquæ*, a species not yet found in Lake Maxinkuckee.

The character of the plankton scum varies of course with the organisms composing it. And the characteristics of Anabæna and

Microcystis, and, indeed, of most blue-green algæ, are such as to make it undesirable. Upon reaching the surface on hot days the scum turns white and milky, emits a rank "green-corn" odor and dies, giving all the water about it a milky tinge. Under such circumstances it is quite natural that bathers would avoid it. There is, indeed, a prevalent notion that the plankton scum is irritating to the skin, producing, in mild form, about the same symptoms as those of ivy poisoning. Several people were met who claimed that they had thus been poisoned. Two boys living in Culver claimed to have so suffered, and another person reported that about 1904 or 1905, he had been badly poisoned by the water of Lake Maxinkuckee wherever it had touched him. A doctor diagnosed his case as "old fashioned prairie itch."

On another occasion, a young man, on being invited to go in bathing during the period of plankton scum, remarked that he was afraid of getting poisoned. We have never suffered nor personally seen any one affected. In many parts of the country there is a prejudice against going swimming during "dog days." This probably has some reference to plankton-scum; for along the Maumee River at Defiance, Ohio, some boys were noted observing some scum on the water and remarking: "It's coming dog-days and we must quit going in swimming."

A very heavy plankton-scum indicates an excess of vegetation in the plankton. It is a decided nuisance both on account of the prejudice against it and the uncleanly appearance it gives the shore. It could, of course, be removed by the addition of sufficient quantities of copper sulphate, but the use of this kills algæ indiscriminately and should not be attempted except as a last resort. Minnows of various species (*Notropis blennius, N. cayuga, Fundulus diaphanus, Labidesthes sicculus*, etc.) and painted turtles eat some of the plankton. Fresh water mussels, however, are the heaviest feeders on it, subsisting almost entirely upon it and consuming considerable quantities. Their presence in the lake is desirable, and they can easily be propagated in great numbers. Perhaps the thick-shelled forms of *Lampsilis luteola*, such as those found at Lake Pokegama, Minn., could be planted in sufficient quantities to keep the excess of plankton down, and at the same time, in due season, furnish a valuable amount of button material for the markets.

The study of the vertical distribution of the plankton carried on by Juday in 1899 and by Young in 1900, and reported on by them, was discontinued in the early autumn of 1900. After that time efforts were made by whatever suitable means were at hand

to obtain examples of the different microscopic forms in and about the lake. During the winter, while raking up the various weeds of the bottom through holes cut in the ice, it was observed that they were thickly populated by various organisms, and by washing them off a great amount of interesting material was obtained. On one occasion it was observed that the drippings of Chara raked up at the Weedpatch stained the snow a bright green, and an investigation showed this to be due to myriads of green Stentors.

During the sounding of the lake in the winter it was noted that entomostraca (Cyclops) flocked up in considerable numbers to the openings cut through the ice for soundings.

With the coming of spring it was observed that the ponds and pools in the region of the lake were teeming with small forms of life different from those found in the lake. The ponds were too small and shallow to permit the use of the towing-net, so the water was dipped up and the various forms strained out and preserved.

From March 25 to June 28, on trips to the Deephole to take temperatures, the towing-net was usually fastened to the boat and hauled one way. Usually large catches were obtained. On some days the hauls would consist chiefly of entomostraca and the mass had the general appearance of a yellowish jelly. On other occasions it was almost entirely diatomaceous (Asterionella) in which case it had a peculiar bristling appearance and was hard and gritty to the touch.

During the summer and early autumn of 1906, beginning about July 26, when diffused plankton began to show through the water, frequent hauls were made with the towing-net with the following results:

July 26, 1:30 p. m., faintly bright and calm; towing in Outlet Bay, from Chadwick's pier to the ice office. *Lyngbya æstuarii*, common; Diaptomus, small species; casts of shells of amphipods; *Botryococcus braunii*.

July 27, hauls at morning and again at noon, secured Lyngbya, only a few filaments; *Botryococcus braunii*, a few colonies; Diaptomus, common; Daphnia, a few.

July 30, haul over the same grounds with the same results. The Inlet seemed full of suspended algæ, which was so fine it strained through the towing-net.

July 31, in a haul across Outlet Bay was obtained a great mass of entomostraca; the water was full of suspended flocculent algæ; but it escaped the net. By noon the water by the ice-house pier was full of suspended algæ (Anabæna) and in dips taken with the finer net, a good many statoblasts were obtained. Plankton scum first appeared.

On August 1, a haul was taken in Lost Lake, but little was obtained. August 7, a haul from Chadwick's pier across to the ice office; a calm, cloudy morning after a rain; there was obtained mostly Botryococcus, some Lyngbya, and a little Daphnia.

On August 21, a visit was made to Winona Lake or Eagle Lake, near Warsaw, and 2 hauls were taken. It may prove interesting to mention results for comparison with the plankton of Lake Maxinkuckee. The plankton mass was blue-green material, turning brown, and was composed of the following elements:

*Lyngbya æstuarii*, main mass, longer filaments and more abundant than at Lake Maxinkuckee; *Microcystis æruginosa*, abundant, taking the place of Anabæna at Lake Maxinkuckee; *Gomphonema aporica*, common; rotifers, many; naupilii, common; *Anuræa cochlearis*, common; *Ceratium hirundinella*, many; *Ceratium tripos*, a few; *Volvox aureus*, a few; Cyclops, a few; Daphnia, a few.

August 28. Outlet Bay in the morning; material fibrous, dirty brown; many empty sheaths of Lyngbya; Botryococcus, Chydorus and Daphnia. Lyngbya greatly increased by noon, evident to the eye on the surface, and diffused Anabæna in clumps, rising to the surface and collecting along shore.

September 5. A haul across Outlet Bay in the morning; mostly entomostraca (Daphnia), and Lyngbya. The Lyngbya still forming hormogonia. The long spines of the Daphnia projecting from the net gave the mass a bristly appearance.

Up to November 12, the plankton hauls had been taken occasionally with apparently the same results. On this date the haul examined showed a marked change; Asterionella, and *Tabellaria fenestrata*, two species of diatoms, were abundant; Cyclops, and naupilii, Anuræa, *Microcystis æruginosa*, and a little Anabæna were present. A filamentous alga not known was abundant, taking the place of Lyngbya in summer; there were also a few colonial rotifers. On November 13, a plankton haul was taken with much the same results, the material being mainly diatomaceous.

In 1908, a few hauls were made; one on August 22, which consisted of Vorticella, Lyngbya and a little Anabæna. On the night of August 26, a haul made in Lost Lake, consisted of many Corethra larvæ, many Cyclops, Daphnia, a few water-mites, some rotifers, and a little Microcystis.

The marked difference between the plankton of Lost Lake and that of Lake Maxinkuckee was significant; that of Lost Lake approaches rather that of Winona Lake. Indeed, from a comparison of the plankton elements of various lakes it appears that the differences in their plankton flora and fauna are not those of isola-

tion or distance, but the suitability of the lake for certain species. Closely neighboring lakes may have a different, and far distant lakes may have a similar, plankton. Shallow lakes, which have more or less warmth and light to much of the bottom, are more heavily populated and have both more diffused plankton and plankton scum. A lake resembles an organism in that there must be a certain ratio of surface to volume to produce maximum results. Lake Maxinkuckee differs from the neighboring shallower lakes, such as Bass Lake, Winona Lake, etc., both in the relative quantity of its plankton and in the organisms composing it. The smaller lakes have a much greater quantity of plankton, so that the plankton-scum nuisance is much greater in them than at Maxinkuckee.

The plankton elements are most of them easily carried about from place to place on account of their minuteness and many of them, such as Microcystis, Anabæna, Aphanizomenon, etc., are of world wide distribution. They are therefore likely to thrive in any lake where conditions are favorable. Microcystis, which, after a little practice, can be easily recognized by the naked eye, the vacuolated masses resembling minute smoke rings, is more characteristic of warmer, shallower lakes, and Anabæna of deeper, cooler lakes.

Another point worthy of remark is that of the great abundance of diatoms in the plankton during early spring and late autumn, and their scarcity or absence during the summer.

The following are notes concerning a few plankton hauls made in 1908:

August 25. No wasserbluethe yet, but one small bit of minute stuff which soon disappeared; much *Lyngbya æstuarii;* a few colonies of *Microcystis æruginosa; Anabæna flos-aquæ*, a few colonies; Corethra larvæ, common; some rotifers and entomostraca; minute white round worms in some of the plankton, one in a dead insect larva; they may be parasitic.

August 31. Minute green Vorticellæ clustered about a sphere of Anabæna; *Lyngbya æstuarii*, common; Microsystis, a few colonies; Anabæna, 2 or 3 colonies; *Botryococcus braunii;* Vallisneria flowers; statoblasts of Plumatella, several; Œdogonium, one filament; Ostracods, common; broken off Naias, small snails, and Amphipods, abundant; a few Daphnia; Copepods, a few, not so common as in night hauls.

September 7. Lost Lake with a fine scum on top near shore, easily thrown into ripples, composed of fine blue-green grains; *Microcystis æruginosa*, common, forming main mass; *Botryococcus braunii*, frequent; *Anabæna flos-aquæ; Lyngbya æstuarii;* a little Daphnia; Navicula, a few; Cypris, a few.

# THE FLORA OF LAKE MAXINKUCKEE AND VICINITY

## Introduction

In the beginning of the investigations it was intended to limit the botanical studies to the aquatic species of plants and those inhabiting the marsh ground immediately about the lake. It was thought that no attention should be given to the purely terrestrial species. But as the work progressed the difficulty of drawing any hard and fast lines between aquatic species and land species became increasingly difficult. And the segregation of the species which bear a relation to the life of the lake as distinguished from those which bear no such relation, became quite difficult, if not indeed, impossible. Species of herbs, shrubs and trees, which at first thought would not be considered as, by any possibility, exerting any influence on the fishes or other animals of the lake, were found upon investigation really to sustain very important relations to the lake and its inhabitants.

This compelled us to make our studies more and more inclusive until finally it became evident that all species of phanerogams should be included. This we have done. We have not only listed all the species determined as belonging to Lake Maxinkuckee and its catchment basin, but we have embodied in the report many of our observations regarding the abundance, distribution, and habits of the various species.

In order to emphasize the importance of the strictly aquatic species it was thought best to treat them in a separate chapter, and in a special way. This we have done even at the risk of some repetition.

The relation of the plants of the land to the lake, in the matter of the trees furnishing a mass of leaves to the lake bottom, preventing erosion, etc., has already been referred to. In addition to this there are intimate relations of the land flora to the soil and topography which make a consideration of them necessary to a complete understanding of the lake.

During the survey of the lake an attempt was made to obtain a complete series of herbarium specimens of the various species of plants growing therein, and the work thus started, it was the most natural thing in the world to collect also along the shore and farther back from the water's edge. Many hundred specimens representing most of the species were collected and deposited in the United States National Herbarium.

Collections in the country around the lake were made when other work permitted, but all seasons of the year were not as fully

represented as might be desired. Some forms were doubtless overlooked, but from time to time, additional species were added to the list on subsequent visits. Listing all the species will serve a manifold purpose:

1. The list will assist materially in helping one to realize the great varieties of soil and surface, and will form a valuable supplement to the soil survey. For example, the mere mention of the pitcher-plant will suggest one sort of surroundings, and the mention of the Indian-pipe, another.

2. During the time that has elapsed since the beginning of the survey, numerous changes have taken place; some species have disappeared or become scarce, and new forms have come in from time to time. In the brief infrequent visits and pressure of other work while at the lake, doubtless a number of the changes have been overlooked, but such as have been observed have been recorded.

3. As much time as opportunity allowed has been given to the habits of plants, the time of their leafing, flowering, ripening, dying and other features. This is an important and generally neglected subject and it is unfortunate that more time could not have been devoted to it. It is believed that extended studies along these lines would lead to important results. Some of the widely diverging habits of closely related species such as the fact that the whole process of flowering, fruiting, ripening and germination of seed in the silver maple requires but a few weeks while in the hard maple it requires the good part of a year, and the fact that some of the sassafras trees of a neighborhood will blossom a week or more later than others, making cross fertilization impossible and the origin of a new breed possible, are only examples of suggestions that may be brought to mind by such observations. In the discussion of the various species an attempt has generally been made to give a familiar study of each species as seen in many places and under various circumstances and conditions. The latent possibilities of many of our species of plants, their wide diversity of form and feature under different conditions, and the possibility of discovering or developing variations that might prove valuable for use or ornament, have hardly begun to be realized. A careful study of many of our common plants, especially where seedlings come in great abundance, as in the case of silver maples, elms, and sycamores, will occasionally discover interesting and curious mutants which are worth our careful study and contemplation. And, most important of all in this connection, is the consideration of various land herbs, shrubs and trees in their many relations as factors in determining the physical and biological characteristics of the lake.

## THE AQUATIC FLORA

### Introduction

The entire animal life of any lake is dependent for its sustenance ultimately upon the plant life of the same lake. The complete destruction of the plant life would inevitably result sooner or later in the total disappearance of all animal life. This general statement includes, of course, the microscopic as well as the macroscopic flora and fauna, the diatoms, desmids and all minute forms of plant life, and all entomostraca and other minute forms of animal life, as well as all those larger, more conspicuous forms of animal and plant life which are evident even to the most casual observer.

Without the plants the lake would be uninhabitable and zoologically, an uninhabited desert. The plants of the lake are as important to its animals as are the grasses of the plains to the cattle that range over them. The importance of the microscopic flora is discussed elsewhere in this report in connection with the subject of plankton; we may therefore omit from detailed consideration at this time the subject of infant fishes and their food, and pass directly to a discussion of the more conspicuous plant life of the lake and the more evident phenomena connected with its relation to the lake's fauna.

### Uses of the Aquatic Flora

*As oxygenators:*—The plants of a lake perform an important function in furnishing a supply of oxygen to the water. The importance of this function in any lake depends upon its area as compared with its depth; in other words, upon the ratio between the surface area where oxygen can be absorbed, and the volume of water to be oxygenated. In a lake with large area and little depth, and winds sufficient in strength and frequency to keep the surface well disturbed, the need of oxygenation by plants is less imperative. Lake Maxinkuckee, with its considerable areas of deep water and infrequency of summer storms, needs the assistance of aquatic plants to keep up the supply of oxygen. Their presence, provided there are enough fishes and other animals to use up the oxygen, makes the lake a large balanced aquarium.

Some idea of the activity of the plants in supplying oxygen to the water may be obtained by visiting and observing large, dense patches of certain water-weeds in clear shallow water on any bright day. On a bright day in autumn it was observed that the constant breaking of minute bubbles above dense patches of Philotria

actually gave rise to a musical tinkle, and the water might almost be said to sing and sparkle like champagne.

Closely associated with supplying oxygen to the water are two or three other functions of considerable importance. The first of these is the softening effect which the plants have upon the water. Certain plants, such as the Charas and the Potamogetons, abstract considerable quantities of lime from the water. These plants become thickly covered with a coating of carbonate of lime from which in turn they receive some of their oxygen by reducing the calcium carbonate. These and other plants also modify the bottom of the lake by the deposition of the lime as marl and also by the deposition of vegetable débris to form black muck.

*As shade:*—Some of the plants, such as the water-lilies with their broad sheltering pads, furnish grateful shade to fishes and other animals of the lake. Any one who has ever rowed silently along the edge of a patch of spatterdock on a bright summer day and seen bass and sunfish and other animals resting in the shade of the broad leaves, can not doubt this value of the plants.

*As protection:*—The larger aquatic plants offer protection to the fishes in various ways. They protect the fishes from each other. The young of many species habitually dwell among the vegetation until they have attained size and strength to compete with their larger kin; and even fishes of considerable size find a dense patch of hornwort or Potamogeton quite helpful when pressed by larger fish. The plants also afford protection to the fishes from the watchful eye of kingfishers, herons, fishhawks, and other fish-eating birds. Moreover, many an angler has lost many a good fish because his hook became fouled in the weeds, to the mutual advantage of both fish and angler, in that the fish escaped and the angler was given the opportunity to report that "the largest one got away".

*As food:*—Many of the plants furnish food to the fishes, either directly or indirectly. So much attention has been given in recent years to plankton and its importance in the menu of young fishes and of the adults of some species such as the shad, white-fish, and shovel-nosed sturgeon, that we are likely to overlook the larger forms of plant life when considering the food of fishes. As a matter of fact, during a large part of the year many of the fishes of the lake obtain a considerable portion of their food from the more conspicuous plants. With the exception of the skipjack, few of the small fishes, after they have passed infancy, feed upon entomostraca. The vegetarian minnows feed upon plants or plant

fragments of appreciable size, and the carnivorous forms feed largely on aquatic insects or their larvæ which in turn feed on the plants. The bluegill, which is largely a vegetarian, feeds directly at times upon the leaves of pond-weeds (Potamogeton), and at other times upon the little crustacean, Asellus, which feeds upon the weeds. Another small crustacean which furnishes considerable food to fishes is the beach-flea, which feeds upon the larger plants and is usually found associated with the hornwort, Ceratophyllum. The coarser growths of the lake are used directly by some fishes and they furnish food or lurking places to a multitude of small animals—mollusks, insects, insect larvæ, crustaceans, etc., upon which the fishes feed. And again, the value of aquatic plants as food for water-fowl must not be forgotten. The quality and quantity of vegetation in the lake is of prime importance to the great flocks of ducks and coots which visit the lake every fall. These birds first feed upon the rich tender stolons of the wild celery, then upon the tender bases of the leaves. When the wild celery has become scarce they then begin feeding upon the more suitable parts of other plants such as the various species of Potamogeton, and even Philotria, Naias, Ceratophyllum, Myriophyllum, and various species of Chara; so that, in the season, the total amount of vegetable food which the ducks, coots and other water-fowl eat at this lake is very great, indeed. It can safely be said that the abundance in the fall of water-fowl at this and similar lakes, and the period of time during which they will tarry, are largely determined by the character and abundance of the aquatic vegetation.

*General considerations:*—A peculiarity of the lake flora is that there are very few annual plants, using that term in the sense of a plant that springs from seed, then flowers, fruits, and dies down in a single year. They are, indeed, generally like annuals in texture, herbaceous and weak, but with little wood. We are dealing with plants growing in a region where it never freezes, and where there is never any drouth. From this point of view the region down in the water where the plants thrive may aptly be likened to a continually moist portion of the tropics.

According to the commonly accepted philosophy of biology, seed-production among plants is a device for tiding the plant over unfavorable conditions much the same as the protozoa going into a resting stage or encysting. Regarded in this light, flowering and seed-production are unnecessary among the submerged aquatics, and persist mainly as an inherited habit. Considered from this point of view, one of the most curious phenomena is the efforts made by Philotria and wild celery (Vallisneria) to become fertil-

ized and set seed, the pistillate flower extending on a long peduncle to the surface of the water and the staminate blossom breaking off and floating away. Moreover, where conditions are so favorable for vegetative propagation one might naturally expect this to be a common mode. And so it proves to be; nearly all the aquatics propagate freely by means of special buds or tubers. Some of them, especially those of *Potamogeton pectinatus*, are of a remarkable character.

The peculiarities of the various species in regard to reproduction, method of dissemination, and distribution, will be taken up under each species. A few general remarks may be made here, however, concerning the behavior of the aquatic flora as a whole.

In addition to bearing seeds, most of the aquatics propagate by means of so-called winter buds, which are merely fragments or bits of branches sometimes more or less modified. The expression "winter-bud" is hardly a happy one, as it serves to keep in mind the notion that the aquatic plants need some special device for surviving unfavorable seasons, and in that it increases the difficulty, already great enough, of divesting our minds of the notion of severe changes of season to which we are accustomed and for which the land plants must provide, but which do not apply to the aquatics. The propagation buds may be formed at almost any time of the year during the growing season, many of them during August. Every one is acquainted with the facility with which many of our herbaceous plants, such as the geranium, purslane, wild morning glory, etc., send out roots from cuttings, and how the presence of water or moisture favors the formation of such roots, so that the usual way to start some plants, such as the willow, oleander, etc., is simply to place the end of a cutting in a vase or bottle of water. Among the aquatics we have the herbaceous growth and the water always present. A cause contributing to the formation and detachment of "winter-buds" during the autumn months is that there is then considerable wind and choppy weather so that the plants are subjected to unusual stress and strain, and portions are easily detached. The portions detached drift about hither and yon with the various movements of the water. They rest during the period when the lake is covered with ice, but are further disseminated and scattered by the gales of early spring after the ice has melted.

As a result of the more or less permanent nature of the plants and plant-patches in the lake, and of the habit of detached portions rooting and growing wherever they settle or the shifting currents carry them, the locations of the old plant-patches do not change much, but new patches spring up here and there. Such influences

as the removal of protecting trees, opening the lake more to the sweep of winds, conduce to the dissemination of the under-water plants. It is perhaps due to this, and perhaps to other less evident causes, that the lake has become markedly more weedy than it was at the beginning of our study. To cite a specific example, the shallow water just off the north shore of Long Point, which was once over comparatively barren sand, now supports a dense and luxuriant growth of weeds, especially Philotria. It is quite possible that another very active contributing cause is to be found in the increasing scarcity of waterfowl. Formerly, immense flocks of coots and ducks made great raids on some of the water-plants,—first on Vallisneria, and then, when that was gone, upon Chara and other weeds. The birds uprooted the plants before they ripened or set seed, so that the long, heavily seeded fruits of Vallisneria, once almost a curiosity in the lake, are now abundant, due, in part at least, to the greater scarcity of water-fowl. Not only did the ducks uproot the plants, but they also ate as a choice delicacy the tender stolons upon which the plant relied for vegetative propagation, and in the early winter, after the ducks had finished their raids, little or none of the Vallisneria was to be found.

So conspicuous and apparent is the increased weediness of the lake that a local report has gained circulation that the "Fish Commission has planted the lake full of weeds for fish-food, and that as a result the fish are so well fed that they will not bite, much to the detriment of good fishing"!

As compared with other lakes of the state, Lake Maxinkuckee is not so weedy as some of the shallower lakes which warm well to the bottom and have all their bottom area at such depths that plants can thrive, but it appears to become more weedy year by year. It is somewhat more weedy than lakes with a smaller area of shallow water, such as Tippecanoe Lake. Its condition as regards quantity of vegetation is well expressed by Dr. Scovell who, in discussing the origin of the marl says: "Out to a depth of 25 feet the lake abounds in vegetation. Over hundreds of acres the vegetation is as rank as in a field of heavy clover, the vegetation consisting largely of different species of Chara and Potamogeton, with Vallisneria, Philotria, Ceratophyllum, Naias and Myriophyllum in abundance."

The comparison with a field of clover suggests at once the importance of the vegetation as soil builders of the bottom, but in this respect it is to some extent misleading, inasmuch as in the case of the Chara and the other plants in deeper water, the dense patches seen year after year are the same, not decaying and being annually

renewed as in the case of the clover, but the same individual plants persisting year after year.

In the shallower water, indeed, many of the plants, such as Vallisneria, do die down, or their leaves are pulled off by ducks and washed up on the shore in great rolls. The rolls of plants which wash ashore decay into a rich black soil to be again washed down into the depths of the lake by the undertow. In shallow lakes, where warmth and sunlight can reach the bottom, doubtless one of the most important influences in oblitering the lakes is the immense mass of vegetation which grows up and dies down yearly.

The importance or efficiency of water plants in filling shallow lakes and shallow parts of lakes is well shown in the southeast part of the lake along Norris Inlet, and along the Outlet where what was once lake bottom has been built up into flat sedgy marshes (Green's marsh and Norris Inlet marsh), the lake already having lost from this cause an area of over 70 acres, along with its continuity with Lost Lake.

## THE LAND FLORA

### Introduction

A striking character of some of the small ponds and kettle-holes about the lake is the sharp division of the vegetation into concentric zones, so that the ecological aspect of botany is abnormally intensified. This is the case at Hawk's marsh and at some of the woodland ponds in Farrar's and Walley's woods. With Lake Maxinkuckee, which is, of course, only a pond on a larger scale, the same condition might be expected to obtain, but generally speaking, it is not the case, because the steep shores come close to the water's edge, making the transition from the high land flora to the lake flora quite abrupt. It is manifest, however, in such regions as Norris Inlet and Green's marsh which were once parts of the lake. It is much more manifest about Lost Lake than in Lake Maxinkuckee, and formerly, when the marsh about Lost Lake was more flooded than at present, and covered with shallow water species of Chara and Utricularia, it was more marked than at present.

Of course, there are numerous forms, such as the bulrushes, pickerel-weeds, mud plantain and others, which belong equally upon the land or in the water, and in other cases there are dimorphic species having one form adapted to the water and another to the land, so that it is difficult to tell just where the lake forms end and land forms begin. But generally speaking, the lake and land floras are pretty markedly distinct.

While the division line between the lake flora and the land flora is in most cases pretty sharply drawn, it is not so easy to tell where the boundary line lies between the plants having some influence upon the lake and those which have none, if there be any such.

The forests upon the shores of the lake have a marked influence in sheltering it from strong winds. As everywhere else, their leaves break the impact of heavy rains, allowing the water to sink gradually into the soil rather than run directly into the lake carrying their burden of soil with them. In this last mentioned function, indeed, forests some distance back from the lake exercise a very important influence on the lake. It is known that the lake derives its chief supply of water from springs and flowing wells, the waters of which sink into the surface, no one knows just how far from the lake. Everybody knows how the disappearance of springs is associated with the removal of forests. Indeed, during the time that the lake has been under observation there has been a marked diminution in the force and volume of many of the flowing wells, and some of the marshes, such as Green's marsh and the Inlet marsh, which at the beginning of the investigations were miry, quaking bogs, where one could walk only on tussocks, are now comparatively solid ground and are, indeed, mown meadows. This change is a consequence of the lowered water-table of the whole general region, and has taken place in other parts of the state to such an extent that where cattle once would mire there are now fields of corn and alfalfa.

The falling leaves from trees near the lake sink to the bottom of the lake and may be dredged up at all depths. Their decay forms a black mud, and, although on account of the large area of the lake, they are not so great a factor as in some of the smaller lakes, their amount and influence is considerable. In one feature they are quite important. It is between the leaves, as they sink to the bottom, that some of the plankton algæ, especially Anabæna, the most abundant, and when in excessive abundance, the most offensive of all the plankton-scum plants, hibernate during the winter. Even the humble grassy covering of the sand-hills about the lake has a direct bearing upon the latter; for when these are denuded of all vegetation, the sand drifts and blows; during the year a considerable quantity is blown into the lake. During the winter, when there is no protecting snow, the ice is soon covered with a film of sand. Even the meadows about the lake, with their grasses and other plants, bear a relation to the lake, in that they furnish a habitat for various insects, particularly grasshoppers, which in one way or another enter into the menu of the fishes. As shown else-

where in this report, the quantity of grasshoppers caught in the vicinity of the lake and used as bait by the anglers is astonishingly large. Moreover, various trees and shrubs leaning over the lake are the homes of various insects which frequently drop into the lake. In the spring of 1901 it was observed that the water-surface was covered with vast numbers of leaf-eating beetles. It was later discovered that these laid their eggs on the leaves of the willow trees along shore and that the black larvæ which hatched, defoliated the willows. Moreover, the myriads of midges, may-flies and caddis-flies which spend the larval period of their lives in the water and furnish an important part of the food of the fishes, when they emerge from the water and take their nuptial flight, run a gauntlet while in the air, and are reduced to a remarkable degree by the forest-dwelling birds along shore—cuckoos, warblers, song sparrows, night hawks, etc.

The number of forest and weed seeds that blow into the lake and float upon its surface is very great. The sycamore seeds blow out on the ice in great numbers and are washed ashore in spring. Some conception of the immense amount of seeds borne on the surface of the lake can be obtained by a walk along the beach almost any season of the year. In places there are long rows of seedling sycamores, in others, seedling elm and willow. In the autumn of 1913 whole stretches of beach were covered by an almost continuous mat of little seedlings of Erigeron. These seeds, it is true, probably never have any important influence on the lake, probably none of the lake-dwelling animals feeds upon them; but they form at times a noteworthy part of the plankton towings, and increase greatly the number of forms the plankton-student has to puzzle over. If not a part of the actual plankton, as generally understood, they certainly constitute at times a considerable part of the plankton catch.

There is another consideration which makes the land flora worthy of our attention in an attempt to study the lake. Lake Maxinkuckee was taken at first as a typical glacial lake; but careful study proves it not to be such; at any rate, a large number of small Indiana lakes are pretty markedly different from it and have a closer set of resemblances among themselves than it has to any of them. It is a lake of marked individuality, and this individuality is indissolubly associated with its surroundngs—the sorts of soil and accompanying plants and animals. A given association of plants will at once suggest to the botanist the type of soil, slope, etc., and soil surveys to be complete, should always be associated with botanical surveys.

The botanical study here given can therefore be regarded as complementary to the soil survey of the region. The Miami sand, which extends from Culver Academy grounds to Murray's, reaching west beyond Culver to the large muck areas, exhibits, in the main, a different flora from the Miami sandy loam about the south half of the lake, from Murray's around to Aubeenaubee Creek, and this again is different from the rich woodlands of the Miami gravelly sandy loam extending from Aubeenaubee Creek to Culver Academy grounds. The small intercalated areas of muck along the Inlet and Outlet, and other soil areas, are also associated with more or less peculiar floras, so that on the whole the area about the lake is a veritable botanist's paradise.

Attention is called to the fact that the botanical work about the lake was done at a time when other duties occupied attention, and, indeed, was done only when studies of the lake permitted momentary interruption. While it is believed practically all the phanerogams of the lake are represented in the list, the same thing can not be said of the land plants, and there is doubtless a considerable number of gaps yet to be filled to make the list complete, a number of species of the land plants having escaped observation on account of the pressure of more insistent duties. During only one year, 1900-1901, was the work carried on without considerable interruptions. From time to time since then, on short visits to the lake, attention has been paid to the flora as opportunity permitted.

Although the botanical studies of the lake have been only intermittent and fitful, they have extended through a considerable series of years and have attracted attention to a phase of botanical study which has not been generally appreciated, namely, the historical phase.

Of recent years the cataloging of the plants of limited areas has begun to be looked upon as the lowest form of botanical activity, so thoroughly despised, indeed, in some quarters, that it is not considered sufficiently worth while to engage the attention of first-year high-school pupils, and as a corollary to the contempt with which the "mere systematist" has fallen, the good old habit of "botanizing" and making herbariums and getting acquainted with local floras has given way in many places to comfortable indoor studies, and the study of botany has become a "sedentary occupation." A complete list of the plants of a given area, however, made as a basis for the study of changes of flora in the progress of the years, keeping record of forests removed, of wholesale marsh floras exterminated by drainage and tillage, and of the date of disappearance of original forms and the entrance of new, would

be of inestimable value and interest. It was during the period in which the lake was under observation that several species, such as the tamarack, pitcher-plant, yellow-fringed orchis, and a few others wholly disappeared in places where they were once abundant, and appear on the way to complete extermination in this region. It was only a few years before the investigations began that the yellow and white sweet clovers made their appearance in the region. The entire-leaved prickly lettuce had just appeared and was represented only by a few pioneers; the typical form with incised leaves had not yet appeared. A few adventurers, like the first colonists of the new world, attempted and failed. About 1906, the Russian thistle first made its appearance in the form of a small patch along the Assembly grounds, but this did not persist. It was the same year that the tumbleweed or winged tumbleweed, Cycloloma, made its appearance at the lake, although it had been seen several miles west of the lake in 1904. It was only in the year 1909 that the dainty Galinsoga, whose advent had been looked for for some time, and a red-leaved Oxalis, perhaps *O. rufa*, first made their appearance in the railroad grounds, in all probability from seed in soil brought directly from Sewickley, Pa., the location of the Pennsylvania Railroad's propagating gardens.

## General Floral Regions

As has been said, the general floral regions correspond pretty closely with the soil regions. The following general areas are recognized in this report: (1) the beach, (2) the lake plains, corresponding to the muck of the soil survey and most marked at Inlet marsh and the marsh about Lost Lake, (3) low woodland, (4) high gravelly sandy woodland as at Long Point, (5) upland clay woodland, as Overmyer's field, and, back of the Inlet marsh around beyond Van Schoiack's on the east side, (6) upland sandy woodland, as the stretch of forest north of Lost Lake marsh, (7) upland loamy woodland, as Culver's woods and northeast of the lake, (8) gullies or creek bottoms such as those along Culver's and Overmyer's creeks, (9) woodland ponds, (10) sphagnous bogs, and (11) shifting sand regions.

*The beach flora:*—The wide beach on the east side is comparatively barren, its barrenness being due to its sandy soil, which is easily moved about by waves. From Culver Academy grounds on around to Norris Inlet there is on the narrow, sandy, gravelly beach a pretty well marked flora, the elements of which are cockle-

burs (*Xanthium*), *Cyperus diandrus*, *Verbesina alba*, peppermint, spearmint, spotted touch-me-not, barnyard grass, germander, water hoarhound, all pretty well distributed, with the cockle-bur, touch-me-not, Verbesina and Cyperus most abundant at Long Point, the Teucrium and water-hoarhound most abundant north of Winfield's. There are long patches of bulrushes and chairmakers rushes, the location of which is given in detail under those species, a few patches of arrow-head and pickerel-weed, also described elsewhere, garden parsnip in front of Green's, barnyard grass, and *Cicuta bulbifera*, the bulb-bearing water hemlock, along the southern shore of the lake. There was a small clump of sand-bar willows at Long Point, but these have disappeared, and below Farrar's low Cornus and Cephalanthus leaned over the shore in places. Where springs entered the lake and flowed over the sandy shore, as at Lakeview Hotel, a species of Chara grows on shore, making a beach plant, and at the entrance of a few creeks watercress grows luxuriantly at the water's edge. In addition to these there is at various times a temporary flora of seedlings of all sorts of winged-seeded plants such as willow, sycamore, elm, Erigeron, etc., but these always soon disappeared.

Behind the beach in certain places where there is no steep shore, such as along the low woodland at Overmyer's and from there to beyond the Norris Inlet marsh and again in front of a small pond on the southeastern shore of the lake, there is a well-defined ice-ridge. Although this is a well-defined area, differing markedly from the land on either side, especially as regards drainage, it can not on the whole be said to have a distinct flora. The only plum tree close to the lake grows on the ice-ridge, and the only patch of running strawberry bush, *Euonymus oboratus*, about the lake region was found on the ice-beach in front of Overmyer's low woods.

*The Lake Plains:*—These are represented by the Inlet marsh and Lost Lake marsh, the latter including Green's marsh. The soil is mucky, and mucky areas along Aubeenaubee Creek and the Outlet below Lost Lake much of the way down to the Tippecanoe River are of this character as regards both soil and flora. They are flat level plains, densely overgrown with various sedges, chiefly *Carex stricta* and *C. lanuginosa*, along with the tall marsh shield-fern, *Dryopteris thelypteris*. In the Inlet marsh there are plenty of cattails, considerable swamp loosestrife, and scattered *Comarum palustre*. Green's marsh contains various low shrubs principally Bebb's willow, red-osier dogwood, and button-bush. There was

originally a level flat area much like a lake-plain across the road at the mouth of Culver Creek which was densely overgrown with the chair-maker's rush (*S. americanus*) but these have disappeared and the area is now a flat meadow.

*Low woodlands* are represented only by a small area at the mouth of Overmyer's Creek, and the most prominent characteristic of this is the abundance of swamp ash.

*The upland clay woodland* is modified in many places by clearing and cultivation, a characteristic of it being the presence of the shellbark hickory which is generally replaced on more sandy areas by the small fruited hickory, *Hicoria microcarpa*. A clump of redbud, *Cercis canadensis*, the only patch about the lake, is found in this soil back of Van Schoiack's. In other respects it is much like the other upland forest.

*The high gravelly sandy woodland* is represented by the Long Point forest. This, being near the base of operations, was studied in some detail. The trees were rather scattered and clumpy. Within an area of 4 square rods chosen as typical there were 4 trees of *Quercus velutina* or black oak, 5 trees of *Hicoria microcarpa* or small fruited hickory, and 5 trees of white oak. The largest tree within this area was a black oak a foot in diameter, and the smallest a hickory 3½ inches in diameter. The trees averaged 6 inches in diameter. There were a few scattered sycamore and willow along shore, and large-toothed poplar, *Populus grandidentata*, and occasional elms. The herbage consisted of only a few scattered spears of grass and much scattered elm-leaved goldenrod. Much of Long Point had been cleared off so that the original forest was gone. Green's woods near Lost Lake, a continuation of the same but perhaps a trifle more sandy, contains numerous patches of moss near its edges, and usually plenty of scattered toadstools and occasional Indian pipes in the rich woods mould.

*The almost pure sand woodland* is exemplified in the forest on Long Point. This is chiefly of small black oak and contains very little or no herbage. The accumulated leaf fall of years has not decayed, but the crisp, dry leaves even in mid-summer lie as thick and rustling as they do in most woodlands in autumn, and in the exceeding dryness of the forest floor it reminds one of the dry pine-needles that carpet a pine forest.

*The upland loamy woodland*, exemplified by Culver's wood, consists of an exceedingly rich black sandy loam surface soil with a magnificent forest of immense tulip-trees, sugar, black and white walnut, beech, coffee-nut, bitter-nut, red oak, elm, white oak, chest-

nut oak or sweet oak (*Q. muhlenbergii*), with immense fruitful groves of papaw, scattered spice brush, and for herbage all the common plants that grow in rich woods mould,—hepaticas, anemones, pepper-and-salt, in that great variety which delights the flower lover and botanist. Some notion of the variety produced in this region may be obtained from the remark, probably not exaggerated, of a man who was hauling wood from this region and who said he had 27 species of wood in one cord.

*The gullies* have a rich, springy soil usually black and in places more or less miry. On their sides grow luxuriant but tender moisture-loving ferns, while in the bottoms flourish patches of skunk cabbage, large flowered asters of various sorts, lizard's-tail and the like.

Farrar's woods, Walley's woods and Zechiel's woods along the south and southwest shores of the lake are mostly rather flat, sandy but moist woods, in general without salient characters enough to be characterized briefly except that all contain woodland ponds, and the two latter are characterized by having plentiful low heaths such as *Gaylussacia baccata*, checkerberry, false beech-drops, etc., scattered through them. Holton's woods near Walley's contain the only clump of river birch in the region, and Walley's woods the only clump of Princess pine, *Chimaphila umbellata*.

*The woodland ponds* are so various that it would prove wearisome to describe them in detail. Those of Farrar's woods are shallow, the bottoms thickly covered with leaves, the water, which is present only during the wet season of the year, is usually of a tea color. The plants are few. A few trees of the various-leaved cottonwood, *Populus heterophylla*, Cephalanthus bushes, their bases skirted with mosses and liverworts, a few herbaceous species remarkable for their adaptability and variability of form, the water-parsnip, yellow water-crowfoot and the curious *Riccia lutescens* which floats about on the surface like green butterflies and reproduces by a division into almost exactly equal parts. All these herbaceous plants flourish, but assume entirely different forms during the dry season. For their fauna they have numerous frogs, speckled and Blanding's tortoises, both almost entirely absent from the lake, the slender-pincered crawfish *Cambarus blandingi acutus*, not found in the lake, and a remarkable Sphærium which spends half its life, the dry season, among the moist leaves in a state approaching suspended animation. They, along with other shallow pools, contain the fairy shrimp and doubtless various Entomostraca of unusual habits and characters. Farther down toward Walley's

woods the woodland marshes are different, usually containing quaking aspen about the margin along with winterberry or black alder and choke-berry with Sphagnum in the center. One of the circular woodland ponds studied more in detail consisted of 4 distinct zones of vegetation, the outer border being the usual high-ground forest, then a ring of willows and *Rosa carolina*, then a ring of sedges, boneset, smartweed and Erechtites, and in the center a circle of rice cut-grass. Swamp white oak was common in this pond.

*The peat bogs*, once extensive west of the lake, have most of them been greatly changed if not destroyed by drainage, and their curious faunas exterminated. Most of them contained the tamarack as their principal or only tree. Hawk's marsh, on the southwest corner of Culver, fortunately remains, and it is to be hoped will long continue in its present state. It is surrounded by an almost impenetrable tangle of various low bushes, principally mountain holly, black alder, tall bush huckleberry and poison sumac. Inside this tangle is a deep, spongy bed of Sphagnum, the outer border thickly overgrown with tall, erect ferns (Anchistea) and farther inward evergreen heaths, leather-leaf, marsh-rosemary, etc., with a sprinkling of pitcher-plants and cotton-grass. Various orchids, such as the yellow-fringed orchis, are common. At the inner edge of the Sphagnum are masses of cranberry vines and spatulate-leaved sundew, while innermost of all is a pond full of spatterdock and Utricularia.

*The shifting sand regions* are composed of a somewhat heavier sand than dune sand and are areas once covered with a growth of forest, chiefly low scrub oak (*Q. velutina*). These sand-hills do not drift in a mass as do the genuine dunes, but the winds gutter out the sand in places leaving angular rock fragments. The blown sand drifts fence corners and forests full and gradually buries them. The flora is generally a scattered growth of *Cyperus filmiculmis*. Some cacti, said to have escaped from a neighboring cemetery where they are said to have been planted, are slowly occupying these hills.

Patches or peculiarities of distribution of individual species, such as the long line of sour gum (*Nyssa sylvatica*) along the edge of Green's woods and the east bank of the outlet in Walley's woods, clumps of witch hazel back of Green's and on the east side of the lake, are best treated in discussing the different species.

In the following discussion of species the various plants are described as seen in varied places and times, representing the species in as many lights as possible.

## Comparison of Aquatic and Land Floras

Perhaps the most striking difference between the flora of a land and of a water area is that the land flora lies open to the eye while much of the flora of a lake, especially of a deep lake, is hidden from view. It is easy to form a fairly complete mental picture of a landscape with which we are familiar, but in the case of a flora at the bottom of a lake the situation is entirely different. In the case of permanence or persistence of individuals, there are curious differences. On the land, there are herbs, shrubs and trees—annuals, biennials and perennials—the trees conspicuous landmarks enduring year after year, the herbs many of them dying entirely down with the course of a year. On the other hand, the aquatic flora is almost entirely herbaceous; the only analogue we have to trees being the water-lilies and spatterdocks, the thick horizontal rootstocks of which would, if standing erect, make respectable saplings. But while the plants under water are all herbaceous and relatively frail, the phenomenon of annual growths which live but to produce seed, and perish when that is done, does not obtain among the aquatic plants. The only case that comes to mind is that of some of the delicate Charas and Nitellas, and the slender Naias which grows at the water's edge, and the deeper growing plants of Naias. In a certain sense, at least so far as plant life is concerned, the region under water may be described as sub-tropical. The most important difference between the temperate zone and the tropics is, not only in a greater amount of heat in the tropics, but also in the more equable distribution of the heat throughout the year, and the absence of a freezing temperature at any time; and this is just what we have in the waters of the lake everywhere below the freezing surface. The temperature of the air about the lake has a range of about 125° F., frequently going considerable below freezing, while the water under the freezing layer at the surface has a range of only about 55°, or not half as much as that of the air, and is always exempt from a freezing temperature.

In the region immediately about the lake the lover of beautiful grounds may wish in vain for the "broad-leaved evergreens", the holly, the ivy and the rhododendron, but just a little way beneath the ice the broad green delicate leaves of the pond-weeds retain throughout the coldest winters almost the freshness of summer days.

Moreover, in the methods of perpetuating their kind, the aquatic plants differ considerably from the land plants in that there is hardly a single species which does not have some effective method

of vegetative propagation, either by special propagating buds or by the rooting of broken-off portions. In only a few are seeds formed in great abundance; in many, seeds are formed scarcely or never at all.

In the botanies concerning land plants, there is much about ecological groups, plant societies, halophytes, xerophytes, mesophytes and the like, and one of the most striking features dwelt upon is the association of plants in related groups as regards soil, moisture, slope, and the like; but in the lake bottom no such differences obtain; the only difference in the amount of moisture is in its depth, and the drainage is the same everywhere; the only differences affecting distribution of the plants being those of the depth of water, the nature of the bottom and the question of previous occupancy by some other species.

*Plant patches in the lake:*—The positions of the plant patches of the lake are fairly constant, inasmuch as most of the plants are perennial or grow from perennial rootstocks. New patches may of course spring up in various places. The most conspicuous plant patches are those of aquatics with aerial or emersed leaves and of these the ones most likely to be remarked are the white and yellow pond-lilies, *Castalia odorata* and *Nymphæa advena*. These species, though abundant in Lost Lake, are rare in Lake Maxinkuckee, as there is not enough of the deep soft black mud in which they thrive best. There is a small patch of both species at the beginning of the Outlet, and considerable of the Nymphæa but only a little of the Castalia, in the Norris Inlet region.

Next to the water lilies, the most conspicuous patch-forming plant is the large-leaved pondweed, *Potamogeton amplifolius*. This plant is abundant at the Weedpatch, and forms large noteworthy patches near Norris Inlet, southwest of the Kettlehole, east of the Gravelpit, east of Arlington Hotel, and in scattered localities through Outlet Bay. Along with other pondweeds whose leaves come in masses near the surface, the resistance which the foliage of this plant offers to water in motion has a marked calming effect on small waves, and at times when most of the lake surface is well-rippled the Potamogeton patches are marked by areas of calm.

*Potamogeton natans*, like *P. amplifolius*, forms pretty well-marked and conspicuous patches. These are all rather close to shore, consist of only a few plants, and occur most frequently in the Norris Inlet region. With the exception of the species of Chara, some of which grow over large areas, and shore plants, such as bulrushes which will be considered later, these are about the only plants of the lake which form definite patches. The gen-

eral locality where other species grow will be taken up in discussing the various species.

While considering the question of permanence and position of plant-patches in the lake it may not be out of place to refer to unattached plants, including the floating duckweeds, and of course, the alga-masses, but more especially those anomalous forms which have no roots developed, such as Ceratophyllum and Utricularia. There is nothing among land plants which is analogous to them. The tumble-weeds suggest them somewhat, but the disassociation of the tumble-weed from its roots is for the sake of great motility and distribution of seeds, while the Ceratophyllums and Utriculariias are loggy, hardly affected at all by currents of air and little by currents of water. They really appear to be forms of immensely overgrown propagating buds, and, although they produce seeds, are themselves largely propagated by vegetative reproduction.

In entering upon the discussion of the several species of plants which inhabit the lakes, it has been thought best to take them in the order in which they occur, first disposing of the floating forms, and then beginning with those inhabiting the deeper waters, and proceeding from thence toward the shallow water. The usual method of taking plants in the order of their supposed relationships has been avoided, chiefly because they occur in that order in the general list accompanying this report, and partly because the question of genetic relationship is not here the one primarily under consideration. It was thought best to begin with the center and proceed centrifugally, because there is no doubt of where to begin here, while beginning at the shore would leave no definite starting point. Considering species in the order suggested, moreover, will present them in the societies in which they occur as nearly as that can be done.

The floating aquatics, including the rootless phanerogams, Ceratophyllum, the various species of Utricularia, the minute floating duckweeds, and the unattached algal masses, such as Spirogyra, Mougeotia and the like, form a class by themselves. Ecologically, they belong in the group with the plankton. Theoretically speaking, these plants have no local habitation but drift hither and yon as currents and winds drive them. As a matter of fact, they are not so continually in motion as one might imagine, the algal masses often becoming tangled in the tops of the rooted plants, the loggy submerged Ceratophyllum and Utricularias responding very little to winds, and the duckweeds occupying nearly the same position year by year in the sheltered nooks. The duckweeds are always

found rather near shore, but the other plants are found throughout the lake at nearly all depths.

The strictly aquatic plants living within the borders of the lake, being an essential part of the environment of the fishes and other denizens of the lake, were studied in considerable detail. During these studies one of the salient facts that impressed itself continually upon the mind was that the different plants of the lake were aquatic in different degrees.

Taking the large genus of pond weeds or Potamogetons, for instance, we have among them a number of forms with all the leaves fitted only to under-water life, and so constituted that upon exposure to the air they crumple up and perish almost as soon as does a fish out of the water. One of the most pronounced species of this type is the handsome *P. robbinsii*, which lies nearly flat on the bottom, and has become so thoroughly and completely aquatic that it rarely or almost never even ventures a flower-spike up out of the water, but depends almost entirely upon vegetative buds for propagation.

The large-leaved pondweed, *Potamogeton amplifolius*, on the other hand, has two well-marked kinds of leaves—thin, almost transparent submersed leaves, and thick, leathery floating leaves. It has a well-developed flower-spike which projects prominently above the surface of the water.

Finally, in *Potamogeton natans*, we have a form in which the submersed leaves, though present, are small, undeveloped, and only temporary, the leathery floating leaves being the most prominent and functional ones. Indeed, where these plants grow near shore they are frequently stranded on mud-banks by the receding of the water, and there develop into mud-plants rather than aquatics, with stiff aerial instead of leathery floating leaves.

Another case is that of the water star-grass, *Heteranthera dubia*. This frequently grows in several feet of water, entirely submersed, and very closely resembles some of the narrow-leaved forms of Potamogeton. In this situation it rarely flowers. Sprigs broken off by the waves and cast ashore, however, quickly strike root, bear firm aerial leaves, and produce numerous pretty yellow flowers.

Again, we have one of the species of arrowhead, *Sagittaria graminea*, the leaves of which form a close rosette at the bottom of the water, these leaves being strictly aquatic and the whole plant, when not in flower, hardly distinguishable from a strict aquatic in all its relations, the seven-angled pipewort, *Eriocaulon septangulare*.

Two more noteworthy instances occur to mind. At certain places along shore there is found growing in the water a plant which in leaf-form and general habit, resembles *Potamogeton natans*, but which is really a smartweed bearing pretty spikes of pink blossoms; and finally in the waters of the lake among the pondweeds and milfoils one finds a most remarkable plant which has whorls of dissected leaves and bears a considerable resemblance to some sort of milfoil or a close resemblance to the aquatic form, Cabomba. This plant upon blossoming and fruiting proves to be a species of bur-marigold.

It will occur at once to the reader that the region along the shore-line is an excellent place to study evolutionary forces at work, and the question of the possible relations between the shore plants and the aquatics will at once arise.

In the temporary woodland ponds the changes of form of plants to suit conditions is much more striking, but not so deep-seated. Here we have the remarkable water-parsnip, which in early spring when the pond is full of water, is a rosette of purple; finely-dissected leaves appear, but later as it shoots up, its stalk puts out leaves more and more nearly entire as it approaches the water-surface until the aerial leaves of the same plant that bore collapsible submersed leaves below, are firm and almost entire. A water crowfoot of the ponds changes the shape, texture, and general aspect of its leaves so much after the water dries that it looks like an entirely different plant. And the woodland pond and the lake edge each has its own species of Riccia that have parallel changes and land forms entirely different from the floating form.

A contemplation of these facts arouses speculation as to the relationship and origin of the land and water floras. Consciousness of the great adaptability which plants possess, and the recognition of a greatly modified bur-marigold and smartweed among the members of the water flora, cause us naturally to expect some genetic relationship between the plants on land and those in the lake. In this expectation we are disappointed. With the two exceptions given above, the aquatic plants belong not only to strictly aquatic genera but usually also to strictly aquatic families and perhaps orders. Zoological and botanical systems are so unlike that it is impossible to make exact comparisons, but, generally speaking, the plants of the lake are about as far removed in relationship from the plants of the land as the fishes of the lake are from the animals of the land. And yet we recognize among the plants tantalizing similarities.

The flowering plants of the lake evidently arose from terrestrial

ancestors and stand in the vegetable world much where whales do in the animal kingdom. The mechanism of fertilization among the phanerogams is not at all adapted to aquatic life and generally special devices have to be arranged to bring it about, such as the breaking off and floating of the staminate flower and elongation of the flower-stalk or flower-tube of the pistillate flower as in Vallisneria and Philotria. Few of the aquatic plants bear conspicuous flowers, the water-lilies being notable exceptions, and none bears fruit in the garden or horticultural sense of the term, that of the water-lilies again being the closest approach to it. The problem of just how the blossom of the hornwort, Ceratophyllum, is fertilized we have not solved; probably the plants float at the surface during the flowering season. Of the phanerogams in the lake, Naias seems to have solved the problem of under-water fertilization, although we do not know how this is accomplished. It is, therefore, the furthest removed from the land series. Two of its relatives not found in the lake, Zannichellia and Zostera, flower and fruit under water, the latter by the development of a peculiar glutinous, stringy pollen.

## THE ALGÆ

### Introduction

With the exception of the Characeæ, which stand rather in a group by themselves, the algæ do not as a whole form a very conspicuous part of the flora of the lake, the waters out from shore being generally pretty free from forms that would attract attention. This is in keeping with the character of the lake, it having few capes or bays, relatively little shore and considerable deep water. A luxuriant algal growth is generally associated with much shore-line or shore conditions, large areas of shallow water and rich, muddy or leafy bottom. The various ponds about the lake in their proper season are richest in algal growths, some of them so much so that after they have dried in summer their place is covered by almost a single immense white sheet of paper—the bleached-out mats of algæ which once covered the water surface. Lost Lake taken as a whole is richer in the coarser forms of algæ than Lake Maxinkuckee. However, in the larger lake, along shallow or sheltered stretches of shore with rich bottom, as in the neighborhood of the Inlet and Outlet regions, Aubeenaubee Bay and the artificial channel by the Medbourn ice-houses the filamentous forms originally grew in great abundance and very luxuriantly, furnishing hiding places and a good deal of food for the

great number of turtles that dwelt among them. Some of the algæ are to be found the year round, especially where there are springs which keep the water abnormally warm. Others as Draparnaldia (which is rare in the lake) and the diatoms thrive more in cold water and appear in the greatest abundance during the winter.

The coarser filamentous algæ function in the lake as the higher plants do, i. e., they help oxygenate the water and serve as food and shade for fishes. Various insect larvæ and probably most of the smaller herbivorous fishes, as well as some species of turtles, use them for food. At times they, along with fragments of larger plants, are washed upon the shore where they decay, forming a soft black mud.

More important, but generally less conspicuous, are the minute algæ barely visible to the naked eye and including many of the blue-green colonial forms, the diatoms, desmids, etc. By far the greater number of these minute forms, like the coarser algæ, stay near shore, either because they are attached to or generally more or less entangled, among other growths, or, to sum up all in one sentence, because they find the best conditions for life there. These are the so-called limnetic forms. Others, however, stray far out from shore and are driven hither and thither by the winds, waves and currents; these form the vegetable part of the plankton or phyto-plankton and affect the lake in various ways. They give the water, in a certain sense, its optical quality, just as minute specks of dust and motes give the air what might in an artistic sense be called its "atmosphere"—its blueness or grayness and so on. Moreover it is upon these plankton algæ that the newly hatched fish all feed, either directly or indirectly, by feeding upon the small animals that feed upon it; and again when the plankton algæ become too abundant they rise to the surface and form a disagreeable and ill-smelling scum which appears to affect some people who "go swimming in dog days" much as a mild case of ivy poisoning might. And they render the water of some reservoirs so rank and unpalatable that they become a nuisance for which dosage of the affected water with copper sulphate was devised as a remedy.

The free floating forms of algæ were collected by means of various sorts of plankton nets, one so constructed as to take vertical hauls showing the vertical distribution of the organisms captured, the others, towing-nets taking horizontal hauls along the surface. Many of the algæ, especially the coarser ones, along with attached or entangled diatoms and desmids were collected by hand along shore. The charas were all gathered by hand or dredge.

The algæ obtained by the plankton hauls of 1899 and 1900, along with a few others collected by hand were identified by Dr. George T. Moore, then associated with Dartmouth College, later of the U. S. Department of Agriculture, now the Director of Missouri Botanic Gardens, and the originator of the scheme of keeping the algæ within bounds by the use of copper sulphate.

A part of the diatoms collected in the plankton hauls of 1901, as well as various samples of hand gathered material, were identified by Dr. Albert Mann then of the U. S. Department of Agriculture, now of the Carnegie Institution of Washington. Some of the alcoholic Characeæ material sent along with the plankton were identified by Dr. George T. Moore, while much of the alcoholic and all the dried Chara material was kindly identified by the late Prof. C. B. Robinson of the New York Botanic Garden. We wish here to express our appreciation of the assistance so generously renedered by these specialists.

During the summer and autumn of 1906 a fair number of towings and hand collections were made, 113 in all, in all sorts of conditions, chiefly about shore. This material has been very hastily examined and a number of the more easily recognized forms identified, leaving a large number of the more critical species untouched. Much of the coarser algæ obtained were unfortunately sterile, and the species accordingly problematical; they show a great diversity of species and suggest a very interesting and fruitful field for collection and research.

The collections taken in the various plankton hauls of 1900 and 1901 are so very similar that a general statement will suffice, leaving any individual peculiarity to be considered in the discussion of the species.

The following are the most abundant plankton species, having been taken in almost every haul: *Lyngbya aestuarii* Liebmann, *Coelosphaerium kentzingianum* Naegeli, *Anabaena flos-aquae* Brébisson, *Eremosphaera viridis* de Bary and *Ceratium macroceras* Schrenk. Among the less common forms are *Pediastrum boryanum* Meneghini, occurring in seven hauls, *Oscillatoria tenuis* Agardh, taken once, *Peridinium tabulatum* Ehrenberg, taken twice, and *Chlamydomonas reticulata* Gorosch, taken three times. The species represented are rather few in number, and the work of examining the material may be aptly described as monotonous. In the discussion of the algæ, the plankton forms are not discussed separately, but are considered along with other species that do not enter into the plankton.

## ANNOTATED LISTS OF SPECIES

### THE GREEN ALGÆ, ETC.

#### 1. CHROCOCCUS TURGIDUS (Kuetz.)

This is not a plankton alga, and occurs under such circumstances that it can not be obtained by wholesale methods. It was obtained only once, in hand-gathered material along the shore of the lake, along with such forms as Œdogonium, Bulbochæte, etc. Its natural habitat is in springs, and it is probably fairly common about the edges of the lake and the numerous springy places.

#### 2. GLOEOCAPSA MAGMA (Bieb.)

Encountered only occasionally, especially in the stomachs of mussels obtained along the shore of Lost Lake.

#### 3. GLOEOCAPSA POLYDERMATICA Kuetz.

Forming a crinkled, gelatinous blue-green mass near Culver, August 30, 1906.

#### 4. MICROCYSTIS AERUGINOSA Kuetz.

This species, which is excessively abundant in Winona or Eagle Lake, Kosciusko County, is rather scarce in the plankton of Lake Maxinkuckee; a few colonies occasionally found in some of the towings near shore.

It is probably more abundant in Lost Lake—a shallow lake with muddy bottom more like Eagle Lake in character. A note of September 7, 1908, says: "It is this which makes an exceedingly fine granular scum, easily thrown into fine lines; abundant on Lost Lake among rushes, and some on sand at the edge of the lake." It is very abundant in some of the weedy lakes north of Lake Maxinkuckee. At the latter lake it is very frequently encountered as an element of mussel food. This species is, perhaps, more widely known under the name Clathrocystis, the question of names being in this case a matter of opinion. West, with whose opinion we concur, says, "the three genera, Microcystis, Polycystis and Clathrocystis, are not sufficiently distinct to warrant their separation. The differences between them are only differences of degree."

#### 5. GOMPHOSPHAERIA APONINA Kuetz.

Not frequently obtained in towings or hand-gathered material, but a rather common element of the mussel food. The mussel makes one of the most efficient substitutes that could be utilized for a towing-net or plankton collector.

6. COELOSPHAERIUM KUETZINGIANUM Naeg.

A frequent element in the plankton, occurring in almost every haul, both the vertical and towing-net hauls. Along with much of the other plankton algæ it was a common element in the food of the freshwater mussels of the lake.

7. MERISMOPEDIA GLAUCA (Ehren.)

This is not a plankton alga and was usually found not far from shore. It was occasionally found in material collected in Outlet Bay not far from shore, and was taken in connection with Oscillatoria, Œdogonium, Bulbochaete, etc. This delicate plate-like form is not well adapted for preservation and is best recognized when fresh material is studied in the field.

8. APHANOTHECA STAGNINA (Sprengel)

Although very abundant in parts of the lake, this species does not enter into the plankton but remains lying scattered over the bottom, especially where it is peaty and firm, in the form of tough blue-green jelly-like balls about the size of peas or larger. Some was collected near shore August 29, 1900, and on the northwest shore of Lost Lake, September 4. When placed in a vial of fresh water it does not die and decay, as do most of the algæ, but retains its bright color and emits no odor.

The colonies remained unchanged through the winter and were frequently noted through the ice, lying on the bottom. In the bottom of Outlet Bay, a little way out from shore the ground, a tough, peaty soil, appeared to be covered with small pebbles from the size of hazelnuts to a trifle larger. Upon scooping them up they proved to be Aphanotheca. Some of the colonies were dark blue-green, others more brownish or yellowish. We know nothing of its relationships with the organisms of the lake.

9. RIVULARIA NATANS (Hedw.)

Rare in the lake; not found in the plankton, and obtained only once, in hand-gathered material from Outlet Bay, October 12, 1900.

10. RIVULARIA ECHINULA (Smith)

Rare; a little found tangled up in brown and blue-green filaments obtained from the south end of the lake, August 11, 1906. It resembles pretty much the *Rivularia natans* which is so abundant, free-floating, in Bass and Chapman lakes. One filament in the colony examined showed the saccate base of "Gloiotrichia" which, however, was not subdivided. The colony looks much like Apstein's figure.

11. RIVULARIA DURA Roth

Not a plankton-alga; obtained from hand-gathered material. The following is a note on the Weedpatch vegetation, August 28, 1900: "All these plants are covered thickly with Rivularia, some in quite large colonies. It was also found on Chara, collected the same date. On September 12 (1900) sticks in Lost Lake were thickly covered with globular brownish-black beads of Rivularia and bright green beads of Chætophora. A good deal of Rivularia was noted, attached to Potamogetons at McSheehy's pier, September 20.

Rivularia is one of the most abundant algæ in the lake, thickly dotting stems and leaves of water-plants with brown or blue-green hemispherical gelatinous masses about the size of a pinhead or somewhat larger. It is, indeed, at times difficult to find an example of water plant in the lake which is not more or less thickly dotted with these colonies. It is found the year round, but is probably more abundant in summer. It is never found free-floating in the lake. It is probable that fishes sometimes nibble it off the leaves, especially off the Chara where it stands out in bold relief. In the collections it appears associated with Œdogonium, Bulbochaete, Oscillatoria, etc.

12. RIVULARIA HAEMATILES Agardh

Like the other species, this is not a plankton alga; it is probably not common, and was obtained on only two occasions, once September 12, and again on September 29, 1900. We have no notes concerning it except the records of its occurrence.

13. CALOTHRIX FUSCA B. & F.

Not a plankton alga but obtained by hand-gathering along with Chaetophora, Cladophora, etc., and various desmids. Fairly common and well distributed near shore.

14. SPIRULINA JENNERI Kuetzing

Very common in a red, gelatinous coating on west shore by Chadwick's, August 13, 1906, with *Anabaena stagnalis* and Protococcus. The exceedingly slender filaments have a peculiar spiral appearance.

15. OSCILLATORIA TENUIS Ag.

Not common; obtained in one of the vertical plankton hauls and represented in four other collections. It was probably more common in the neighborhood of Norris Inlet. Floating, black, slimy masses, composed of Oscillatoria, may occur now and then in the lake, one such being observed September 12, 1900.

As a general thing the Oscillatorias grow on wet ground forming dense mats along the shores of rivers and lakes. With a sudden rise of the water they are lifted loose and float until they find suitable resting places. In August, 1906, Oscillatoria, probably this species, was observed forming a firm bottom stratum on the bottom where the road north of Green's marsh passes along the lake shore.

16. OSCILLATORIA MAJOR Vaucher

A large, stiff, straight Oscillatoria, probably this, was abundant (August 6, 1906) on mud at the edge of the lake and in shallow water, along the northeast shore of the lake where the public highway borders the lake.

17. LYNGBYA ÆSTUARII Liebman

The Lyngbya found at Lake Maxinkuckee is the form described by Walle as *L. obscura*, which is regarded as a synonym of *æstuarii*. It is an almost constant element in the vertical plankton hauls made at the stations. While not generally conspicuous in the plankton scum it sometimes collects pretty thickly along shore in sheltered places, among rushes on calm days. It is not nearly so common at Lake Maxinkuckee as at Winona Lake near Warsaw, where it was seen diffused through the water in great quantities, resembling stiff hair-clippings.

In addition to being obtained in the vertical hauls, this was often taken in the towing-net; it was also often simply skimmed off of the surface of the lake when it formed masses of scum along shore. In this manner quantities were obtained August 28, 1900, and again on August 29, the material obtained August 29 being dark brown in color, due to its condition, the sheaths frequently projecting beyond the cells, some of the latter having escaped. August 31, 1900, large patches of blue-green scum washed up against the west shore of the lake proved to be composed of this. On the afternoon of September 1, large, brown filaments of this were found covered with diatoms. On September 4 there was a brown scum near Arlington Hotel composed of this, Anabæna, Microcystis and Statoblasts. A thick scum was also observed September 13 and 18. None was observed during the spring of 1901, it being more abundant and conspicuous in the autumn. In the late summer and autumn of 1906, hauls were frequently made with the towing-net from the Chadwick pier across to the ice-office. On July 26, when first observed, it was noted as not rare in a scant haul made. It was actively forming hormogonia, or breaking up into reproductive fragments, but not present in appreciable quantities in the lake.

On July 28 it was still scarce. By August 8 it was abundant, a large quantity being obtained in a towing in Outlet Bay. It was noted again on the 16th. On August 21, on a visit to Winona Lake, a towing was made and it was observed that filaments there were longer and more abundant than at Lake Maxinkuckee. On September 28 the plankton taken in Outlet Bay was a dirty brown fibrous mass, composed mainly of the empty sheaths of the filaments of this species, the interior cells having mostly escaped to make new independent colonies or filaments. By noon of the same day the quantity of this species had so greatly increased in the lake that it was evident to the eye. On September 5 it was still forming hormogonia.

The stomach of a small painted turtle examined in September, 1906, contained Lyngbya in such quantities that it must have been taken in intentionally, although it is difficult to explain where the turtle had obtained so much. Examinations of the stomachs of these turtles have shown that they partake largely of various algæ; indeed, algæ seem at times to furnish the turtles' main diet.

The rapid increase of Lyngbya during the late summer and early autumn months is due to its excessively rapid reproductive process which is simply the slipping out of short portions of filaments and occasionally single disc-shaped shells from the sheaths of the old filaments.

We know little about the part this species plays in the economy of the lake. It never appears, even in its greatest abundance, to become a positive nuisance. Entomostraca may, and mussels do, feed upon the shorter filaments, but the longer filaments are unhandy for most of the plankton-consuming organisms except the painted turtle.

#### 18. APHANIZOMENON FLOS-AQUÆ (Linnæus)

On August 4, 1906, some was taken with the No. 2 towing-net in front of the ice-office. Taken also in Lost Lake, but it does not appear to be common.

This is the most common plankton element in some of the lakes of Minnesota and is abundant at times in the upper Mississippi. The waters of reservoirs sometimes seem almost thickened with it.

#### 19. ANABÆNA FLOS-AQUÆ Bréhisson

This is the most abundant plankton species of the lake, it having been taken in almost every haul of the plankton net during 1899 and 1900.

During 1900 and 1901 plankton-scum quite frequently accumu-

lated along the shore in sheltered places, usually in rather small amounts, however. It was only occasionally collected and only a few notes were made concerning it. Anabæna was almost always present, but apparently did not make up the main mass.

During the summer of 1906—a calm, dry summer—the plankton-scum was present in unusual abundance and was made up chiefly of this species. It was frequently examined, so that the species was under pretty continuous observation for that year, and its history is nearly the same as that of the scum in general.

On July 30, 1906, on a trip to Norris Inlet it was noticed that the water of that region was full of diffused minute blue-green flecks. Hauls were made with the towing-net but nothing was obtained but duckweeds. The fine, flocculent material was probably Anabæna. It was found later that it readily strained through the finest towing-net on hand.

The next day the water of the lake seemed full of suspended algæ. A towing was taken in the morning from Long Point (Chadwick's) to the office, and many entomostraca were taken, but the small algæ escaped. At noon the water by the office seemed very full of the same material and dips were taken with the fine net, but nothing much was obtained; the fine algæ again escaped. In the afternoon of the same day a fine blue scum, the first of the year, was observed in a minnow-box. This was secured by dipping with a vial, and proved to be Anabæna. About 2 o'clock the scum was quite pronounced, first in a ditch-like artificial channel (boat slip), dug into the shore in the south side of Outlet Bay, the excavation being 15 or 20 feet wide, and 80 to 100 feet long, forming a calm, sheltered harbor. Somewhat later in the same day, the scum gathered thickly in front of the office, and was collected and examined.

In this particular instance the appearance was somewhat different from usual; the scum was composed of minute dark green balls in active motion, somewhat resembling minute colonies of Volvox except for the darker color. On examination the material was found to be composed of dense balls of tangled Anabæna filaments, almost every ball surrounded by a halo of attached Vorticellas, the contractions of which had caused the motions of the mass. The appearance of the balls with the radiating, jerking Vorticellas was quite striking.

From this time on until late autumn, scum composed mainly of Anabæna, was present in considerable quantities somewhere along shore every calm day, and on some days covered the whole lake more or less completely (August 6 and August 7). It frequently

occurred on the surface ranged in fine parallel lines, into which it had been thrown by undulations of the water surface.

Anabæna, after having been often seen, can easily be distinguished in the water by the naked eye, its peculiarities of color and structure rendering it distinguishable from the other plankton-algæ. Both its appearance in mass and its microscopic appearance differ somewhat under different conditions. Soon after coming to the surface and forming a scum, especially after forming a dense scum along shore, it changes in color from dark blue-green to very pale blue, and the dense, tangled balls disintegrate into single coiled filaments. In many cases great, thick masses were formed along shore, especially in the bay southeast of the Academy along the road, and then the algæ apparently died. The water in the vicinity became whey-like in appearance, and the mass had a rank vegetable odor, so persistent that it remained after the addition of considerable formalin to vials containing the specimens. A vial of the live material placed in the hot sun appeared to die soon; the water became decidedly milky and the cells became colorless.

As the alga is known to disappear during the winter, close watch was kept of the scum during the later part of the season to observe what became of it. Late in the autumn it was found to have sunken to the bottom along shore and was being covered up by the forest leaves which fell into the water and sank to the bottom.

So far as observations go, it is not known whether this species furnishes much food to the various animals of the lake or not. It is a form which would be difficult to recognize in the stomach of any animal, as the teguments are thin and the cells quickly separate from each other, their attachment being weak.

Because it forms a scum on the surface of the lake and along shore, this plant is to some slight extent a nuisance. Its presence in great profusion, as well as its unpleasant odor, detracts somewhat from the appearance of the lake. There is a prevalent notion about the lake that the plankton-scum is poisonous, the effect of it being to produce intense itching where it touches the skin. No cases were observed, and no unpleasant sensations were experienced, however, and the few cases heard of which could be reasonably authenticated might very likely be attributed to some other cause, or to especial sensibility of the persons affected.

Its exceptional abundance during the summer of 1906 was followed by an exceptional abundance of entomostraca in the autumn of the same year, and it is possible that there was some connection between the two.

Apstein (Süsswasserplankton, p. 136) gives a figure and notes on the life history of this species. He found it abundant in various places examined. He says nothing of its being eaten by pelagic organisms. In his description of its wintering over he says: "At the end of summer the spores are formed in abundance, which sink to the bottom and here rest until the next spring. Many are naturally eaten by the animals of the bottom, since in them the nutritiveness is much concentrated."

His figure shows numerous Vorticellas intermixed with the filaments; it is probable that the same relation exists between them here as above noted.

#### 20. ANABÆNA STAGNALIS Kuetzing

Common in a red film or scum coating the wet shore by Chadwick's, August 13, 1906, along with *Spirulina jenneri* and Protococcus. Some of the filaments were much knotted and coiled.

#### 21. ANABÆNA SACCATA (Wolle)

Off Assembly grounds, August 8, 1906, collected by hand; forming finger-like lobate blue-green masses in great abundance in shallow water near shore. Quite unlike the other species of Anabæna, and put in a different genus by different authors,—West in Anabæna, Wolle in Sphærozyga, and Bornet and Flahault in the genus Wollea.

#### 22. NOSTOC VERRUCOSUM Vaucher

Not a plankton alga, but represented by hand-gathered material. Green's marsh and the quaking, boggy plain west of Lost Lake contained an abundance of Nostoc in the form of beads of blue-green, at times almost black, firm jelly ranging from the size of a pinhead up to nearly the size of a hazelnut. On March 23, 1901, a film of this material was noted in Green's marsh, and on March 25 in the same place old Nostoc balls were noted shrivelled up, looking much like dried grapes. Almost any time of the year these globular colonies of Nostoc can be found in abundance near the moist base of grasses and sedges in the flat, sedgy plains about the lake.

#### 23. TOLYPOTHRIX TENUIS Kuetzing

Not a plankton alga, and not obtained in the lake, but procured in the bottom of the woodland ponds, along with Draparnaldia, Tetraspora, etc., in hand-gathered material. Probably common in the woodland ponds where algæ of many forms luxiuriate on the bed of old leaves forming the bottom of the pools.

24. BOTRYDIUM GRANULATUM (Linnæus)

Noted growing abundantly on the surface of cracking, moist mud at the shore of one of Zechiel's ponds, the plants having the appearance of small green shot.

25. TRIBONEMA BOMBYCINUM (Agardh)

Abundant along shore and common in numerous shore collections along with Hydrodictyon, Spirogyra, Œdogonium, etc., probably helping form the great mass of algæ along the shore near the Outlet.

26. TETRASPORA LUBRICA (Roth.)

Not found in the lake at all but very abundant in spring in woodland ponds on the dead leaves which formed the bottom, where it was collected by hand (April 27, 1901), along with Draparnaldia, Tolypothrix and Zygnema. Our material was from a small pond near Farrar's. It is probably common in parts of the lake at certain seasons.

27. BOTRYOCOCCUS BRAUNII Kuetzing

Quite abundant in the plankton scum during the summer and autumn of 1906, mixed in with a great amount of *Anabaena flos-aquae* which formed the main mass. The colonies were of two colors, yellowish green and bright red. On account of its vivid color and commonness the plant excited an unusual interest and it was studied somewhat in detail. The following notes were made: Colonies rather solid, irregularly lobed masses, a rather large colony measuring 250 x 120 mic. Margin of colony with minute but bluntish, sometimes clavate, projections. In fresh material the structure of the colony is difficult to make out satisfactorily on account of the diffiused red color which renders it opaque. A colony of formalin material was kept in a moist chamber for several days and much of the coloring matter dissolved out in the form of oil-like orange-red drops, leaving the margins of the thallus paler.

The thallus was then seen to be a firm mass containing rather widely separated oval or ovate lacunæ (diameter of lacunæ 7-10 mic. separated by spaces 7-10 mic. wide). The vegetable cells had escaped from the lacunæ and were ovoid or pear-shaped, measuring about 7 mic. across the short axis and 12 mic. along the long axis. No cilia were visible.

On account of its vivid color this species can be recognized quickly among heterogenous material. It appears to be eaten in considerable amounts by various entomostraca, the stomach contents of which are colored red by it.

28. DICTYOSPHÆRIUM EHRENBERGIANUM Naegeli

Not a plankton form; staying near shore and obtained in hand-gathered material along with Oscillatoria, Rivularia, Œdogonium, etc. It occurs in only one sample.

29. TETRAËDRON MINIMUM (A. Braun)

Common among material found in the contents of mussel stomachs along with Scenedesmus, Pediastrum, etc. On account of its small size it is easily ingested by the mussels.

30. CHORELLA sp.

Common, associated with Ophrydium, which is one of the most abundant protozoans in the lake.

31. EREMOSPHÆRA VIRIDIS de Bary

A common element of the plankton occurring in most of the vertical hauls at the established stations. It is said to be "a constant associate of certain desmids" in the British Isles, where it is especially common in Sphagnum bogs.

32. ANKISTRODESMUS sp.

Various forms of Ankistrodesmus are common elements of the mussel food. This genus is perhaps better known under the name Rhaphidium.

33. SCENEDESMUS ABUNDANS Kirchner

Various forms of *Scenedesmus*, especially *abundans* and *obliquus*, as well as numerous forms for which no descriptions or figures could be found, were abundant elements of mussel food. Indeed, along with Pediastrum, they may be regarded as the most characteristic elements of the mussels' bill of fare. They were especially common in Lost Lake.

34. SCENEDESMUS OBLIQUUS (Turpin)

Common in towings taken near the shore.

35. CRUCIGENIA TETRAPEDIA (Kirchner)

Rare; only a few colonies seen mixed up in collections of minute algæ. Its striking appearance, a flat plate composed of an aggregation of minute green maltese crosses arranged in regular order, attracts attention at once.

36. SORASTRUM sp.

Not a rare plankton element along the edge of Lost Lake, where it is occasionally taken in as food by the mussels.

37. CŒLASTRUM MICROPORUM Naegeli

Common in plankton hauls along shore, and a frequent element in the material forming the food of mussels.

38. CŒLASTRUM SPHÆRICUM Naegeli

Probably common along shore and quite frequently found in the algal mixtures taken from mussel stomachs.

39. PEDIASTRUM BORYANUM (Turpin)

Occasional but not abundant, occurring in a number of the vertical plankton hauls and now and then in towings along shore. Usually only one or two taken in a gathering. The mussels are the best collectors of Pediastrum, almost every stomach examined containing from one to several examples.

40. PEDIASTRUM DUPLEX Meyen

Occasionally taken in towings near shore. Variable in length of horns, etc. Characterized by the perforate disk. Like the other Pediastrums it appears to be a favorite food for mussels; indeed, the best way to obtain examples of Pediastrum is to examine the intestinal contents of mussels which almost always have present representatives of some of the species.

41. PEDIASTRUM EHRENBERGII (Corda)

Not common; a good example obtained among algæ in the Outlet near the bridge on July 23, 1906, among the marl-like blue material. In general form the example found agrees with Wolle's figure (Desm. U. S. Pl. LIII, fig. 25) of the 4-celled phase of this species, but differs markedly in the inner cusps of the cells, which are bluntish. Diameter of the cœnobium 18 mic. It is probably the young of the variety represented by Wolle's fig. 27. A peculiar form of what appears to be this species is rather common in the lake, and reaches a large size. Its most striking peculiarity consists in having the interior cells of the colony retain their horns in a rudimentary form so that each cell has a markedly concave side. This form is most frequently found along shore where the bottom is shallow and the bottom more or less a black mud, as at Norris Inlet and the Outlet.

42. HYDRODICTYON RETICULATUM (Linnæus)

Not taken in plankton but represented in a hand-gathering along with Spirogyra, Œdogonium, etc. Not especially common about the lake; indeed, not so common as one might naturally expect, but

found growing quite abundantly and constantly in the mouth of the small creek under the railroad bridge at Culver. In its habits of reproduction one of the most striking of the algæ, not differing in manner from Pediastrum but on such a large scale that the phenomenon is striking, the whole mass giving birth to minute colonies, the adult form in miniature. In time of freshets, these minute new-born colonies may be washed out a considerable distance into the lake when they become a part of the plankton, but their normal habitat is near the shore of lakes, although they may cover thickly the entire surface of small ponds, forming dense masses.

In 1906 (July 21) it was noted as being very abundant near Chadwick's.

13. GONIUM PECTORALE Müller

Not common; one example found in the Outlet, August 13, 1906, a 16-celled colony. Diameter 38 mic., individual cells 10 mic. in diameter. Cœnobium in active motion when observed.

14. CHLAMYDOMONAS RETICULATA Gorosch

Occasional in plankton hauls in July and August; found in the plankton far out in the lake.

15. DESMIDIUM SCHWARTZII Agardh

Rare in the lake, obtained only once in a shore gathering of heterogeneous material.

16. DESMIDIUM QUADRATUM Nordstedt

Common in Hawk's marsh where it grows among other filamentous algæ in the form of long filaments. Obtained September 14, 1906. Almost all algal gatherings from Hawk's marsh contained this form in abundance.

17. STAURASTRUM BREBISSONII Archer

Taken in several plankton hauls and evidently found farther out from shore than most desmids. A fairly common element in mussel food.

Several other forms of Staurastrum were encountered in the mussel food, but were not identified.

18. COSMARIUM GRANATUM Brébisson

Only a few obtained in shore gatherings of miscellaneous material.

19. COSMARIUM LATUM Brébisson

Obtained in a mass of weeds (Naias and Chara) collected at Long Point, near shore, July 24, 1906.

50. COSMARIUM INTERMEDIUM Delponte

Found in some fine, fibrous material obtained at the ice-houses, July 23, 1906, the material being gathered for the rich amount of diatoms it contained.

51. COSMARIUM SUBCRENATUM Hantzsch

In a mass of tangled Cladophora collected along shore.

52. MISCASTERIAS TRUNCATA SEMIRADIATA Naegeli

A fine example obtained from the south end of Lost Lake, July 30, 1906, along with various diatoms, Pediastrum and Scenedesmus. An unusually handsome desmid.

53. DOCIDIUM VERRUCOSUM (Bailey)

Apparently rare. Obtained only once, in a collection along shore.

54. CLOSTERIUM DIANÆ Ehrenberg

Frequent in surface plankton hauls near shore, especially in the region of Norris Inlet.

55. SPIROGYRA CONDENSATA (Vaucher)

Obtained in several hand collections along shore with Hydrodictyon, Œdogonium, Ulothrix, etc. Found in fruit in autumn.

The genus Spirogyra is represented by numerous species in and about the lake. Sterile filaments could be obtained abundantly at all times of the year. Lost Lake, the Inlet region, Outlet Bay and Culver Inlet on the Academy grounds were luxuriantly overgrown with filamentous algæ of all sorts, the growth in the Academy grounds being especially luxuriant. Attempts were made to procure as many species as possible, but the difficulty of obtaining fruiting specimens, especially with the pressure of other work and interests, made it impossible to get a representative collection. The task of making a complete or anything like a complete collection of these algæ is a great deal different from that of collecting floating forms where such wholesale methods can be used as towing-nets, etc., and would require the undivided attention of a specialist.

In the economy of the lake, the coarse filamentous algæ belong rather with the pondweeds than with the plankton. They are probably eaten to some extent by herbivorous fishes, and certainly furnish a good deal of turtle food, especially to the painted turtles, which feed upon them to a considerable extent.

There is, perhaps, a darker side to their case. One of the dwellers of the lake region called them "malaria." We found that Chironomus larvæ eat them greedily and in all likelihood mosquito

larvæ also. Whether their great abundance goes hand in hand with the prevalence of malaria is a question yet to be investigated.

Sterile filaments were collected with a diameter of 29 mic. and length of cell of 174 mic.; probably *Spirogyra quadrata;* another with a diameter of 33 mic. and length of 140 mic. with 3 spiral bands; another with the cells measuring 35 x 105 mic. with only 1 spiral band; a fourth with cells measuring 65 x 205 mic. and 2 spiral bands; a fifth with cells 80 mic. in diameter and 75 mic. long and 2 bands; a sixth with cells measuring 70 x 125 mic. and 4 bands; a seventh with a diameter of 70 mic., cell-length 200 mic. and 3 bands; an eighth with cells measuring 125 x 220 mic. The coarse Spirogyras of Lost Lake were noted conjugating in early spring and a special trip was made a few days later to collect them but they had produced spores, disintegrated, and dropped to the bottom.

Among many forms of Spirogyra noted at the lake which could not be identified satisfactorily on account of having not been in fruit, the following may be mentioned:

#### 56. SPIROGYRA MAJUSCULA

Common along shore by the ice office; frequently left in pools along the shore by the receding water. The filaments left in the pools soon conjugated and formed fruit. Found with ripe spores August 7, 1906.

#### 57. SPIROGYRA MIRABILE Hass

Found conjugating among a lot of fine filamentous algæ gathered by hand along the east shore of the lake, August 8, 1906.

#### 58. ZYGNEMA sp.

Zygnema is fairly common in the lake during the summer. Most of our species are more slender than Spirogyra and form yellowish green masses floating far out in the lake, and not clinging closely to shore as most Spirogyras do. It was common in Lost Lake and abundant in the shallow water near the ice-houses.

None was found in fruit.

#### 59. MOUGEOTIA sp?

This was quite abundant, especially in the shallower portions of the lake, as in Outlet Bay and Lost Lake. Sometimes it grew abundantly in great masses in the bottom, attached or rather tangled up with short plants. Frequently it floated in large yellowish-green, loose masses. It seems to thrive best when the water is rather warm, though it often persists until late autumn, making

cloudy masses in the bottom in shallow water. In 1906 (July 24) considerable was seen in Lost Lake attached to plants, by being tangled up with them.

60. VAUCHERIA sp.

Abundant, forming thick, dark green, felted masses in the bottom of shallow ditches near the lake, and more especially on the surface of saturated ground near Overmyer's spring. Not found in fruit. There may have been several species. Not found in the lake itself.

61. CLADOPHORA FLOTOWIANA

Collected in the Inlet, July 30, 1906. Fruiting cells large and clavate.

62. CLADOPHORA GLOMERATA (Linnæus)

Abundant in the lake, forming dense tufts growing attached at the base to submersed stones along the shore; most abundant along Long Point and off from the Depot pier. The dense tufts furnish hiding places for numerous small larvæ, snails, beach fleas, caddis-cases, etc. Filaments are frequently thickly beset with the parasitic diatom *Cocconeis pediculus*.

63. PRASIOLA PARIETINA (Vaucher)

Found in a single shore collection of miscellaneous material, such as Utricularia, Conferva, Chaetophora, etc.

64. MICROTHAMNION sp.

A dichotomously branching slender alga, found abundantly in shallow water around the margin of Lost Lake in the spring of 1901, the basal portion being attached in the mud. It closely resembles West's figure of *M. strictissimum* Raben.

65. DRAPARNALDIA GLOMERATA (Vaucher)

Not found in the lake in great quantities but growing thickly on submerged dead leaves in the bottom of woodland ponds in the spring. Obtained from a pond near Farrar's, April 24 and 27, 1901. A considerable quantity was seen along a ditch west of the lake. It thrives best in cold water and for that reason is generally seen only early in spring. A little was collected in the lake May 25, 1901.

66. MYXONEMA RADIANS (Kuetzing)

Found in Norris Inlet, July 30, 1906, attached to Cladophora.

(As has been pointed out by Hazen, the familiar name Stigeoclonium Kuetzing should be replaced by the older name Myxonema Fries.)

67. CHÆTOPHORA PISIFORMIS (Roth)

Abundant in both lakes, attached to dead, submerged sticks, especially where the bottom is muddy but the water clear, forming little bright-green globules flattened on the attached side, closely resembling Rivularia with which it is associated, except in color in which it forms a distinct contrast. As it is an attached form it does not enter the plankton net.

68. CHÆTOPHORA INCRASSATA (Hudson)

Frequent on mucky or turfy bottom, especially common along shore in the neighborhood of the Inlet region. A long, irregularly, or dichotomously branching, ribbon-like bright green form resembling in shape the liverwort, *Riccia fluitans*. It is found the year round but is probably more abundant in the spring.

69. SCHIZOMERIS LIEBLEINII Kuetzing

Abundant in the region of Norris Inlet, attached to the submerged parts of bulrushes, water-lilies, pond lilies, etc. It stands in strong contrast with the other filamentous algæ of the lake by its complex multicellular structure. To the naked eye it bears a considerable resemblance to a coarse Spirogyra.

70. ULOTHRIX ZONATA (Webber & Mohr)

Common in a mass of fine blue-green algæ taken from the stems of the yellow pond lily *Nymphæa advena*, July 30, 1906.

71. ULOTHRIX TENUISSIMA Kuetzing

Obtained in hand-gathered material along shore August 30, 1900, along with Lyngbya, Spirogyra, and diatoms.

72. COLEOCHÆTE SCUTATA Brébisson

Found abundantly in the lake attached to fragments of drainage tile that were lying in 18 inches of water a little north of the ice offices. The plants were observed in August, 1906.

73. BULBOCHÆTE PYGMÆA (Pringsheim)

Fairly common in the lake attached to weeds and other algæ.

74. ŒDOGONIUM BOSCII (Le Clerc)

One of the most abundant of the attached algæ of the lake, growing abundantly on rocks and pebbles, and attached to submerged plants, forming a dense, lemon-green fine hair-like growth over the substratum. Although very common, its small size as compared with the Cladophoras and Spirogyras renders it rela-

tively inconspicuous. It grew very abundantly at Long Point, both on stones and weeds, and was found attached more sparsely to weeds in other places, as at Kruetzberger's pier.

At Long Point, after the water had retreated from the rocks where this alga had been growing, it died and bleached out, leaving a firm, linty covering on the rocks.

The specimens agree very closely with Wolle's figures of *landsboroughii*, but are considerably more slender than given in his description, the following being the measurements:

Length of cells 62 mic., diameter 22 mic., the younger being 55 mic. long and 20 mic. in diameter. Oogonium, diameter 45 mic., length 65 mic. Egg cell, diameter 30 mic., length 50 mic. Male filaments somewhat more slender. Spermogonia usually 7 or 8. The plants fruited abundantly during the summer, the oogonia being frequently two or three in succession, green when young, rich brown when ripe. Terminal cell blunt, opening of oogonium above the middle.

75. ŒDOGONIUM LONGATUM Kuetzing

A dwarf species, common at Long Point, attached to other algæ.

76. ŒDOGONIUM LANDSBOROUGHII (Hass.)

Common in filamentous material gathered for diatoms near Kreutzberger's pier, July 24, 1906. Male plants uusually called spermogonia common.

## THE CHARACEÆ

One of the first things to attract the attention of the visitor to the lake who is interested in the aquatic flora is the abundance and variety of the peculiar and attractive group constituting the Characeæ. The greater part of the shallow bottom of Lake Maxinkuckee from a foot or 18 inches to 8 or 10 feet, is covered with a stout Chara 8 or 10 inches high, yellowed or browned with an incrustation of lime and forming a dense mat over most of the bottom like a brown, subaqueous meadow.

A visit to Lost Lake but intensified the impression produced by Lake Maxinkuckee. The subaqueous meadow was lacking, indeed, but the shore was lined with various strange forms, some of them with a silky softness as compared with the harshness of most common forms, the plants bushy with an abundance of slender, delicate leaves and glowing with an abundance of red fruit, while in the depths of the lake, arising from the black mud, were long, slender, semitransparent forms, and others strong, robust and

bristly. In Green's marsh between the lakes other species throve, maturing their fruit early in the year in the shallow warm ponds.

The Charas form so important a part of the lake flora that no labor was spared in an attempt to get an abundance of specimens of all sorts in fruit. According to ancient custom much of the material was pressed and made into herbarium material, while other material was preserved in alcohol and formalin; which is the better way, it is, of course, for curators in museums to decide. The herbarium specimens fit in well with other botanical material and take up but little room, but some are so brittle that they usually break to fragments with but little handling.

The Charas are an important part of the life of the lake; by their abstraction of the lime from the water they do much to add to its softness, and by the deposition of that same lime on the bottom they do much to add to the marly bottom of the lake bed. They furnish hiding places for various species of fish, the madtoms and darters inhabiting them throughout the year, and the young bluegill, redeye, etc., hiding in them throughout the winter. A number of important animals used by the fishes for food, such as beach fleas, Asellus, etc., live among the Chara, and it is among the Chara patches that the bluegill, perch and various sunfishes usually stay during the spring months, feasting upon the abundant life to be found there. The ducks and coots, after the more delicate plants such as wild celery have been exhausted, feed upon the Chara.

The Characeæ were submitted to various specialists for identification, the herbarium material to the late Dr. C. B. Robinson, and the alcoholic material along with the plankton to Dr. George T. Moore. Many of the specimens on account of their variability were difficult to determine satisfactorily. Indeed, there have been so few workers in the field and relatively little material collected over the country generally that classification is exceedingly difficult. The following notes on the various species are given:

#### 1. CHARA CONTRARIA A. Braun

This is the most common Chara in the lake, forming the extensive meadows over the bottom. On account of its abundance it is the most important Chara of the lake. Because of its forming a brown carpet on the bottom of much of the lake, especially Outlet Bay, it was referred to in our notes as the "carpet Chara." On account of its heavy incrustation of lime, this Chara presented much the same appearance the year round, looking much as if dead. In the spring it sent up little delicate green shoots from the tips of the

branches. Its presence is so universal over the lake in shallow water that details of distribution need not be given, except that it grew best in a mixture of marl and sand, and was absent from very mucky or peaty places and from gravel and pure sand, as along the east shore. According to Dr. Robinson "this is a very polymorphic form, several of our specimens representing the common American form, a few being more robust and heavily encrusted, others unusually slender, and another form with very short whorls. Again, one specimen was peculiar in appearing, through hypertrophy of the secondary rows of cortex, to be triply corticated."

#### 2. CHARA FOLIOLOSA Mühlenberg & Willdenow

On the shore of Lake Maxinkuckee on the west side by Winfield's, and again extending from Long Point down to about Farrar's, there occurs in shallow water hardly a foot deep, an exceedingly handsome bushy Chara which bore fruit in such great abundance that the whole plant, upon a close inspection, had a reddish appearance. On account of this peculiarity we named the plant the "full-fruited Chara." Perhaps a better known scientific name for this plant among collectors is *Chara gymnopus* A. Br. a name applied because of the absence of cortication in the lower node. According to Dr. Robinson, Braun's name is preoccupied by the name given above.

The full-fruited Chara is an annual; it grows at a depth where the water freezes to the bottom; and even if it attempted to persist, it would be taken out by the ice. It usually disappears before ice comes, however, probably having exhausted itself by fruiting.

Various modifications or subspecies of this form, such as *Chara foliolosa macilenta*, and another resembling *Chara foliolosa conjugens*, are to be found along the shores of Lost Lake.

#### 3. CHARA FRAGILIS Desv.

This is the identification of a specimen obtained from Long Point near Scovell's. We have no record of its distribution but it does not appear to be abundant, and is usually dredged up with various lake weeds. It bears a considerable resemblance to the common carpet Chara of the lake, *C. contraria*, but is a more graceful plant, having longer leaves and a more slender habit.

#### 4. CHARA VULGARIS Linnæus

Represented in our collection by numerous examples. Found growing in water from 2 to 6½ feet deep. Inasmuch as we were unfamiliar with the various species of Chara at the time our collections were made, we have no details of its distribution.

5. CHARA GYMNOPITYS A. Braun

Common on the large quaking bog surrounding the north end of Lost Lake, growing almost out of the water. Rare in Lake Maxinkuckee, two examples being found near shore in the region of the green boathouse by Norris Inlet in the autumn of 1900.

This species is heavily branched, and is exceedingly soft and fine, of a delicate, bright green color. It fruits heavily, and is an annual, generally disappearing before frost.

6. CHARA SUBVERRUCOSA A. Braun

Occasional in the lake, represented in the collection by several specimens. Dr. Robinson says of these: "A majority of the plants appear dioecious, antheridia being very rarely found, but they are present in a number of cases."

7. NITELLA TENUISSIMA (Desv.)

An exceedingly dainty little Nitella growing in shallow water (1-3 feet) along shore in the neighborhood of Farrar's. The whole plant grows in rather dense tufts about 25 mm. in diameter. Color dark green; rhizoids not conspicuous, main stems many, exceedingly slender, internodes hardly more than 2 mm. long. Leaves in whorls making a dense, globular mass at each node, so that the plant looks a good deal like large Rivularia spheres attached to a slender stalk. These spheroids of leaves, or whorls, are larger and closer together toward the apex of the plants.

8. NITELLA BATRACHOSPERMA (Reichenbach)

One specimen from Lost Lake. Dr. Robinson says of it: "No. 1576 (578) agrees well both with the description and with named material in the Allen collection of *Nitella batrachosperma* (Reichb.) except that no trace can be seen of mucus in which the fertile verticils in that species are usually contained. Possibly therefore it may be *N. tenuissima* Kuetzing which is very similar, but the former alternative is greatly preferable."

9. NITELLA MUCRONATA A. Braun

A delicate species growing in the muddy bottom of Lost Lake. One of the most attractive species of the region. Abundant at Bass Lake.

10. NITELLA MONODACTYLA A. Braun

Reported from two specimens. We have no record of its distribution.

## The Diatoms, Etc.

One of the first things to strike the attention of any one interested in the flora of the lake, especially if he happen to visit it during the cooler season of the year, is the great abundance and variety of diatoms. The collector of the filamentous algæ, such as Cladophora or Spirogyra or of the various Characeæ, will find his catches overgrown with diatoms, and one of our earliest botanical notes concering the botany of the lake was, "The charas of Lost Lake are thickly covered with brown, boat-shaped diatoms." In the autumn of 1901 it was noted that the bottom of Aubeenaubee Creek was covered with a brown diatomaceous scum.

The diatoms prefer cold water and in the winter they thrive luxuriantly in the lake, forming a thick, gelatinous coating over the weeds.

During the summer, floating diatoms are not especially abundant in the lake, and do not form a conspicuous part of plankton obtained by surface-towing, this being composed mostly of blue-green algæ, or entomostraca, or both. During the colder portions of the year, in early spring and late autumn, that is in early April and late September, the free floating diatoms are much more abundant, largely taking the place of the blue-green algæ. On some days the towing in deep water would be chiefly entomostracan, resembling a soft, jelly mass, on other days they would consist chiefly of diatoms, and would have a harsh feeling and bristly appearance. For example, a haul of April 29 was nearly all diatomaceous. During the autumn of 1906, after towing all August, September and October, and getting little vegetable plankton but blue-green algæ, a haul on November 12 contained an abundance of diatoms. It is unfortunate that plankton was not taken by means of a pump or other device, during the winter; the probabilities are that the plant-plankton would have been almost all or entirely diatomaceous.

The various diatom gatherings were submitted to Dr. Albert Mann of the U. S. Department of Agriculture for his identification. The following are his notes:

"Sample No. 1. [*Cladophora glomerata* growing on submerged rocks, November 17, 1904]. *Cocconeis pediculus* E; *Gomphonema olivaceum* E; *Cymbella cymbiformis* E; *Cymbella maculata* Kuetzing; *Cymbella naviculiformis* Auerwald (variety); *Cymatopleura elliptica* W. S., *Cymatopleura solea* W. S., *Epithemia argus* Kuetzing; *Epithemia gibba* Kuetzing; *Navicula reinhardti* Grun; *Navicula gastrum* Ehrenberg; *Synedra obtusa* W. S., *Synedra radians* W. S. (variety).

This gathering is very rich in two species, both rather uncommon, the oval *Cocconeis pediculus* E., and the minute club-shaped *Gomphonema olivaceum* E.

Sample No. 2. [*Cladophora glomerata* with sponges, Depot grounds, November 22, 1904]. *Cocconeis pediculus* E.; *Gomphonema olivaceum* E.; *Gomphonema constrictum* E.; *Cymbella maculata* Kuetzing; *Epithemia argus* Kuetzing; *Epithemia gibba* Kuetzing; *Epithemia zebra* Kuetzing; *Cymatopleura solea* W. S., *Navicula gastrum* E.; *Synedra obtusa* W. S., *Synedra radians* W. S.

Similar to sample No. 1, but inferior in richness of the 2 species there named.

Sample No. 3. (Spirogyra, Outlet Bay, October 29, 1904). *Amphora ovalis* Kuetzing; *Cymbella cymbiformis* E.; *Epithemia gibba* Kuetzing; *Cocconeis pediculus* E.; *Gomphonema constrictum* E.; *Melosira varians* Ag.; *Fragilaria mutabilis* (W. S.); *Navicula gastrum* E.; *Synedra obtusa* W. S.; *Synedra radians* W. S.

Though this gathering contained species common to Nos. 1 and 2, it is quite different in composition, being particularly rich in species of Cymbella, Epithemia and Synedra.

Nos. 4, 5, and 6, unimportant as to contents of diatoms. No. 4. Spirogyra, Depot grounds, November 22, 1904. No. 5. Plankton haul No. 22 along shore off the Gravelpit, April 10, 1901. No. 6. Fine algæ near ice-houses, November 28, 1904.)

No. 7. (Blue-green algal mass, for diatoms, near ice-houses, November 28, 1904.) *Amphora ovalis* Kuetzing; *Cocconeis pediculus* E.; *Cymbella cymbiformis* E.; *Cymbella maculata* Kuetzing; *Cymatopleura solea* W. S.; *Epithemia gibba* Kuetzing; *Epithemia zebra* Kuetzing; *Gomphonema constrictum* E.; *Gomphonema olivaceum* E.; *Gomphonema acuminatum* E.; *Fragilaria mutabilis* (W. S.); *Melosira varians* Ag.; *Navicula rhynchocephala* Kuetzing; *Navicula gastrum* E.; *Synedra obtusa* W. S.; *Synedra radians* W. S. The diatoms make up a considerable per cent of this gathering."

These identifications along with the descriptions of the conditions under which the diatoms were obtained, give a pretty clear notion as to their occurrence in the lake.

It will be noted that the above collections consist wholly of shore gatherings, and are composed largely of species which are usually attached to other algæ. The diatom taken most abundantly in the plankton hauls was a species of Asterionella.

A few brief notes concerning the more striking or characteristic forms may prove of interest:

1. CYMATOPLEURA ELLIPTICA (Bréb.)

This large, handsome diatom was only occasionally encountered, chiefly in gatherings from Lost Lake.

2. CYMATOPLEURA SOLEA (Bréb.)

Occasionally scattered through gatherings near shore.

3. EPHITHEMIA GIBBA Kuetz.

Fairly common, mixed in with other diatoms; an occasional element in mussel food.

4. EPITHEMIA ARGUS (Ehrenb.)

Found in the same conditions as the preceding.

5. EPITHEMIA ZEBRA (Ehrenb.)

Presence simply noted. No notes.

6. AMPHORA OVALIS Kuetz.

Presence simply noted.

7. CYMBELLA CYMBIFORMIS Ehrenb.

One of the most common forms in shore gathering.

8. CYMBELLA MACULATA Kuetz.

9. CYMBELLA PROSTRATA (Berk.)

The shallow water near the ice-houses where the chutes up which the ice is taken enter the lake, was remarkably rich in fine brown, short filamentous tufts which covered the submerged stones and timbers at that place. The material collected here proved to be especially rich in the jelly-like filaments of this species which, while not wholly absent from other parts of the lake, appeared to be nowhere else so abundant as here.

The above list mentions only the most frequently encountered species or those noteworthy for some particular reason, and is only a beginning of what might be done at or about the lake by one's devoting more than only occasional or rare attention to this special subject.

10. CYMBELLA NAVICULIFORMIS Auersw.

11. RHOICOSPHENIA CURVATA (Kuetz.)

Occasional, attached to fixed algæ such as Cladophora, etc. A wedge-shaped diatom closely resembling species of Gomphonema, but somewhat curved.

12. GOMPHONEMA CONSTRICTUM Ehrenb.

This, along with two other species, was common along shore in shallow water, particularly near the ice-houses. They are easily recognized by their wedge-shaped frustules, and all are similar in habit, being attached by a slender gelatinous stipe which proceeds from the acute end to other algæ such as Cladophora, and even growing in bunches on rocks. Occasionally they separate from the stalk and are free-floating.

13. GOMPHONEMA OLIVACEUM Ehrenb.

14. NAVICULA REINHARDTH Grün.

15. NAVICULA GASTRUM E.

Naviculas of numerous undetermined species were present in considerable abundance in the food of the mussels of the lakes.

16. COCCONEIS PEDICULUS Ehrenb.

One of the most abundant diatoms of the lake, frequently covering filaments of Cladophora and Spirogyra like an incrustation, being closely attached to the filament by one side. Its habit and appearance, suggesting a nit or louse attached to a hair, makes its specific name highly appropriate.

17. ASTERIONELLA sp.

A species of *Asterionella*, probably *formosa* Hass, was exceedingly abundant throughout the lake in the early spring and again in late autumn after the water had cooled. It was found not only near shore but it extended out to the center of the lake. On some days it formed the main bulk of surface towings. The colonies of frustules arranged like the spokes of a wheel are striking objects under the microscope.

18. SYNEDRA RADIANS W. Sm.

Rather common in gatherings along shore.

19. SYNEDRA LONGISSIMA W. Sm.

20. SYNEDRA OBTUSA W. Sm.

Besides being frequent in gatherings along shore, various species of Synedra, some of them elongate, rather needle-like objects, were frequent in mussel food.

21. MELOSIRA VARIANS Ag.

This is a very common diatom in the lake and is obtained both in plankton hauls and in hand-gatherings along shore. According to Apstein (Süsswasserplankton, p. 140) this species furnishes food for various entomostraca (Chydorus, Daphnia, and Diaptomus). The Melosiras are especially interesting as they form the nearest approach among diatoms to the form of ordinary filamentous algæ.

22. MELOSIRA CRENULATA (E.)

This, like *Melosira varians*, is a free-floating form, often taken in towings and probably also used by entomostraca for food.

## The Aquatic Plants of Lake Maxinkuckee

### 1. HORNWORT

**CERATOPHYLLUM DEMERSUM Linnæus**

This plant grows rather abundantly in Lake Maxinkuckee over mud where the water is shallow, as in Outlet Bay, near Norris Inlet, and at the Weedpatch. There was a great abundance in the water off the springy flat on the southwest shore, and it was also plentiful near the boathouse by Norris Inlet. It grows thickly in Norris Inlet, where it is very dirty and helps form the great weed-mass which extends out from the inlet mouth. It has been found growing thick in 16 feet of water, a little in 18 feet, and has been dredged up in 24-foot water. Drifts were found cast up by the waves on the east side of Long Point September 20, 1900, and on September 28, 1900, by the pumping station bridge.

The Hornwort retains its shape and color and also signs of life through the winter. There is generally above the apices of these plants under the ice large bubbles frozen in the ice, and toward the latter part of the winter, crossing and recrossing curves of rows of fine bubbles like strings of minute beads, suggesting that the apices of the plants have a gyrating movement, and slowly exhale small bubbles of gas.

During the early summer these plants are places of attachment of Rivularia and also great myriads of white globular colonies of Vorticella, small, white, ball-shaped objects which shrink almost to nothing when touched.

The Hornwort is one of the most familiar plants to dwellers about lakes and by many is simply known as "moss". It is the plant that the inexpert angler on his first visit to the lake drags up in great masses on his hook, if he attempt fishing near the bottom. Many of the animals upon which fishes like to feed dwell among the masses of Hornwort. One example is the beach flea, and some of our herbarium specimens taken from the lake were found on later study to be full of pressed beach fleas. It is among the tangled masses of Hornwort that the fishes like to lurk. They afford fishes protection in various ways, and anyone who has tried to seine out a pond full of Hornwort, and had the lead line get full of the weed and roll up, permitting the fishes to escape, readily realizes that an abundance of these plants near the shore is about as good a protection for young fishes as could be devised.

### 2. GREATER DUCKWEED

SPIRODELA POLYRHIZA (Linnæus)

Abundant, floating on the surface of quiet waters. In general it thrives best on the surface of calm pools, where the water is permanent. When found in lakes at all, it harbors in the quiet shallow bays. It is usually associated with interesting forms of animal life such as Hydra, Vorticella, and the like. In the lake it is found near the Inlet, also in permanent ponds. These, as well as some of the other duckweeds, seem to form a favorite food for various insects, as one often finds them badly marred by having portions gnawed out of the margins of the fronds. The stomach of one duck examined contained duckweed in abundance.

### 3. IVY-LEAVED DUCKWEED

LEMNA TRISULCA Linnæus

This is one of the most beautiful and curious of the duckweeds with its elongate semi-transparent green fronds with their peculiar manner of branching, a side shoot coming from each side of each frond at the middle, and forming a very regular but intricate and complicated branching system where conditions are favorable, and the fronds tilting at all sorts of angles to avoid interference. Besides the minute and inconspicuous *Wolffiella floridana*, this is our only duckweed which will cling together with other plants of the same species in masses forming coherent tangles. It grows much more vigorously under leaves in shallow water than in unprotected places, and hardly looks like the same plant in different situations although the general form of the fronds is always the same. Found along the lake shore east of Farrar's (September 24, 1900), in a dried-up pond southwest of the lake (October 1, 1900), and by the boathouse near the Inlet (October 2, 1900). It is abundant at the southeast end of the lake near Norris Inlet during all seasons when there is no ice. Found also occasionally along shore among cattails and rushes, as north of Winfield's and at various other places.

On October 24, 1900, an immense amount of this species was found drifted in Lost Lake, near the middle of the western shore. This formed a thick tangled "scum" extending some way from shore and also making great masses in the bottom. It was also frequently found growing and thriving well in wet places among dead leaves in the water, and appears to hibernate in such places.

### 4. LESSER DUCKWEED

**LEMNA MINOR** Linnæus

Not particularly abundant in the lake; found mostly among the great mass of duckweeds at Norris Inlet. On September 24, 1900, it was found along shore near Farrar's, but not thriving. On October 12, 1900, it was found in the lake opposite the springy flat by Overmyer's field.

It was found abundantly in flower in pools by the Norris Inlet June 13, 1901. The blossoms are minute white specks, like bits of dust.

In general appearance, this duckweed much resembles *Spirodela polyrhiza* with which it is usually associated, but differs from that plant in its somewhat smaller size and in the possession of one instead of several rootlets.

### 5. MINUTE DUCKWEED

**LEMNA PERPUSILLA** Torrey

A small duckweed, resembling *L. minor*, but somewhat smaller. Abundant, mixed in with the other duckweeds near Norris Inlet and in other suitable situations, often associated with *Wolfiella floridana*.

### 6. COLUMBIA WOLFFIA

**WOLFFIA COLUMBIANA** Karsten

This interesting duckweed represents the smallest of the flowering plants,* the whole plant being a spherical light-green body about the size of a pinhead. The flowers appear as minute white specks.

Plants are quite abundant about Norris Inlet, where they help form the great mass of duckweed-scum at that place. They are not, however, so abundant nor widely distributed, nor in such clear cultures as at Eagle Lake, where some of the bayous are completely covered by them. Besides the great mass at Norris Inlet, a few plants were found south of Winfield's, sheltered among the rushes. On October 9, 1900, down at the Inlet, we obtained a large quantity of these plants, the greater number of which were in flower.

Although *W. punctata* was tolerably abundant at Eagle Lake, not far distant, it has not been recognized at Maxinkuckee. It differs from *W. columbiana* in being a trifle smaller, riding deeper in the water, and having a somewhat flat-topped upper surface.

This little plant is an important portion of the food of certain small fishes, among which may be mentioned the mud minnow

*The smallest known flowering plant is *Wolffia microscopica* of Asia.

(*Umbra limi*). Dr. Forbes, in 1883, found that forty per cent of the food of this fish was vegetable matter, chiefly Wolffia.

"Five specimens of the *Umbra limi* obtained from a pond, covered in September with a film of Wolffia and other vegetation, yielded to the dissector stomach contents consisting of sixty per cent of the Wolffia."

### 7. FLORIDA WOLFFIELLA

#### WOLFFIELLA FLORIDANA (J. D. Smith)

This plant is rather common at Norris Inlet among other duckweeds, but it is much less abundant than most of the others, and on account of its slenderness, and its habit of hiding among other duckweeds, it is not always easy to obtain in quantities. The thalli are very slender, somewhat flattened, attenuate, light-green affairs, sometimes hanging together in quite large stellate masses. It rides deeper in the water than the other duckweeds, and therefore forms the bottom portion of the layer. Sometimes it grows in thick tangles in the submersed tops of Ceratophyllum.

Besides being found in the Inlet, it sometimes becomes scattered by south winds to various parts of the shore. A few plants were seen off the springy flat by Overmyer's field. A few near Farrar's pier, and some mixed with Wolffia were observed south of Winfield's.

Stays green all winter. In 1904 (Dec. 20) bright green plants were noted floating under the ice on the surface of the water. Probably most of the plants sink to the bottom during the winter, as not many can be seen through the clear ice. This plant, which was very common in 1900 and 1901 is now becoming rare and will probably soon be extinct at the lake.

### 8. RICCIA

#### RICCIOCARPUS NATANS (Linnæus)

Intermediate between the floating plants and plants growing on shore; exceedingly similar to the duckweeds during its floating life and behaving much like an ordinary land plant during the other part of its life, is the curious liverwort, *Ricciocarpus natans*. This plant exhibits in some degree the dimorphism which is generally a well-marked feature of shore-line plants, but which is intensified and reaches its highest expression in woodland ponds. *R. natans* is predominantly an aquatic plant and is never found where the water supply is not permanent. It is a thin heart-shaped form with prominent masses of rhizoids on the under side, often found

floating near shore; or when left on shore, doing very well, creeping along on the wet mud banks without any marked change of appearance.

In the temporary woodland ponds near the lake is a remarkable form, a rather close relative to *R. natans, Riccia lutescens*, which is a true aquatic during the wet portion of the year, and a true land plant, wholly different in appearance during the dry season, which one cannot forbear mentioning at this place but which space forbids enlarging upon.

### 9. EEL-GRASS PONDWEED

**POTAMOGETON COMPRESSUS (Linnæus)**

According to Dr. Scovell's records this species exceeds any other of the lake in the depth to which it grows, examples having been taken at a depth of 26 feet, and the range extending from 26 to 2 feet, the plants being most abundant between 10 and 16 feet. It does not form dense patches but grows scattered among other plants. Its rather small size and relatively narrow leaves, together with its habit of being wholly submerged, make it rather inconspicuous. It is most common in the southeastern part of the lake and seems to prefer muddy bottom. It is pretty easily recognized by its much flattened stem and grass-like leaves. Although the plants in shallow water produce flowers and seeds, a very common form of propagation is by means of peculiar fan-shaped winter buds in which the 2-ranked flat leaves are closely appressed. Many such buds were raked up during the winter of 1900 and 1901 and it is doubtless from such buds being carried to the deeper portions of the lake that the deeper seated plants owe their origin. The buds have a habit of becoming very crooked during their early growth, the delicate internodes perhaps strongly curving toward the light. Two such very crooked buds were raked up in the spring of 1901, one on April 13 and the other on May 29. The new leafy stem springs from the apex of the bud and the roots from the axils of old leaves.

### 10. FRIES' PONDWEED

**POTAMOGETON FRIESII Ruprecht**

This is another pondweed thriving in deep water, being widely distributed in water from 8 to 25 feet but most abundant in water from 12 to 16 feet deep. It also grows in shallow water, in which case it often blossoms and bears fruit. It is also disseminated by means of propagating buds but these are not formed so frequently as in *P. compressus*. It was frequently obtained in dredge hauls.

This pondweed bears some general resemblance to *P. compressus* from which it can be distinguished by the presence of 2 glands at the base of each leaf. Some of the propagation buds were collected along shore March 27, 1901. Some was found up Aubeenaubee Creek on a seining trip September 3, 1900. It does not grow in patches but is scattered among other plants.

### 11. SMALL PONDWEED

**POTAMOGETON PUSILLUS** Linnæus

A small insignificant species, growing scattered among other plants; more common in the southeastern portion of the lake, in deep water ranging from 10 to 24 feet. It also probably grows occasionally in shallow water. Like all the deep-water Potamogetons it relies largely upon propagating buds for its dissemination.

### 12. FILIFORM PONDWEED

**POTAMOGETON FILIFORMIS** Persoon

Very abundant in 10 to 13 feet of water, ranging from 2 to 24 feet. It is occasional along shore in shallow water. It was noted in flower at Norris Inlet June 24, 1901 and observed in flower some time earlier in the northern part of the lake. It does not form dense patches but grows rather scattered.

### 13. ROBBINS' PONDWEED

**POTAMOGETON ROBBINSII** Oakes

Rather common and widely distributed in Lake Maxinkuckee in depths ranging from 3 to 24 feet, and common in water from 10 to 18 feet deep. Rather common in Lost Lake and in the shallow waters of Outlet Bay, forming especially fine patches in front of the Ice-houses. It was dredged at the Weedpatch, and in fact can be raked up almost anywhere. It prefers rather muddy bottom, and lies almost prostrate on the ground, never rising to the surface, even in shallow water, to form flower or fruit. It is one of the most handsome species of the genus and the large plume-like branches lying on the bottom, do more than almost any other species to add charm to the Chara carpet over shallow bottoms. The white or yellowish color of the plumes, due to a coating of lime over the old leaves, makes them all the more conspicuous against the dark bottom through the clear water.

*P. robbinsii* retains its form throughout the winter. The lower leaves assume a brown and somewhat deadish appearance, but the tips are firm and of a lively purplish-green.

This plant propagates by means of buds which are often formed as early as the middle of July, and are found from then on through the winter. They appear to be formed in the axils of the leaves. They are the shape of a closed fan, the thick flat leaves (quite unlike the thin wavy vegetative leaves) being packed full of reserve food material and closely pressed together. During the winter the plants also put out abundant roots just a little behind the apex and these may detach themselves and produce new plants.

### 14. LARGE-LEAVED PONDWEED

#### POTAMOGETON AMPLIFOLIUS Tuckerman

This is one of the most attractive species of plants in the lake, the large, gracefully curved delicate green leaves showing up through the water very handsomely. It prefers rich mucky soil and water of moderate depth. It is rarely found in water less than 6 feet deep and is most abundant in water from 8 to 12 feet. It has been dredged in water 24 feet deep. In shallow water it has oval smooth floating leaves quite unlike the thin and wavy submersed ones and much like the floating leaves of *P. natans* to which it is closely related. In deep water there are no special floating leaves. Good-sized patches are common near the Ice-houses, and throughout Outlet Bay. It is also found in abundance at the Weed-patch and there is a large fine patch in the neighborhood of Norris Inlet. There is another large patch off from the green boat-house in the Inlet region, but there is none along the east side. Chara and some of the less conspicuous species of pondweed, such as *P. pectinatus,* often grow intermixed with it. Where it grows very densely, however, it conceals or excludes other species.

### 15. TAPE-GRASS; EEL-GRASS

#### VALLISNERIA SPIRALIS Linnæus

Rather abundant and apparently considerably on the increase. It grows scattered over the bottom at various depths. It has been dredged at a depth of 24 feet, and from this depth it extends almost to the water's edge in suitable places. Dr. Scovell has made the interesting observation that the plants bearing the pistillate flowers grow in shallow water, none of them having been observed in water at a greater depth than 2 or 3 feet, while the staminate plants were most abundant in water from 8 to 18 feet. The higher plants are of course only indirectly sexual, but this observation suggests experiments along the line of planting seed of Vallisneria at different depths and observing the effect of depth of water in sex-determina-

tion. Still more interesting and significant would be the experiment of taking a propagating bud from a pistillate plant and planting it in deep water and noting the result. The reason for the peculiar distribution of the staminate and pistillate plants is perfectly clear. The pistillate flower is carried to the surface of the water by a long, slender scape, inasmuch as it is necessary for it to be fertilized in the air, and there are naturally limits to which it is practicable to send up this scape. The staminate flower, on the other hand, breaks loose from the parent plant, rises to the surface and depends upon chance currents to float it to the pistillate plant, which it fertilizes. During August the staminate flowers are often found floating on the surface in great numbers. They frequently formed a thick scum in the region of the Outlet in 1906, and towings from the surface plankton-net consisted mainly of them. As soon as the pistillate flower is fertilized the flower stalk coils up into a spiral and draws it beneath the water where it develops into a long cylindrical or obtusely triangular pod full of mucilage, with an abundance of minute dark seeds and with a slightly acid taste.

The Eel-grass usually grows rather scattered and a few plants are often dredged up intermixed with Chara and other weeds. Some was dredged at the Weedpatch. A very dense little patch was found growing in a bait-can which had been dropped in the lake. It frequently makes pretty dense patches not far from shore. It grows abundantly at the head of the Outlet, at the railroad pier, and along the west side of the lake east of Long Point. It seems in general to prefer rich bottom with a good admixture of sand.

During the earlier years of the lake survey this plant did not appear to be so abundant as it now is. This was probably due to the raids made upon it by the ducks and coots, which almost exterminated it every year, but with the growing scarcity of these birds it seems greatly on the increase. New patches are being formed, one along the northern shore of Long Point and many in other places.

This plant is the favorite food of ducks and coot, and it is said the canvasback duck owes its superior flavor to this plant, upon which it largely feeds and to which indeed it owes its specific name, *valisineria*. During the latter part of September great rolls of this plant which have all been torn up by the water fowl, are washed up along the shore of the lake, making long windrows. The "wild celery" as this plant is known along the Chesapeake, bears at its base a white pleasant-tasted rootstock which terminates

in a delicate bud for the next year's plant, and it is upon these delicate portions that the ducks and coots delight to feed.

The leaves of the plants near shore turn white and decay in autumn even before freezing weather sets in, but occasional bits can be raked up, as green as ever, the year round. Among the numerous dates at which it was observed washed up in conspicuous rolls are September 20 and 29, 1903, and October 16, 1913.

### 16. STOUT NAIAS

**NAIAS FLEXILIS ROBUSTA** Morong

Very abundant, ranging in depth from 1 to 24 feet, most common in the northeastern part of the lake. This general statement includes both forms, the typical species and the subspecies. The references to the deeper-growing form apply to the subspecies.

*Naias flexilis* is confined near shore in shallow water, and dies down every autumn. *N. flexilus robusta* grows in deeper water, being common at a depth of 9 feet, and remains green all winter. It was not found in fruit, and has no special propagating buds, so that the method of propagation is unknown, unless broken-off fragments of the ordinary stems strike root and grow.

The Coarse Naias was found in considerable quantities in the stomachs of coots, and it evidently formed an important article in their diet.

### 17. FŒTID CHARA

**CHARA FŒTIDA** A. Braun

Plant quite long and slender, rather dark green when wet, white and harsh when dry, on account of the encasing lime. Internodes long (about 2 inches) and quite slender. Branches cylindrical, rather blunt, mostly unbranched or sometimes abruptly bent where apparently a branch will appear later on. Branches 8 or 6, and at the top, 2 or 3 in a whorl. No fruit at all (August 28, 1900). An occasional branch arises apparently from the axil of one leaf in the whorl.

Cortex composed of rather narrow tubes, 6 or 8 seen at the surface of a leaf, and about the same number on the stem. Small knobs (stipules) below a node quite conspicuous, just above which can be seen rather round clear cells in which active protoplasmic movements are visible.

Leaves with frequent nodes, where there is a round knoblike cell between each two alternate sinuses of the cortical tubes, and the ends of the cells, form a ring perpendicular to the long axis of the leaf. The cortical cells all end somewhat truncately in the

middle of the internode and make an oblique ring. The end of the leaf is peculiar, the corticated portion ending abruptly with a circle of knobs, and beyond this extends a curved cone consisting of 2 or 3 rather large cells diminishing in size from base to apex. The terminal cell is sometimes cuspidate, more often acutish.

### 18. WATER-WEED; DITCH-MOSS; WATER-THYME

PHILOTRIA CANADENSIS (Michaux)

Widely distributed in deep waters, having been dredged at a depth of 22 feet. Abundant in some places in shallow water where it forms dense patches. There are good patches near the railroad bridge at Culver and by the pier near the Outlet. It was found near Norris Inlet and with other weeds forms a dense patch along shore by the Culver Military Academy grounds. It seems to be increasing in the lake and within late years an immense and very dense patch has formed along the north shore of Long Point, by Chadwick's pier.

Many of the patches appear to die down completely during the winter, others remain green. The elongate pistillate flowers are delicate, curious objects, and are produced throughout the summer. The floating staminate ones are hard to find and but few were seen. The plant is exceedingly variable in general form and compactness, some being quite loose and long-jointed with 3 leaves in a whorl, others quite dense and compact with 4 or 5 leaves in a whorl. Some dense off-shoots probably serve as propagating buds. This plant, which has been introduced into Europe, is said to be a great nuisance there in rivers and bears the name of water-pest. It has been reported also that in Europe it propagates exclusively by vegetative propagation, only the pistillate plants having been introduced.

### 19. FENNEL-LEAVED PONDWEED

POTAMOGETON PECTINATUS Linnæus

One of the most common pondweeds in shallow water near shore, the general fan-shaped arrangement of the narrow, thickly crowded leaves making it quite attractive. It was frequent to a depth of 10 feet and was occasionally dredged in 16 feet of water. It was noted everywhere along the beach, growing in either sandy or muddy bottom, and in rather dense patches by itself or among Chara. Among the numerous places where it was noted may be mentioned Long Point, McSheehy's pier, in front of the Barnes cottage, off from the Depot grounds and east of there, along shore

near the green boat-house, by Norris Inlet, etc. A fine patch grew at the head of the thoroughfare between the lakes, above the wagon bridge. The plants frequently grew out in long straight rows from shore, the different stems coming up in line from a white strong underground rootstock.

### 20. WHORLED WATER-MILFOIL

**MYRIOPHYLLUM VERTICILLATUM** Linnæus

Found growing in both lakes, not deeper than 14 feet. Abundant and widely distributed, growing in rather compact patches with other plants where there is rich bottom and rather shallow water (6 to 10 feet), as about the west edge of Outlet Bay, in the neighborhood of the Ice-houses, about Norris Inlet and most of Lost Lake. It grows far out in the water at a point in line with Norris pier and opposite Overmyer's field. It also grows near Norris Inlet.

The plants retain their form during the winter, but become very brown and homely, the tips forming rather compact buds not nearly so neat and well differentiated from the rest of the plant as those of *M. spicatum*. Found in flower September 1, 1900. Flowers and fruit, as in others of the genus, inconspicuous. During April (5th, 6th, 7th, 12th and 13th) a large number of buds were washed ashore in the neighborhood of Long Point and Outlet Bay, and became greener and brighter as the days passed.

On April 14 the plants looked much as they had in winter, only a trifle greener. On April 19 the buds were quite green, and by April 23 the buds had begun to elongate and were considerably looser than had been noted before.

### 21. CLASPING-LEAVED PONDWEED

**POTAMOGETON PERFOLIATUS** Linnæus

Not common in general, but fairly abundant in a few localities in the south part of the lake. More common in water from 8 to 12 feet deep. It does not form patches but is dredged up intermixed with other weeds. Some plants were found growing in sandy bottom in water about 8 feet deep in the neighborhood of the Merchants' pier. A good patch was also found, in 1904, near the Ice-houses.

In form this is one of the most regular and attractive of the pondweeds; the broad wavy close-set dark-green leaves in 2 ranks giving it the appearance of a full plume quite different from the broad open plume of *P. robbinsii*. It is not so showy in the water

as *P. robbinsii*, as it stands erect and is usually seen only at an angle. It is quite fragile and easily torn and tattered by handling. It remains green all winter.

### 22. LONG-LEAVED PONDWEED; RIVER PONDWEED

**POTAMOGETON AMERICANUS Chamisso & Schlechtendahl**

This potamogeton is one of the shallow-water species, rarely or never growing in water more than 10 feet deep. It is rather common in the lake, growing in small scattered patches not far from shore. It has flat, leathery, floating leaves which very closely resemble those of *P. natans* except that they are more acute. The submerged leaves are thinner, and long and narrow. Patches were observed north of the Barnes cottage not far from shore, near Long Point, and in Outlet Bay. A healthy patch grows in the bottom of the Outlet where it joins with the lake, extending on both sides of the wagon bridge. Here the swift rushing current kept the leaves in a constant tension and flapping like a flag on a windy day, and the plant took on a peculiar form. There were no floating leaves and the submersed leaves were exceedingly long and attenuate as if drawn out by the stress of the passing current. A patch was noted 2 miles down the outlet below Lost Lake, the plants being long and slender without many leaves. It grows in Tippecanoe and Yellow rivers and is the form most frequently found in rivers.

*P. americanus* frequently grows on wet sandbanks at the water's edge wholly out of the water. In this case it is much changed in appearance, being short and leafy and all the leaves of a firm leathery texture, much in substance like the floating leaves of the aquatic plant, but firmer. Proceeding from the deeper water plants outward, it is the first of the many plants encountered which are characteristic of the shore line regions. It has two pretty well marked forms, one for the water and one for the land, although the habit of having 2 sorts of leaves, one submersed and the other emersed, is a step in this direction.

### 25. SHINING PONDWEED

**POTAMOGETON LUCENS Linnæus**

Widely scattered in small patches through the lake in shallow water growing at a depth of from 6 to 8 feet, and usually mixed in with other pondweeds such as *P. amplifolius* and the like. It usually grows in rather small patches of only a few plants each. There is, however, a fairly large patch of about 500 feet directly

out from the ice elevator at a depth of 4 or 5 feet. In general form it resembles *P. natans* or *P. americanus* from which it can be distinguished by its shining leaves. What was thought to be this species was seen in flower by Norris Inlet June 24, 1901, although its usual time of flowering is in September and October. It remains green all winter, even the floating leaves not decaying in autumn but becoming embedded in the ice during the winter.

### 24. VARIOUS-LEAVED PONDWEED

**POTAMOGETON HETEROPHYLLUS** Schreber

Although this species apparently strays out into deep water at times it is in the main a shallow water plant found rather close to shore and confined chiefly within the five-foot line. One of the largest and best known patches is out a little way in front of the Scovell cottage on Long Point. There are occasional patches or single plants scattered along the shore of Long Point, and it was found rather frequently in the northern part of the lake. It keeps its form all winter, the leaves turning purplish-brown.

### 25. COMMON FLOATING PONDWEED

**POTAMOGETON NATANS** Linnæus

This, one of the most common and widely distributed of the pondweeds, does not cover large areas in Lake Maxinkuckee, but is frequently found in small scattered patches in shallow water near shore, frequently associated with other pondweeds, especially the fennel-leaved pondweed, *P. pectinatus*. It was not noted in water over 6 or 8 feet deep. Among the localities at which it was noted are: A few plants near McSheehy's pier, a good patch near Murray's, a patch south of the old ice elevator, some in lagoons in Long Point flat (an area now all filled in), a small patch by Darnell's, a dense thick patch near Overmyer's low woodland, and at the delta at the mouth of Spangler Creek.

It is common in the shallow water and black muddy bottom at the upper end of Lost Lake. Here, however, no floating leaves were produced. Some grew in the thoroughfare between the lakes.

*P. natans* grows either in sandy or mucky bottom and retains its form and green color after the ice has covered the lake, and probably some plants remain green the whole winter through. It produces a new growth early in the spring. By May 30 slender phyllodia had been developed on some of the plants for several days and the broad floating leaves were beginning to show well. It was noted in flower July 24.

### 26. INTERRUPTED PONDWEED

**POTAMOGETON INTERRUPTUS** Kitaibel

A small pondweed much resembling *P. pectinatus*, growing in shallow water. Found near the Depot pier in the autumn of 1904. In the winter the rootstocks are thickened into tuber-like objects which are often uncovered by the waves which probably function as agents of dissemination.

### 27. WATER MARIGOLD

**MEGALODONTA BECKII** (Torrey)

Rather common in the lake; of irregular distribution. During the autumn of 1900, there was a dense and quite large patch near the Ice-houses, but during the following winter it disappeared. Some of the plants remain green all winter—the tops break off, and drift, sometimes into deeper and occasionally into shallow water. They strike root at the basal end and probably catch and grow. In plants of such a habit, the patches in the lake have no permanent position, but may be found in one place one year and another the next, according to where they have drifted and found congenial conditions. This is one of the handsomest of our water-plants.

### 28. CARPET CHARA

**CHARA CONTRARIA** A. Braun

A stout species of Chara, growing about 8 inches high, forming a dense mat over marly portions of the lake in water from 5 to 8 feet deep. It forms a covering over most of the bottom of Outlet Bay out from Long Point, and, indeed, almost everywhere in the lake where bottom and depth are favorable. It was scarce or absent in shallow water from Norris pier over toward the eastern shore, probably on account of the peaty bottom. It is among this Chara that the small organisms of the lake, insect larvæ, Asellus, and the like find refuge, and here, too, the darters and small fishes spend much of the winter. On account of the habit of this species of forming a dense mat over the bottom it is generally referred to as the Carpet Chara.

### 29. LARGE YELLOW POND LILY

**NYMPHÆA ADVENA** Solander

Distribution rather scattered in Lake Maxinkuckee, as it is fond of shallow water and rich mud, and these places are only occasional in the lake. It is found in the Outlet below the wagon bridge, along

the southwest shore of the lake at the beginning of Overmyer's woods, and some along shore in front of Culver Military Academy grounds, also in the region of Norris Inlet.

It is very abundant in Lost Lake. Here great masses of roots occasionally arise to the surface, making a sort of floating island. They have the appearance of having been lifted by some upheaving force. Some have attributed these upheavals to the presence of marsh gas, but it is more probable the soft bottom is unable to hold down the buoyant mass when it has grown beyond certain dimensions. These great masses, floating on the surface, impede boating and give a tropical aspect to the sluggish dark water of Lost Lake. This plant also grows in Green's marsh. It is one of those plants of tolerably wide range of environment varying from a marsh plant to one growing in rather deep water with only floating leaves and flowers exposed, and it exhibits a marked response to environment, as do most plants of this sort. The swamp plants have stout stems, with the leaves stiff and firm, standing at an angle and sometimes with traces of fluting radiating from the base of the petiole, suggesting that of a palm leaf fan. The stems of the water forms are flaccid, and the leaves always horizontal, floating on the surface of the water. The young leaves have a peculiar rich violet coloration which may serve as a protection from the rays of the sun.

By April 26, 1901, the leaves were up and floating quite in summer fashion, and by May 19, 1901 the plants were in flower in Green's marsh.

### 30. WATER-SHIELD

#### BRASENIA SCHREBERI Gmelin

Rather common in the north edge of Lost Lake, and along near the Inlet, and by the green boathouse. It does not appear to blossom frequently here. The young leaves down close to the rootstock do not die during winter, but remain ready to come up at once on the return of spring.

Green leaves washed ashore on east side Lost Lake November 3, 1904.

The floating leaves have a beautiful autumnal coloration, turning bright red or purplish. The flower, although not showy, is handsome and attractive. A remarkable feature of the plant is its gelatinous coating which makes it appear as if enclosed in glass. The function of this coating is not clear, and it is absent in its near relatives, the water-lilies.

### 31. SWEET-SCENTED WHITE WATER LILY; POND LILY

CASTALIA ODORATA (Dryander)

Rather scarce in Lake Maxinkuckee, only a few plants having been found,—some at the head of the Outlet, some near Norris Inlet, a small patch at the culvert north of Winfield's and a few over near the Academy grounds. It does not thrive nor increase much in the lake as it does not find there the rich deep mucky bottom in which it delights.

It is common in Lost Lake, and flowers fairly well, but the flowers are not so large nor so fragrant as those found in Twin Lakes near Plymouth. Our plant seems indeed to approach more nearly to *C. tuberosa* (Paine) Greene, but has the leaves purplish beneath, which is a characteristic of *odorata*.

### 32. FULL-FRUITED CHARA

CHARA FOLIOLOSA Muhlenberg

This, according to Robinson, is the proper name for the species generally known as *gymnopus*.

This is the species mentioned in the field notes as the "full-fruited Chara". A short, very fuzzy, leafy Chara growing in small clumps just below the water's edge along Long Point, Winfield's, etc., in sand. It was usually conspicuously red from the great abundance of fruit. The following are field notes:

"Chara, alcoholic specimen in bottle marked Sp. No. 4, a Chara growing in dense tufts near the shore. Roots or rhizoids very thin, numerous, hyaline. Stems much branched from the base, many branches arising in clumps on a rather stout, short transparent prostrate stem. Internodes of secondary stems somewhat stout, all above the first quite rough, the first smooth. Internodes yellowish (lowest) or pale green (upper) about ¼ inch long, turning white on drying. Leaves 6 or 7 in a whorl, with a branch bearing fruit and leaves in almost every whorl. Leaves and whole aspect of plant roughish, the upper leaves densely crowded along the upper side with small globular orange-red antheridia. Leaves very rough from rows of "stipules". Whole plant about 2 or 3 inches high. The fruits consist of about 2 or 3 pairs of sex-organs arranged as follows, counting from below: (1) a dark orange, red globular antheridium, and above it an oblong light orange oogonium. The simple lens shows the roughness of the main stem to be due to small downward-projecting "stickers" or stipules. On the leaves the same structures are in circles around the leaf and point upward.

With the low power of the microscope the rhizoids are long hyaline unicellular hairs. Clear rootstock-like object with large irregular tubercle-like lumps; perhaps from these lumps the branches have been accidently removed. Connected with these and without any intervening septæ is a long tubular uncorticated cell, hyaline below where there is no coating of material. In this cell very active protoplasmic streaming may be noted, downward on one side and upward on the other, each side of a narrow oblique line of rest. A considerable number of large clear globular bodies like oil-drops, and innumerable minute granules make up the rapid streaming mass. Above this cell is encrusted, and movements cannot be observed. At the upper end of this cell is a node where there is a large number of turgid approximately equiaxial nodal cells. There was no cortex on the second internode. The third and all following internodes are corticated in the manner described below.

The cortex extends parallel with the long axis of the internode, or nearly so, exhibiting very little torsion. The cortical cells are turgid, cylindrical, about 3 times as long as broad, and there are as many as 10 or more placed end to end in one internode. In every third row of cortical cells there is between the ends of any two succeeding cells, a short rectangular cell of a rich dark-green color. These cells are at about the same height on the internode, so each series makes a circle of studs around the central cell. The cortical cells each side of those furnished with the rectangular stud-cells are not thus furnished but have their ends in contact at about the middle point of the stud-cells, so that the series of cortical cells with the stud-cells breaks ranks with the next pair of series of each side where there are no intercalations. These intercalated cells prove on further examination to be optical sections of the base of trichomes or "stipules" which project from the internode. These stipules are elongate conical cells, somewhat acute at the apex, and the fact that they are viewed end on, showing greater depth, makes them appear much greener than the other cells.

The stipules situated at the base of the internode appear in general to point upward, those in the upper part downward. Just below each node these form a long thick fringe which hangs downward.

Antheridia, brick-red globes with shield cells finely displayed surrounded by a peripheral layer of light clear green cells, are situated below the oogonium and its subtending leaves.

Oogonium lighter orange-red, barrel-shaped, its investing cells twisted very strongly. Coronal cells 5, the apex being blunt. Stems or branches corticated to near the end with a series of

straight cells, reaching the whole length of the internode. At each node a whorl of trichomes or stipules of the shape and form already described. Beyond any cortex is one long cylindrical naked cell with its chloroplasts apparently in rows. This cell has near its apex a whorl of short trichomes. The entire series ends in a pyramidal acutish apical cell. This plant is frequently covered with very brown, boatshaped diatoms (Navicula).

Common along the east shore of Long Point in sandy bottom and shallow water. Found also near Lakeview hotel, and by Winfield's.

April 30, 1901, and for a few days after, patches were observed coming up rapidly near shore, probably this. May 30, 1901, a very dense minute growth probably this, east side, Culver Bay.

#### 33. NITELLA sp.

One of the deepest growing species of plants in the lake is a charad of which there appears to be considerable difficulty in getting any satisfactory identification. It is found growing at a depth of 25 feet, its range being from 12-25 feet. Dr. Scovell gives the following notes concerning it:

"A tall, slender, rank-growing plant, soft and flexible and quite free from lime. To the naked eye the plant seems made up of alternating light and dark sections of about the same length, perhaps one thirty-second of an inch. It was most abundant in water from 18 to 22 feet in depth, ranging from 12 ft. to 25 ft. It was especially abundant in the deep hole just east of the Gravelpit and along the bar running northeasterly from Long Point. Dredging in over 60 different localities we found this Nitella in 46 localities in water from 18 to 22 feet deep. In 37 localities we found it between 22 and 24 feet in depth, and in 34 localities we found it between 16 and 18 feet in depth. It is rather more abundant in the north, west and south than on the east."

We have no record of having found this species in fruit, and it is possible that, growing at such depths, it produces fruit but rarely. It appears to be this species of which Dr. Robinson remarks: "The material seems to be entirely sterile and I cannot match it with anything. It has much in common with the South American *N. monodactyla* A. Br., so far as can be told from the descriptions and from drawings and notes in the Allen herbarium, but there is no South American material of that species in the collections of the N. Y. Botanical Garden. There has also been preserved a copy of a letter from Dr. Allen to some unnamed person, probably Rev. Thomas Morong, from which it would seem that the

former had received from his correspondent material from North America of what he believed was *N. monodactyla*. This might well refer to early collections of the present species, but too many of the present deductions are conjectural to admit of anything approaching certainty. If this species should turn up in fruit, its study may be of great interest."

#### 34. NITELLA TENUISSIMA Kuetzing

A Nitella growing in rather shallow water, 1-3 feet, in positions similar to "sp. No. 4 Chara". The specimens were preserved in alcohol labelled "Sp. No. 5 Nitella".

The whole plant grows in rather dense tufts, about 1 inch in diameter. Color dark green. Rhizoids not conspicuous. Main stems many, exceedingly slender, the internodes hardly more than 1 12 in. long. The branches arise in whorls making a dense globular mass at each node, so that the plant looks a good deal like Rivularia spheres attached to a slender stalk. These spheroids of branches are larger and closer together toward the apex of the plant.

With low power of the microscope: Rhizoids long, hyaline, cylindrical tubes with occasional peculiar thickenings. The internode below the whorl is clear, and in it active movements of the protoplasm may be seen. Higher internodes light green. The internodal cell is expanded like the ball of a ball and socket joint at the node.

The masses formed by the nodes were quite firm, and had to be flattened out by compression, before study. A node flattened out presented the following appearance: From the node on the central axis radiate several rather stout cells, the basal cells of branches which branch repeatedly in the manner described above. About the axis of the tertiary branches are formed the reproductive organs. Antheridia globular, brick-red, the brick-red portion surrounding clear cells. The shield-cells show up fairly well, but are not so large as in the Chara just described (*foliolosa*). All the internodal cells of whatever order are tolerably short. The final members of the series or leaves are long slender cylindrical cells composed of one long slender cell of uniform diameter and a sharp attenuated conical cell at the apex.

Oogonia from nearby globular to short ovoid, on the same node as the antheridium and on a level with it. Contents dark in color, the cells of its investing integument in a close spiral. Crown 2-celled. In the autumn of 1900 a great deal of this Nitella was

found in Outlet Bay in water 2 to 3 feet deep and generally associated with the shortish very stout hispidulous Chara common in Lost Lake.

35. CHARA FRAGILIS Desvaux

Occasional in the lake, rather similar to *Chara contraria* but more slender and with longer leaves. It was occasionally raked up with other plants but we have no specific knowledge of its distribution.

### 36. SLENDER NAIAS

NAIAS FLEXILIS (Willdenow)

Common along shore in water from 1 to 4 feet deep, the plant preferring sandy bottom. Some of the plants have a reddish cast while others are bright green. The plants, especially those of the shallow water, die down completely during the winter, reproducing by minute shining black seeds. Its general habit suggests unusual methods of fertilization but nothing was found out about how this takes place. It is a very graceful, attractive plant.

### 37. GRASS-LEAVED ARROWHEAD

SAGITTARIA GRAMINEA Michaux

Not common in Lake Maxinkuckee, only one patch known, in the vicinity of the old ice office. There is a fair-sized patch in Lost Lake below the Bardsley cottage. Unlike any of the other Sagittarias in habit, the sharp broad leaves form a rosette at the base, at the bottom of the lake, bearing a considerable resemblance to the plant of seven-angled pipewort or a more remote resemblance to the old-fashioned "hen and chickens". It propagates extensively by runners, and the deeper water plants perhaps propagate entirely in that manner. The flowers, which are rather few, are exceedingly pretty, both inner and outer perianth-segments being petal-like, variously waved and crumped so that the flower looks somewhat double, the color being a faint delicate pink.

### 38. SEVEN-ANGLED PIPEWORT

ERIOCAULON SEPTANGULARE Withering

Not very common, except in a few patches. About June 5, 1901, young green leaves were noted in Lake Maxinkuckee; found in 3 places (1) by Winfield's; (2) southwest side of Outlet Bay east of the wagon road; and (3) by Norris Inlet. It grows in shallow water 3 or 4 feet deep, in mud not far from shore. The plant has a rosette of leaves much resembling that of *Sagittaria graminea*. The plants are very common at Bass Lake. The flower

heads are of a peculiar misty gray, at the same time so quietly self-obliterating that one turns to a well known patch where he confidently expected them to be with a sense of discovery and surprise.

### 39. AMERICAN GREAT BULRUSH; MAT-RUSH

SCIRPUS VALIDUS Vahl

This bulrush is the most aquatic species of the genus. It is, perhaps, on account of its more aquatic habit that it departs more than a great number of them from the sedge type of stem. For while it is here cylindrical it is in *S. americanus* and many of the land dwelling species actually triangular, and in a number of leafy species—*S. cyprinus*, *S. lineatus* and *S. atrovirens*, triangular with blunt rounded angles.

There were many patches about the lake and in the water as follows: A small patch in a longer and denser patch of *S. americanus* at Long Point, and north of the base of Long Point. It is also in the water near the Outlet, and there is a small patch opposite elevator pond. Near the Ice-houses it runs out far into the water in a long sharp point. There is a patch west of Lakeview hotel. A thin patch runs far out into the lake south of Farrar's on shoals, and still farther out, south of the pond, along the southwest shore of the lake, and in front of Farrar's, though no rushes come to the shore there. At the place where the forest comes to the shore, on the south side of the lake, a patch of these rushes begins about 10 feet from shore, and beyond a patch of *S. americanus* which fringes the shore. This patch of bulrushes is very thin. At Overmyer's spring *S. validus* is thin near the shore, but is abundant far out. It also grows on the shore here. There is a great patch in the water opposite the green boat-house and they grow abundantly far from shore in the Inlet marsh. From Norris Inlet halfway to Norris's they extend far out into the water. The eastern shore—on account of its pebbly and rather steep bottom—is wholly free from them and none is found until the patches in Culver Bay, south of the Academy grounds. One patch here is peculiar, very small, glaucus and soft. The scattered patches here are few, and pretty far out directly in front of the Academy grounds. Bulrushes also grow about the edges of Lost Lake, especially at the entrance of Lake Maxinkuckee Outlet, and they are found in scattered patches on Green's marsh.

Both *S. validus* and *S. americanus* occasionally present culms that grow in the form of a spiral. Because of the absence of mud, the great bulrush is not nearly so common and thick at Lake Max-

inkuckee as at many of the small lakes of Indiana. At Eagle Lake near Warsaw, this plant presented two distinct forms, one soft, easily crushed and pale glaucus, and the other bright green and very firm. The soft pale form was very rare at Lake Maxinkuckee, but appears to be increasing considerably of late years. At Eagle Lake, too, the bases of the culms were very frequently covered with green sponges, while this was not at all common at Lake Maxinkuckee. The parts of the plants above water seem to die very slowly and imperceptibly during the winter, and their bases under water remain fresh, succulent, and green down to the white base. On April 14, 1901, bases were washed up fresh and green. They seem to be pulled up somewhat by ice cakes. On April 30 the old bases were noted thickly coated with a much-branched fine sort of alga. By May 3, the plants were observed sticking up well out of the water in Lost Lake. On May 4 they were up and ready to blossom near the Outlet in Lake Maxinkuckee, and were observed in about the same condition May 10 in Green's marsh. By May 20 they were in blossom.

The rush-patches offer a retreat for small floating plants, and the patch north of the Ice-houses contained Wolffia, Spirodela and Ricciocarpus. This was the only place these plants ventured to grow in the lake except in the sheltered region near the Norris Inlet. Muskrats like to keep among rush-patches and use the stems to some extent in their nests.

### 40. THREE-CORNERED BULRUSH

**SCIRPUS AMERICANUS** Persoon

Very common, fringing the lake in patches wherever the conditions were favorable, as about Long Point, in front of the Barnes cottage, a small patch at Green's pier, a very long patch south of Green's extending to Murray's, south of the pond or marsh south of Farrar's, opposite the spongy spring hill on the southwest shore of the lake, by the green boathouse near Norris Inlet, and from Norris Inlet to beyond the Norris farm, where a long row of tall willows comes down to the lake. From this point to Culver Bay there is none, the descent of land to the water being too sudden. It begins again in occasional patches where the road comes down to the lake near Culver Military Academy, and a patch fringes most of Culver Bay in front of the grounds. It grows east of the Palmer House, and east of Lakeview Hotel and beginning again at the railroad pumping station it extends in pretty continuous patches to the Outlet. It seems to prefer a flattish bottom of mixed marl,

muck and sand, and rarely extends in water deeper than 18 inches or two feet. Where the bottom is level and shallow it will extend out into the lake considerable distances, but where there is more slope to the shore the belt is narrow. At Long Point a little grows on the shore; as also south of Green's. It grows in a swamp back of the ice-beach south of the lake. On the springy hill south of the lake a little patch grows on land quite a way back from the lake, while in a low, flat springy field along the lake near the Culver Military Academy grounds (across the road from the lake) there is a great continuous patch of this plant. Like the great bulrush, *S. validus*, and like the various species of Eleocharis, this plant spreads by means of rootstocks and proceeds out into the water in more or less straight rows. In the autumn the part above water gradually dies and turns brown, but the portion under water stays green all winter. It had begun to look dead and brown by September 28, 1900.

By May 5, 1901, it began to show in the bottom near shore as exceedingly short stubble; it soon showed up well and green at the edge of the lake; by May 25 the flower buds showed, and by June 7 it was in flower, though short (6 inches) in the lake.

A large patch of this species was observed on a bar at the edge of Tuttle's Island in the Auglaize River a few miles above Defiance, Ohio, all or nearly all of the culms of which were markedly spiral, and the patch as a whole presented a remarkable aspect quite unlike anything else that comes to mind, especially when the wind swayed them slightly and the masses of light and shade ran up and down them in a fantastic manner. There was something attractively tipsy in the appearance of the group, and this form, if it remained fixed, would be a valuable addition to parks containing ponds or lakes.

### 41. STIFF WHITE WATER CROW-FOOT

**BATRACHIUM TRICHOPHYLLUM** (Chaix)

Rather common in the lake near shore from the Ice-houses north to Culver; also common in Lost Lake near shore south of the Bardsley cottage. Some also found by the green boathouse. In flower in Lost Lake, June 8, 1901. The plants are many of them washed out by the high waves of autumn, but they strike root again. The leaves stay green all winter. Frequently in late autumn the plants are covered, as are most of the plants of the lake, by a thick growth of diatoms. Of recent years this species has increased in abundance and is now common along the shore south of the Ice-houses and in the neighborhood of Chadwick's pier.

### 42. TRUE WATER-CRESS

**SISYMBRIUM NASTURTIUM-AQUATICUM Linnæus**

Scattered in various places along the lake shore, as, at the Barnes cottage, along the north side near the Culver pier, and down near Farrar's. The largest patch was in the mouth of the small creek which enters the lake near the road, at Culver Bay.

### 43. KNOTTED SPIKE-RUSH

**ELEOCHARIS INTERSTINCTA (Vahl)**

This interesting plant is of local distribution in the lakes, there being several patches in Lake Maxinkuckee as follows:

(1) A large irregular patch north of Winfield's, extending in a sharp point some distance out into the water.

(2) A patch in the water opposite the hill between the pumping station and depot.

(3) A patch south of Farrar's, opposite the beginning of the forest.

(4) A good patch out from the hill southwest of the lake where the high bank comes down to the lake.

(5) Great patches by the green boathouse.

There was also a large patch in Lost Lake along the southwest shore.

This plant grows in rather dense patches, and projects high above the water, so the distribution is easily made out. In general appearance it resembles an Equisetum. The fruit is a cone-like affair. In the autumn the plants assume a beautiful golden color, but the tops quite quickly succumb to the frost and lop over. The plants showed above the surface of the water by May 30, 1901. The seeds are shed in autumn before the water freezes. The plants of this species are extensively used by the muskrats in the fall in building their winter houses.

### 44. ANGLED SPIKE-RUSH

**ELEOCHARIS MUTATA (Linnæus)**

Only one small patch of this spike-rush was found in the lake and this was in the neighborhood of the green boathouse west of Norris Inlet. The patch was so mixed in with other weeds—bulrushes and arrow-heads—that it was difficult to find. It grows in shallow water, hardly more than a foot deep, and projects well out of the water.

### 45. CREEPING SPIKE-RUSH

**ELEOCHARIS PALUSTRIS (Linnæus)**

This is one of the most variable in size and general appearance of all the spike-rushes, sometimes being tall and stout, and resembling a small bulrush, and at other times rather small and inconspicuous like its smaller relatives. One tall patch was found at Long Point, along the north side of that cape, and another by the green boathouse. It was also found at Fletcher Lake, near Logansport.

Like the other species of Eleocharis it grows in rather shallow water, hardly ever over a foot in depth, and never far out from shore. Like the other species, too, it spreads by means of rootstalks. It was sticking up well out of the water by May 28, 1901, at Long Point, and by June 6 was in blossom.

**46. ELEOCHARIS PALUSTRIS GLAUCESCENS Willdenow**

This form was found along the beach toward the south end of the lake.

### 47. NEEDLE SPIKE-RUSH

**ELEOCHARIS ACICULARIS (Linnæus)**

One of the most minute of the spike-rushes, common at the water's edge and in low, damp places, often appearing like a growth of fine stiff green hairs. The plants grow in straight rows like drills in every direction in shallow water near shore, forming networks. Patches were found in front of the Arlington Hotel; common on the west shore of Lost Lake, also at bottom of the Outlet, far down, and a large amount found at the tamarack swamp west of Lake Maxinkuckee.

In flower on Green's marsh, May 29, 1901.

### 48. BROAD-LEAVED ARROWHEAD

**SAGITTARIA LATIFOLIA Willdenow**

Found scattered along the shore at the water's edge usually in mud, but sometimes in sandy places, in which case the plants were small with rather narrow leaves, as at Long Point and at Outlet Bay, at Winfield's, etc. Usually it grows in mud, as in the region of Norris Inlet, and here the plants were stout and the leaves broad. Fruiting about September 28 near Winfield's. For propagation, in addition to seeds, these plants form large round bluish tubers about the size of a walnut. These tubers have a rich crisp yellowish interior and a pleasant sweetish taste, and seem to be formed here only exceptionally. The plants had sprouted well by May 24, 1903.

Leaves of a patch growing in a ditch near Farrar's were ornamented with white blotches while some of those growing at the edge of the lake had the leaves ornamented with dark purple spots.

### 49. PICKEREL-WEED

**PONTEDERIA CORDATA** Linnæus

Quite common in shallow water along muddy shores. Locations are as follows: Near Long Point; a large patch in the cut-off swamp between Farrar's and Overmyer's; by the Ice-houses, north of Winfield's; and off Culver Military Academy grounds. South of the marsh near Overmyer's, extending beyond Norris Inlet is a nearly continuous patch, the patch being largest in the vicinity of the green boathouse. Abundant also along Lost Lake outlet.

Pontederia is fond of growing in muddy bottom, from the bank to where the water is about 10 inches to a foot deep. The leaves succumb early to frosts in autumn, but the part below water and young leaves remain green. Cattle do not seem to dislike it, as the plants by the springy flat near Overmyer's field were neatly cropped off.

There is a peculiar attractiveness about this plant with its thick dark green leaves, and spikes of blue flowers with a central spot of yellow, growing in tropical luxuriance at the water's edge. It frequently makes a rather narrow zone between the stretch of *Scirpus americanus*, growing in water to the depth of 1.5 to 2 feet.

### 50. GREEN ARROW-ARUM

**PELTANDRA VIRGINICA** (Linnæus)

Not very abundant but scattered about in various wet places. It was most abundant at the Outlet, both at the head and along the margins. Plants were occasionally seen along the south shore of the lake, and were pretty abundant near Norris Inlet. They were also found in marshes west of the lake. In late autumn the fruits are abundantly scattered along the shore of the Outlet and of Lost Lake. The seeds, enclosed in a large dark-green spathe and surrounded by a clear jelly-like aril, are said to be a favorite food of wild geese along the Kankakee, where it is abundant.

### 51. BRISTLY SEDGE

**CAREX COMOSA** Boott

This very handsome and well-marked sedge grows in tufts in the water at the south end of Lost Lake and along by Norris Inlet.

So strongly aquatic is it in habit that it deserves to be placed among the water plants. The spikes were well developed in swamps by the Norris Inlet June 22, 1901.

### 52. BROAD-LEAVED CAT-TAIL

**TYPHA LATIFOLIA** Linnæus

This plant does not form extensive patches here as it frequently does elsewhere. There are a couple of small patches along the northwest shore of the lake north of the Ice-houses. There is a considerable patch along the railroad between Lake Maxinkuckee and Lost Lake, and another patch, a continuation of this, on the northeast shore of Lost Lake. The plants grow quite thick in a patch—the result of its propagating by underground root-stalks. It likes to grow in rich, soft, mucky soil, from hardly in more than a few inches of water to where the soil is simply soaked. In its moister situations it is associated with Scirpi (*S. americanus* or *S. validus*), and in its dryer, with sedges. Where it grows in water such algæ as Chætophora attach themselves to the submerged portions of the stem. Various marsh loving birds, as song sparrows, red-winged blackbirds, and particularly the marsh wrens, find it a good hiding place, and the latter bird most frequently chooses the cattail patches for nesting places. Some insects, among them grasshoppers, like the brown of the fruit, and frequently eat it off until the seeds are bare and show. The cat-tail generally comes apart, and the seeds with their fuzzy parachutes are distributed by the wind. In the autumn the leaves turn light brown and dead, beginning at the top and drying so gradually that it is impossible to say just when the stalk is fully dead.

### 53. SWAMP LOOSESTRIFE

**DECODON VERTICILLATUS** Linnæus

Common. There was formerly a narrow patch along the south shore of Outlet Bay, near the Outlet, but this has been removed by grading and cleaning out the brush at this place. It is common along the Outlet of Lost Lake but by far the greatest patches are along the sides of Norris Inlet where the wide border of these plants forms an almost impenetrable low thicket particularly hard to penetrate because of the loops made by the bowed-over plants. The tips dipping into the water entangle duckweeds and drift of all sorts, so that this plant is one of the most effective agencies in extending the domain of the sedgy marsh into the lake. This

species is remarkable for the great mass of spongy tissue about the bases of the stems.

In winter the muskrats feed to some extent upon the Decodon bark.

## Aquatic Plants of Lost Lake

The list of aquatic plants given above contains only those to be found in the larger lake and does not by any means include all that are to be found in the region. Very closely connected with Lake Maxinkuckee is a smaller lake known as Lost Lake, Little Lake or Little Lake Maxinkuckee. This lake, a comparatively shallow body of water with a rich muddy bottom, contains a remarkable assemblage of plants some of which are related to the fish life of the lake in a more striking manner than any of the plants of Lake Maxinkuckee. It is somewhat surprising that some, or most, of these plants are not found in Lake Maxinkuckee, especially in the vicinity of Norris Inlet, where conditions are very similar to those of Lost Lake. The various species of bladderworts are to be found in Lost Lake, as well as a species of milfoil and several delicate and exceedingly beautiful forms of Chara and Nitella.

In the discussion of the aquatic flora of Lake Maxinkuckee, any reference to the forms to be found only in Lost Lake has been sedulously avoided, and the incidental reference to Lost Lake, to those found growing in both lakes, was a rather unfortunate necessity, as it was not wished to interrupt the sequence or attract attention from the unity of the flora of the large lake. The fact that Lost Lake has some importance as a fishing resort justifies the addition, in an appendix, of the list of the aquatics to be found in Lost Lake.

### 1. RECLINED BLADDERWORT

**LECTICULA RESUPINATA (B. D. Greene)**

This bladderwort was not found in the region of the lakes until the summer of 1906. In that summer a dam was thrown across the Outlet of Lake Maxinkuckee at the railroad bridge, and as a result the water of Lost Lake drained rapidly away to a large extent, leaving broad beaches. Upon the broad beach thus formed, just south of the Bardsley cottage, the Reclined Bladderwort was found in abundance.

### 2. PURPLE BLADDERWORT

**VESICULINA PURPUREA (Walter)**

Found in flower, September 18, 1900, a little way down the outlet of Lost Lake in shallow water among the dense mixed vegetation

of *Nymphæa advena, Myriophyllum spicatum* and Ceratophyllum. It had previously been recorded from only one locality in the state, in Lake County, and was found about the same time by Mr. W. S. Blatchley in some abundance in Cedar and Mud lakes near South Bend. Winter buds were collected during the winter of 1900-1901 and a few were found in the same region in the early winter of 1904 and on subsequent occasions. An attempt was made to keep some of these plants in a small aquarium but they did not thrive. Under suitable conditions they should do so and would make very desirable plants for aquariums. Strictly speaking, this species does not form winter buds, as most of the bladderworts do. The short young upper leaves and branches simply coil up circinately after the fashion of fern buds, or the sundew, and remain in that condition until the growing season in spring.

This is one of the most graceful species of the genus, the whorled arrangement of the branches giving it the general appearance of a charad. The effectiveness of the rather small bladders as animal traps was not investigated.

### 3. GREATER BLADDERWORT

#### UTRICULARIA MACRORHIZA Leconte

Very common in the north end of Lost Lake, making considerable masses of vegetation; abundant also down the outlet of Lost Lake near Walley's. Common in the shallow ponds and ditches of Green's marsh, and found in a permanent pond east of the lake north of the Maxinkuckee road. Not nearly so abundant in the Lake Maxinkuckee region as in Twin Lakes a few miles farther north, where they grow in great abundance and most luxuriantly in one of the lakes.

The plants begin rather early in the autumn (September 17, 1900) to form hibernating buds which vary in size from that of a pea to that of a good-sized marble. The upper leaves of the plant coil up into an exceedingly firm ball, the lower leaves are shed, leaving the propagating buds at the end of a long delicate looking slender string, which looks easy to break but proves exceedingly tough and strong. The stem decays during the winter. The winter buds are held together by a sort of gluey secretion. They probably, most of them, sink to the bottom and remain all winter. However, in the winter of 1904, great numbers were found half sticking up out of the ice and half buried in it.

Winter buds placed in water in a warm room appear to behave differently, probably according to whether the bud was taken in its

early stages or after it had fully set. Some taken late in the autumn of 1912 were kept all winter in a warm room in a laboratory tank of still water, but made no signs of opening until spring, and then never amounted to a great deal.

If the buds, before too well set, are placed in a vessel in a warm room they open, they will grow rapidly and fill the vessel with surprising quickness. While many of the bladderworts remain a delicate translucent green, in many other cases the bladders develop a purple or violet color, and this hue in some cases becomes so deep that the bladders appear jet black or wholly opaque. Such plants, specially where they can be so arranged as to be compared with the green form, have a high ornamental value. A plant kept in a jar developed this rich color. One naturally thinks such bladders are full of insects or prey, but examination often proves them empty or nearly so.

In the early spring the buds expand and grow with great rapidity. Though no plants had been noted before April 15, 1901, on that date plants about two inches long, with bladders of good size, were observed in Lost Lake and Green's marsh and were of a fine purple color. By May 19, one flower seen in Green's marsh; abundantly in flower and bud in marsh north of Lost Lake; May 24 many flowers seen, same place.

Many of the bladders were opened and found empty. A number of bladders were examined in early summer and abundant remains of copepods and some ostracods were found inside the bladders.

It appears, indeed, to be in the autumn just before the leaves drop off and the bud forms for winter, that these bladders are most active in capturing prey. The structure of the bladder is peculiar, the whole organ bearing considerable superficial resemblance to a water flea (Daphnia), the long guides projecting from the mouth of the bladder resembling much the anterior legs of the crustacean. The plant probably needs an extra amount of food just before going into hibernation to store up as well as to get material for the mucilaginous secretion, and possibly the entomostraca and hydrachnids, benumbed by the coming winter's cold and seeking a place to hibernate, find a place for a long sleep by snuggling up between the guiding hairs and under the fatal trap door. Some collected in late autumn in Twin Lakes had the bladders crammed with various organisms, especially with a red hydrachnid that showed brightly through the thin membranes of his trap. Concerning the relation of this plant to fishes, Mr. E. G. Simms, Jr. (Fishing Gazette, May 31, 1884, quoted in Bull. U. S. F. C. IV, 1884, 257-8), speaks of it

as destroying newly hatched perch and roach by catching them with its bladders, the fish usually being caught by the tail. As an example of its destructive powers, he mentioned the fact that of 150 newly hatched perch placed in a glass vessel only 1 or 2 were alive 2 days subsequently. Under natural conditions it is not to be supposed that by any means so large a percentage of fishes would be entrapped. Prof. H. N. Mosely (l. c. 259, 260, quoted from Nature, May 22, 1884) gives an account of the same case in fuller detail, and, in a letter to Prof. S. F. Baird (l. c. 261) gives further interesting notes, ending with: "I have not found any case of a young fish trapped by any specimen of Utricularia taken from the pond in which it grows here, although there are many fish in the pond."

Prof. S. A. Forbes (Bull. U. S. F. C. IV, 1884, 443, quoted from Forest and Stream of September 4, 1884) speaks of the possible injury Utricularia may cause by entrapping crustacea which form fish food. In 10 bladders of *U. macrorhiza* taken at random he found the remains of 93 animals representing at least 28 species, of which 76 individuals, representing 20 species, were entomostraca, and he concludes that the plant "habitually and continuously contends with them (young fry) for food, and it may be said to thrive largely at their expense."

### 4. FLAT-LEAVED BLADDERWORT

#### UTRICULARIA INTERMEDIA Hayne

Abundant both in Lost Lake, in the flat meadow north of it, and in Green's marsh. The water form differed so much from the land form that it was only by repeated comparisons and study of the two that their identity was established. The land form lies prostrate on the ground with conspicuous two-ranked leaves. The bladders are borne on separate stems; they appear to be few on the aquatic plants and in the land forms they grow more or less under ground. They are larger than those of any other species observed, and possess no chlorophyl so that they are entirely transparent. No organisms were observed in any of them, but they have curious large glands in the interior. The leaves of the water form are differently arranged and are rather inconspicuous. It makes firm winter buds which are much smaller than those of *U. macrorhiza*. On April 25, 1901, it was observed growing in good shape, with large bladders, in Green's marsh. Observed again on May 19 when the first flower was seen; May 24, many flowers seen.

### 5. LESSER BLADDERWORT

**UTRICULARIA MINOR Linnæus**

Found in Lost Lake among the other bladderworts. A small inconspicuous form. Small buds about the size of pinheads or a little larger were found in Lost Lake during the winter which appeared to belong to this species.

### 6. HUMPED BLADDERWORT

**UTRICULARIA GIBBA Linnæus**

This species grows quite abundantly on the sand on the west shore of Lost Lake, coming somewhat into shallow water and extending back a distance into the boggy soil. Here, in early September, 1900, the sprinkling of the numerous yellow flowers made the patch quite attractive.

### 7. WEAK-STALKED CLUB-RUSH

**SCIRPUS DEBILIS Pursh**

Not common. A few plants found on the west shore of Lost Lake at the water's edge, August 30, 1900. Not found in Lake Maxinkuckee.

### 8. SPIKED WATER-MILFOIL

**MYRIOPHYLLUM SPICATUM Linnæus**

Not common, except from the south end of Lost Lake and on down the outlet. A few plants were found in the pools along the railroad between the lakes. This species is considerably more graceful than *M. verticillatum*. In the pools along the railroad and in the stagnant waters of Lost Lake the plants decay quickly in autumn, the apex, which assumes the form of a compact pear-shaped winter-bud of a copper color, alone remaining. Some distance down the outlet this plant was very abundant, and here, where the current was rather swift, it did not decay, nor form these buds, but retained its summer condition.

### 9. TWIG RUSH

**MARISCUS MARISCOIDES (Muhlenberg)**

A bulrush-like plant, found among other rushes close to the water's edge. Found only in a small patch growing along the west shore of Lost Lake.

## The Ferns, Fern-Allies, and Seed-Bearing Plants

In the systematic arrangement of the families and species in this annotated list of the Ferns, Fern-Allies, and Seed-bearing Plants of the Lake Maxinkuckee region, we have followed the second edition of Britton and Brown's "Illustrated Flora of the Northern United States, Canada, and the British Possessions" (New York, 1913). We have also endeavored to follow the same work in the spelling, capitalization, and punctuation of the scientific and vernacular names. This, however, has caused us much embarrassment, as the "Illustrated Flora" is full of inconsistencies and absurdities in all these matters.

Although the aquatic species have been fully discussed in the two preceding lists, it has been decided, for the sake of completeness, to include them in the present chapter.

### Family 1. Ophioglossaceæ. Adder's-Tongue Family

#### 1. TERNATE GRAPE-FERN

BOTRYCHIUM OBLIQUUM Muhl.

This fern is not common about Lake Maxinkuckee, and indeed, does not appear to be particularly common anywhere within the state. It is never found in patches, but usually occurs singly or two or three individuals scattered here and there in rather open woods. Examples were found in moist woods near a small pond on the east side some distance back from the lake. It was also found growing in damp woods on the Zechiel farm south of the lake.

This fern is not often found in fruit in the vicinity of the lake. It sends up from a short erect rootstock only one or two leaves, which are thick and fleshy. The leaves do not die down in winter, but take on a rich coppery-red or bronze tinge, a color assumed by the great majority of our plants with thick persistent leaves (red cedar, Lonicera, Galax, etc.) A microscopic section of the winter leaf shows that the chloroplasts are the seat of the red color and that the redness is probably due to the fact that the chlorophyl has passed into a resting condition.

All examples seen at the lake had entire rounded lobes and belong to the form known as *B. obliquum*. As found in some places there is wide variation in the form of frond-segments, these in some cases being cut up into finely dissected acute segments. Both forms are found at Ft. Wayne, Indiana, and both are common about Washington, D. C.

At Brookland, D. C., a clump of young plants was found, all apparently offsprings of a single plant, and in all probability of a mature individual found in their midst. The mature plant was of the finely dissected form, and of the young (about nine in number) two were finely dissected and the remainder round-lobed.

The low habit of this plant makes it rather inconspicuous during the spring and summer. At this time it cannot compete with the tall-growing ferns as an ornamental plant, and will never perhaps grace gardens made to please the popular eye, which demands flaming azaleas and gorgeous hollyhocks and dazzling Poinsettias. It has a distinct place, however, in adding to the beauty of the world. Like the blossom of the last witch-hazel in autumn, or the hood of the first skunk cabbage in spring, or the red and gray of the lichen and the green of the saturated moss, it makes a ramble in the sere and barren woods pregnant with the possibility of a discovery, and full of hope of the occurrence of a real event.

The plant yields to culture very well, and one planted in a city dooryard flourished year after year without any especial care. Here it passed unnoticed during the heydey of summertime, but later in autumn when flowers were frosted and leaves were fallen and brown, it was especially attractive; the bright green of its summer coloration being tinged with the edge of rose that later spread over the whole leaf.

The clump of little plants spoken of above, showing variation in foliage-form, has been potted. Though most of them appear to be thriving they are as yet too small to tell how they will succeed as potted in clumps. It appears doubtful, however, whether they will have the same charm as they exhibit in their native woodlands.

Sometime, perhaps, our larger cities will have winter-parks, where bittersweet and waxwork and fever-bush, clematis fuzz and wild yam pods, and Christmas fern, and a dozen other things every botanist can think of will show their best during the most cheerless season; and then, in some little nook, the ternate grape-fern will come to its own.

### 2. RATTLESNAKE-FERN; VIRGINIA GRAPE-FERN

BOTRYCHIUM VIRGINIANUM (L.) Sw.

This species is considerably more abundant than the preceding and is found scattered in rich shady woods, such as Farrar's and Walley's. In leaf-texture and habit this plant is in marked contrast with the other. It fruits quite abundantly, and the thin leaf, which withers very quickly upon being plucked, dies down early

in autumn. The plants were up well by May 24, 1901, in Farrar's woods. Herbarium specimens collected southwest of the lake June 26, 1901.

## Family 2. Osmundaceæ. Royal Fern Family

### 3. ROYAL FERN

OSMUNDA REGALIS L.

This tall handsome fern is quite abundant in Walley's swamp, where it grows in large tussocks, often to the height of four or five feet. On September 23, 1900, the ground, or rather peat, of this swamp was covered in places by prothallia of a fern, doubtless this species. On May 12, 1901, the plants were well up. The species was also noted in swamp places in Farrar's woods.

The Royal Fern usually grows in rather deep woods about the edge of ponds and swamps. It does not closely resemble the other ferns of the genus or indeed any other fern, and is attractive as much for its "otherishness"—oddity is not just the word—as anything else. The form of leaf and venation remind one of fossil forms, rather than common living species.

### 4. CINNAMON-FERN

OSMUNDA CINNAMOMEA L.

This is one of the stateliest and most handsome of our native ferns, often growing to a height of five feet or more. A great patch crowned a hillside bordering the southeast side of Lost Lake plain, and it was generally distributed throughout the flat low forest between Murray's and Farrar's along the old road that ran near the shore of the lake.

About the middle of September, 1900, the plants of this species were observed to be sending up from the base peculiar furry protuberances, which, from subsequent observations, appear to have been the buds for the next year's growth. These dense brown wooly conical buds were observed early the next spring. By April 22 they began to show active signs of growth, and five days later they were six inches high, but not unfolded. The spores, which are borne in great abundance in peculiar brown contracted fronds were nearly ripe by May 12. On September 17, 1900, a large number of prothallia were found near and under the parent plants.

This fern is frequently planted in city yards but does not appear to thrive well in such places, as they are usually too dry for it, and the situation too cramped and crowded.

In a tamarack marsh near Lake of the Woods, Ind., in 1909, quite a number of the intermediate fronds, where the foliaceous fronds are more or less contracted and spore-bearing, were observed.

### 5. CLAYTON'S FERN

OSMUNDA CLAYTONIANA L.

This fern very closely resembles the preceding in general appearance and habits, and grows even somewhat taller. During the fruiting season they are easily distinguished. In this species the spores are borne on some of the middle pinnæ of foliaceous leaves, the pinnæ bearing the spores being much contracted and brown. It does not appear to be so common about the lake as the preceding. Some plants were found in the low-ground marsh along the road west of Farrar's.

## Family 3. Polypodiaceæ. Fern Family

### 6. SENSITIVE FERN

ONOCLEA SENSIBILIS L.

This fern is quite common in the vicinity of the lake, especially in flat, moist, rather open, places. It grows most abundantly and bears fruit to the greatest perfection in a swamp at the edge of Zechiel's field, across the railroad from the birch swamp. It was also observed in Green's marsh back of Long Point. It was well up in leaf by May 12. Spores were well ripened by September 18 and dead ripe September 27.

### 7. BRITTLE FERN

FILIX FRAGILIS (L.) Underw.

This bright green delicate fern, which is usually quite common throughout the state in grassy open places at the edges of woodlands, is not very common near Lake Maxinkuckee. A few plants were found at the edge of Culver's woods northeast of the lake, near where the road approaches the shore.

### 8. CHRISTMAS-FERN

POLYSTICHUM ACROSTICHOIDES (Michx.) Schott

Not especially common in the neighborhood of the lake. A few plants occur on a bank in Overmyer's woods. It also clothes the steep sides of the steep gully northeast of the lake known as the cañon. It appears to have no special time for fruiting, as fertile fronds can be found through the year.

Among the plants that give grace to the woodland and charm to the world, the Christmas Fern holds an eminent place. In many places it is about the only plant that furnishes considerable masses of green throughout the barren portions of the year, and the only thing which furnishes both the greenness of summer and the grace of fern. On account of its commonness, however, it is generally much undervalued.

In places where landscape gardening can be carried on on a large scale, especially in the Zoological Park at Washington, D. C., this plant is becoming much used in the planting of steep banks. It is worthy of a place in city parks where there are either natural or artificial terraces. It thrives very well in pot culture and is not greatly inferior in appearance to the "Boston Fern." There also frequently occur forms with cut-lobed pinnæ, or even bi-pinnatifid forms which yield considerable variety.

### 9. NEW YORK FERN

DRYOPTERIS NOVEBORACENSIS (L.) A. Gray

One of the most abundant ferns of the region, growing plentifully among grasses and sedges of the flat meadows and lake plains. The fronds stand rigidly upright, the fertile appearing considerably contracted after fruiting, due to the fact that the edges of the frond roll up. Observed coming up finely in marshes May 11, 1901. The spores ripen in August. It is the abundance of this fern upon the peaty prairies that gives a pleasant fragrance to the wild prairie hay. It was common on the flat west of Long Point.

### 10. MARSH SHIELD-FERN

DRYOPTERIS THELYPTERIS (L.) A. Gray

Not so common as the preceding. Found growing in similar situations and considerably resembling it in general appearance, but distinguished by the fact that the lower-most pinnæ are nearly as long as the middle one.

### 11. CRESTED SHIELD-FERN

DRYOPTERIS CRISTATA (L.) A. Gray

The Crested Shield-fern is not very common about Lake Maxinkuckee, nor indeed, is it generally abundant in the state. It is usually found about the edges of woodland ponds, in most cases growing in the moss that skirts the roots of old trees or stumps, or covers half sunken logs. It generally prefers deep woodlands, but is quite persistent where once established, continuing to thrive

after the removal of timber has greatly changed original conditions. A few plants grew at the edge of Zechiel's pond, and it was fairly common about a pond on the east side of the lake, back of Van Schoiack's and about a pond northeast of the lake.

In sheltered locations this fern remains green all winter. It is so uncommon that stumbling upon a clump in the winter is always a pleasant surprise and in many parts of the country, it is, during the winter, the daintiest thing out doors. The stem is very limber and drooping so that it is not very good as a cut plant. It is doubtful whether it would be satisfactory in parks or landscape gardens. It harmonizes best with wild landscapes in great tracts.

### 12. SPINULOSE SHIELD-FERN

**DRYOPTERIS SPINULOSA (Muell.) Kuntze**

A finely-cut, shy fern usually found in deep rich woodlands. A few examples were found scattered through Farrar's woods.

### 13. BROAD BEECH-FERN

**DRYOPTERIS HEXAGONOPTERA (Michx.) C. Chr.**

A rather common fern throughout the state in dry woods, under trees and in leaf-mold. Not abundant at the lake; most of the plants seen were on the east side. It was most common along gulleys northeast of the lake. It does not grow in clumps but usually is somewhat scattered, only a few fronds in a place. It is one of our earliest plants to die down in autumn. At the end of the growing season the leaves slowly fade to a creamy white before losing their form. They are particularly attractive at this time, and during all the summer have a faint pleasant fragrance.

### 14. VIRGINIA CHAIN-FERN

**ANCHISTEA VIRGINICA (L.) Presl.**

This tall handsome fern is very abundant in Hawk's marsh, where it grows in pure peat moss and forms a characteristic zone outside of the sedge zone, overtopping the low heaths. It grew also pretty abundantly along the east side of Lost Lake outlet in Walley's woods, and bordered the islands and banks of the outlet plain far down toward the Tippecanoe River. The fruit makes interesting and attractive patterns on the back of the leaf. The long stout rootstock with the bases of old fronds attached, often persists along the surface of the ground after the ferns have disappeared, and much resembles the trunk of a tree-fern.

### 15. NARROW-LEAVED SPLEENWORT

**ASPLENIUM PYCNOCARPON Spreng.**

This fern is quite rare in the region about the lake, and, indeed, is very scarce throughout the northern part of Indiana. It usually occurs in rich deep woods. Our specimens came from northeast of the lake. A few were found in rich woods near Plymouth which is about 10 miles north of the lake. It is a thin delicate fern, bearing some general resemblance in form to the Christmas fern. It withers quickly on being cut.

### 16. SILVERY SPLEENWORT

**ATHYRIUM THELYPTEROIDES (Michx.) Desv.**

A specimen of this fern was collected by Dr. Scovell in 1900, probably in Farrar's woods.

### 17. LADY-FERN

**ATHYRIUM FILIX-FOEMINA (L.) Roth**

This delicate, pretty fern is occasional in Farrar's woods, in moist shady places in rich ground.

### 18. MAIDEN-HAIR FERN

**ADIANTUM PEDATUM L.**

This dainty well-known fern is fairly common in some places in Farrar's woods. A few were found also near a pond back of Culver's, on the east side of the lake. Some also grew near a pond by Busart's field. Most of the plants were rather small, and it does not attain the luxuriance of growth near the lake that is often observed in moist rich woods. In well protected situations it retains its form, and frequently its color, late into the winter. In spite of its delicate appearance it does not crumple up at the first touch of frost, but the fronds frequently ripen and bleach out gradually after the manner of the beech-fern.

The Maiden-hair Fern is one of the plants to rapidly disappear before the march of civilization and in many places it is becoming quite rare. It thrives only in the humid, dusky depths of thick woodlands, and such changes as pasturage and thinning out of forests quickly cause it to die out.

### 19. BRAKE; BRACKEN; EAGLE FERN

**PTERIDIUM AQUILINUM (L.) Kuhn**

This coarse, well-known fern grows abundantly in the region of the lake and is particularly common in the open sandy ground

along the railroad south of the lake. It also grows in low woods among the brush. It has a world-wide distribution and was originally described from Europe. It was observed commonly up well by May 12. The spores ripen in August.

## Family 1. Equisetaceæ. Horsetail Family

### 20. Field Horsetail

#### Equisetum arvense L.

The Field Horse-tail has a very wide distribution, ranging through the northern part of North America, Europe and Asia. It is usually found in sandy soils along roads and railroads. Railroad embankments form a favorite habitat and on high steep slopes where the railroad has been graded up considerably the peculiar pale fertile fronds of this species, looking somewhat like odd mushroom growths of some sort, make conspicuous patches in early spring, and are followed later, after these have withered away, by the symmetrical little conical sterile plants which look like miniature evergreens. The peculiar distribution of the species in this country, along the well trodden ways of civilization and travel, points to the possibility that it may be an introduced species, the spores perhaps, carried with the dust of trade. At the lake it was most abundant along the railroad and along the road down by Farrar's.

The fertile fronds have a rather long season in spring, coming up in favorable localities considerably earlier than in others. By April 15, 1901, the spores were ripe by Farrar's. By April 17, plants along the railroad by Winfield's were up abundantly, and by April 26 the spores along the railroad south of the lake were nearly all shed. The sterile shoots began to appear April 28. There is considerable difference in the appearance of the individual sterile fronds; some leaves which form the fringing being absent, so that the node is unfringed. The form in which the whole plant is nearly prostrate (var. *decumbens* Meyer) is quite frequent. On September 28, 1906, some of the green, branching fronds along the railroad back of the cornfields were observed bearing cones of fruit. These represent the variety *serotinum*. On moist mornings in autumn the tips of the branches of the sterile plants were observed heavily covered with transpiration drops, showing that physiological activities had been going on quite actively at the time. The fronds were observed still quite green as late as November 19.

The fertile fronds bear spores quite abundantly and these can be collected in fair-sized masses by simply shaking them out of the spore cone. They are gray-green in color, and are remarkably sensitive to changes of moisture; breathing upon a spore mass causes it to fluff up, while drying causes it to occupy small space. This change of appearance is due to two long appendages to each spore which unfold or fold up according as moisture is added or withdrawn.

Most of our specimens collected represent the form known as *E. pseudo-sylvaticum*.

### 21. SWAMP HORSETAIL

EQUISETUM FLUVIATILE L.

This smoothish, dark-green horsetail is usually found growing in the edges of ponds in shallow water. There was a large patch at the edge of the pond bordering the lake just below Farrar's, and a small patch grew in the edge of the lake below Winfield's.

The plants did not fruit heavily in the region of the lake, and after fruiting they put out numerous branches in whorls. All examples collected belonged to the variety *verticillatum*.

At the opening up of spring, this plant first manifests itself by the appearance of a pale cone-shaped growing point very near the surface of the ground. This growing point was noticeable by April 9. By May 14 the plants were quite conspicuous and by May 27 they were in fruit.

A large clump of these plants, heavily laden with sparkling transpiration drops, on a moist morning, is a sight that lies out of the beaten paths of travel and worth getting up early and going a good way to see. Even to those familiar with the great variety of form exhibited by plant life, it has an out-of-the-way, archaic appearance and makes one think of pictures of carboniferous landscapes.

### 22. STOUT SCOURING-RUSH

EQUISETUM ROBUSTUM A. Br.

The Stout Scouring Rush is fairly common about the lake, growing quite thickly in patches on the steep slopes which form the bank of the lake. It grows both in open and rather well wooded situations, though not usually in dense shade. There was a large dense patch on the steep bank at Lakeview Hotel, and it was common all along the bank on the east side of the lake. There were also a

few scattered small patches on the west side of the lake. It also grew along shore south of Green's.

These hillside plants were fairly large (about 4 feet high) but did not attain the immense size recorded for the species—8 to 10 feet high and an inch in diameter. These gigantic forms are to be found in the rich black mud along the Missouri River.

This horsetail presents much the same appearance all the year round, except that it is a brighter green during the summer months and becomes a brownish green during the winter. Cones of fruit can be found on the apices of some of the stems the whole year round. Growth takes place at the nodes in the portion covered by the sheath and during the growing season the plants can be easily pulled apart at the joints, but during the winter these parts harden and it is difficult to pull the plant apart.

In late autumn the hollow joints are filled with water, which runs out copiously upon pulling the joints apart. This freezes into a solid core of ice during the winter, but does not burst the stems.

Along the Yellow River near Plymouth in 1909, a peculiar spectacle was exhibited by a patch of these plants which had been coated by mud during the early part of the year, while the river was in flood. The plants had grown considerably afterward and displayed alternating bands of yellow where coated with clay, and green, the new growth. By completely staining these plants at various intervals, fruitful studies could be made concerning the rate of growth.

This plant contains an abundance of silex in its composition, so much that it has been used for scouring utensils. By soaking the plants in a mixture of aqua regia, which dissolves out everything but silex and cellulose, and then by soaking the remaining portions in cupro-ammonia, produced by placing copper filings in ammonia, to remove the cellulose, delicate glass skeletons can be formed. Even the guard-cells of the stomata are silicified.

When these plants are decapitated they frequently put out slender branches.

### 23. SMOOTH SCOURING-RUSH

EQUISETUM LAEVIGATUM A. Br.

This species, which was not very common about the lake, is smaller and smoother than the preceding. It grew along the railroad near the lake, and some was found in fruit June 20, 1901. There was also a thick patch on the hillside south of the Plank cottage on Long Point.

## Family 5. Lycopodiaceæ. Club-moss Family

### 24. BOG CLUB-MOSS

**LYCOPODIUM INUNDATUM L.**

Although several species of club-moss might be expected in the region of the lake, only one, the bog club-moss, was seen. It was quite rare and possibly disappearing. A few plants were found in a sphagnum bog in Walley's woods.

## Family 6. Selaginellaceæ. Selaginella Family

### 25. CREEPING SELAGINELLA

**SELAGINELLA APUS (L.) Spring**

This dainty little plant is not particularly common about Lake Maxinkuckee. It is, however, pretty widely spread about the lake plains. It grows almost entirely in the flat black ground, especially in springy places, near the lake. A number of patches were found in the flat north of Lost Lake and there are scattered patches in a springy flat by Norris's. It is fairly common down the outlet. It was observed in fruit June 21, 1901, north of Green's marsh. It is quite abundant about Eagle Lake, Kosciusko County.

It remains green all winter, and on account of its hardiness, would probably make a very satisfactory pot plant. It is quite as pretty as many of the forms seen in greenhouses.

## Family 7. Pinaceæ. Pine Family

### 26. LABRADOR PINE; GRAY PINE

**PINUS BANKSIANA Lamb.**

This species is not strictly native to the region of the lake, and has not become established. It is, however, a fact of too much interest to leave wholly unnoticed, that a small pine tree probably of this species sprang up at the north edge of Lost Lake about 1904, and grew quite rapidly for several years. The browsing of stock and whittling of men or boys proved too much for it, and it gave up the struggle and died about 1908. The place where it grew was of barren, drifting sand. The native forest, mostly of scrub black oak, had been cut away and the wind was cutting a great gully and shearing off the top of the hill, leaving a bald yellow spot conspicuous for a great distance away, the surface of the ground being covered with fragments of rocks too heavy for the wind to carry away, and wind ripple marks and animal tracks.

The young pine may possibly have sprung from evergreen trees of some neighboring farmyard, or it may have been one of the advance guard of the dune flora advancing on the region. At any rate, it indicated significantly what might be done to prevent the blowing of soil away and suggests that an evergreen nursery on the place might yield profitable results.

### 27. AMERICAN LARCH; TAMARACK

LARIX LARICINA (Du Roi) Koch.

The Tamarack was once a common tree in the neighborhood of the lake, but it is now rapidly disappearing, as it is throughout much of the country, on account of drainage. There are remains of large tamarack bogs a few miles west of the lake, a few miles southwest, and some a few miles to the northeast. A few isolated trees are found about the edge of Inlet marsh, and there are remains of a few trees down the outlet.

The tamaracks, or tamarack bogs, form a feature of the landscape quite peculiar and apart. They usually occur in kettle holes or lake plains where there is little or no drainage. Many of them occupy the beds of ancient lakes. Lost Lake, which is a sluggish expansion of the outlet of Lake Maxinkuckee, has patches of sphagnum growing on the borders of its plain and at the water's edge, which seems to indicate something like the beginning of a tamarack marsh. Hawk's marsh, which contains no tamaracks at present, very closely resembles a tamarack marsh. The tamarack marsh is usually a peat bog almost impenetrable about the edges on account of the dense growth of various shrubs—such as poison sumac, mountain holly, blueberry brambles, and the like, all growing together in an impenetrable mass. Beneath the tamarack trees is a region of continual gloom, with springy hummocks of peat moss, much like immense wet sponges. Just out of the denser shadows grow the pitcher plants, droseras, and various heaths and orchids. The perpetual gloom of the tamarack swamp makes it attractive to shy animals which have elsewhere become scarce or have entirely disappeared. Owls and hawks are common, and here the partridge drums or rises in precipitous whirring flight. Few of our native trees, except the cottonwood, are so vocal. The tamarack swamp southwest of the lake, consisting of trees of all heights and ages, each forming a perfect spire and glistening gray with dew, formed an unusually attractive spectacle in 1906. It has since been cut out.

The tamarack is one of the earliest of our trees to leaf out in spring, and one of the latest to shed its leaves in autumn. Before falling, the leaves turn to a clear bright gold. The trees had begun to show green by April 27, 1901, and were still quite green November 4, 1906. The wood of the tamarack is very hard and durable in contact with the soil, and it is valuable for posts. The tree rarely gets large enough to make into saw timber and is rarely or never used for that purpose. Wounds in the tree cause the exudation of a clear resin which dries to a white firm gum that is very agreeably odorous. The tree bears transplanting to uplands well. The tamarack swamp northeast of the lake which had been drained and was being cleared in 1904, differed in some details in flora from those west of the lake. It contained considerable sweet-birch and wild red raspberry, and in that particular resembled those of the Lake-of-the-Woods, Ind., region, which belongs to the Kankakee system.

The largest tamarack swamp or grove in this part of Indiana, and so far as we know the most southern one in the state, is a short distance northeast of Kewanna, about 12 miles south of Lake Maxinkuckee, on the east side of the Vandalia railroad from which it may be easily seen. This grove covers many acres. The trees are unusually large and the grove is very dense and interesting.

### 28. RED CEDAR

#### JUNIPERUS VIRGINIANA L.

A few small Red Cedar trees were found crowning the steep bank of the lake on the east side a little north of Van Schoiack's. They were probably seedlings from dooryard trees. Like many plants whose leaves are persistent, this plant turns quite red in winter. The red cedar is generally quite scarce in northern Indiana and is usually found, when it occurs, in sandy or gravelly places in the regions about lakes. It is often planted in dooryards. By far the greater number of trees appear to be staminate. Whenever a pistillate tree occurs it usually bears heavy crops of blue berries. These are eagerly eaten by birds, especially house sparrows, which scatter the seed, so that the woodlands near a house where a bearing tree is found, are usually well scattered with young trees. In the southern part of the state the young seedlings are abundant in woodlands and pastures and are in places almost a nuisance, forming prickly shrubs something like a permanent thistle.

## Family 8. Typhaceæ. Cat-tail Family

### 29. BROAD-LEAVED CAT-TAIL

**TYPHA LATIFOLIA L.**

The most extensive patch of cat-tail about the lake is that along the north end of Lost Lake. It also grows abundantly in low ground between the lake and Culver, and fringes the shore of the lake from the Assembly grounds down to the vicinity of the ice-houses. There are numerous scattered patches in the marsh about Norris Inlet. A fringe grows on the west side of Lost Lake, and it borders the outlet below Lost Lake in places. There is none along the east or north shores of Lake Maxinkuckee. East of the lake, up Aubeenaubee Creek, however, there are extensive cat-tail marshes. Wherever it grows the cat-tail forms dense patches. It thrives best in a rich soft mucky soil. It rarely grows out in more than six inches of water, and grows out on shore only as far as the soil is soft enough and well saturated. The cat-tails growing farthest out in the lake are associated with bulrushes, while those growing on drier land are intermixed with sedges. Where it grows in water, such algæ as Chætophora are frequently attached to the submerged portion of the stem. The song sparrows, red-winged blackbirds and marsh wrens find the cat-tails a good hiding place, and the wrens almost invariably build their nests in the cat-tail patches and all the large patches contained the queer globular nests of this bird.

The muskrats are fond of dwelling in the cat-tail patches, making their houses partly of the stalks and sometimes feeding on the root-stocks. The seeds with their downy covering are said to have some market value for the purpose of stuffing pillows and on one occasion the local newspaper had an advertisement of a firm wishing to buy them. The leaves appear from a sharp cone-shaped bud in early spring. Green leaves were noted by the third of May, 1901, and the plants in Green's marsh were in blossom by the twelfth of June. With the approach of autumn the cat-tail gradually turns brown and dies. The heads gradually wear away during the winter, probably assisted somewhat by the pecking of birds. They were looking quite ragged by November 2. The seeds probably germinate, for the most part, in spring. One head, water-soaked and with most of the seeds all sprouted, was found at the north end of the lake in autumn, but this was probably an exceptional case.

Along with the sedge patches, the patch of cat-tails north of

Lost Lake formed a choice skulking place for rails, and the fishing or frogging grounds of a great bittern or "thunder pumper" who found the color of the brown stalks a good match for his own brown color.

Where the cat-tails grow out into the water, as they do north of the icehouses, they check the force of waves and form a kind of harbor where duckweeds and other storm-tossed small organisms may find refuge. Just at the water's edge they form a favorite climbing place for the marsh snail, Succinea, and some of the smaller Polygyras.

## Family 9. Sparganiaceæ. Bur-reed Family

### 30. SIMPLE-STEMMED BUR-REED

SPARGANIUM SIMPLEX Huds.

Although the conditions seemed in every way favorable for several species of bur-reed, only the above-mentioned species was observed, and it was found only at the mouth of Norris Inlet, in a shallow pond, and up Aubeenaubee Creek, not far from the lake. Not seen in fruit, but found in flower in the summer of 1901, June 26.

## Family 10. Zannichelliaceæ. Pondweed Family

### 31. COMMON FLOATING PONDWEED

POTAMOGETON NATANS L.

This, one of the most common and widely distributed of the pondweeds, does not cover large areas in Lake Maxinkuckee, but is frequently found in small scattered patches in shallow water near shore frequently associated with other pondweeds, especially *P. pectinatus*. It was not noted in water over six or eight feet deep. Among the localities at which it was noted were: a few plants near McSheehy's pier, a good patch near Murray's, a patch south of the old ice elevator, some in lagoons on Long Point flat, a small patch by Darnell's, a dense thick patch near Overmyer's springy flat, and at the delta at the mouth of Spangler's creek.

It was common in the black muddy bottom at Lost Lake. Here, however, no floating leaves were produced. Some grew in the thoroughfare between the lakes.

*P. natans* grows either in sandy or mucky bottom and retains its form and green color after ice has formed over the lake, and probably some plants live the whole winter through. It produces

a new growth rapidly in spring. By May 30 slender phyllodia had been developed on the plants in the thoroughfare, and broad floating leaves were beginning to show well. It was noticed in flower June 24.

### 32. LARGE-LEAVED PONDWEED

**POTAMOGETON AMPLIFOLIUS Tuckerm.**

The large-leaved pondweed is one of the most attractive species in the lake, the large gracefully curved delicate green leaves showing up from under water very handsomely. It prefers rich mucky soil and water of moderate depth. It is rarely found in water shallower than about six feet, and is not abundant in water much deeper than twelve to fourteen feet although it has been dredged up at a depth of twenty-four feet. In shallow water it has oval smooth floating leaves, quite unlike the submersed thin and curved ones, and much like the floating leaves of *P. natans*, to which it is closely related. In deep water all the leaves are submersed. Good-sized patches are common in the vicinity of the icehouses and in Outlet Bay. It also is found at the Weedpatch and near the Inlet region. One large patch is present off the green boathouse near the Inlet. Chara and some of the smaller species of pondweed such as *P. pectinatus*, frequently grow intermixed with it. Where it grows very densely, however, it seems often to exclude other species.

The large-leaved pondweed makes a shady covert where fishes, especially perch and bluegills, like to hide. The young of some species of snail are common on the underside of the leaves. The Bryozoan, *Plumatella*, often grows quite abundantly on the leaves and perch eat the leaves, apparently for the Plumatella. The bluegill, which is quite largely a vegetarian, eats abundantly of the tender leaves.

In the autumn the older leaves grow weak and flabby. They shed from their surface casts of lime with which, during the growing season, the leaves have coated themselves. These casts, much like plaster or cement casts, frequently cover the bottom around the plants in considerable numbers, and perhaps help considerably in the formation of marl. The young leaves of the extreme tip of the plant, and of its branches, remain green and living the winter through. Rootlets are often put out in late autumn just beneath the terminal buds. These buds break off and float about until spring when they find places of attachment. The plants are widely distributed in this manner.

During the summer the resistance offered by the ample foliage of this plant to the movement of the water has a pronounced effect during storms. The water surface over a patch of this species is often quite calm while the surrounding surface is considerably ruffled.

### 33. RIVER PONDWEED; LONG-LEAVED PONDWEED

**POTAMOGETON AMERICANUS Cham. & Schl.**

The long-leaved pondweed is common in small patches about the lake, especially in shallow water near shore. It thrives well in sandy bottom. The floating leaves considerably resemble those of *P. natans* but are longer and narrower; the submersed leaves are translucent, and wavy-edged. Among the numerous localities near shore where this plant was found are,—a patch in sand in front of the Scovell cottage, and some in a lagoon on Long Point flat. It grew thickly along shore by the swamp below Farrar's, and there was a good deal at the beginning of Overmyer's woods, and a large patch opposite the green boathouse. It was very abundant in the thoroughfare between the lakes, and here the leaves were exceedingly elongate as if pulled out by the force of the swiftly flowing water. All the way down the outlet it grew, in dense, leafy patches, the long-crisped leaves vivid green all winter through and waving like flapping flags in the passing current. It grows also in Tippecanoe and Yellow rivers and is the Potamogeton usually found in streams and rivers.

*P. americanus* frequently grows on wet sand banks at the water's edge, wholly out of the water. In this case it is much changed in appearance, being short and leafy, and all the leaves of a firm leathery texture, much in substance like the floating leaves of the aquatic plant.

### 34. VARIOUS-LEAVED PONDWEED

**POTAMOGETON HETEROPHYLLUS Schreb.**

An odd-looking pondweed, rather unlike the others in general appearance, and confined principally to the shallower water along shore, although we have a few records of its having been dredged up in deep water. The most noteworthy patch was out a few hundred feet from the Scovell cottage; scattered plants were also found along shore in the shallow water just off Long Point, and it was frequently found in the northern part of the lake. It keeps its form all winter, the leaves turning purplish brown.

### 35. SHINING PONDWEED

POTAMOGETON LUCENS L.

*Potamogeton lucens* is widely scattered in small patches through the lake in shallow water, and is usually mixed in with other pondweeds such as *P. amplifolius*, *P. perfoliatus* and the like. It usually grows in quite small patches with only a few plants to the patch, although there was a fairly large patch about 500 feet from the ice-elevator at the depth of 4 or 5 feet. In general form it resembles *P. natans* or the still-water forms of *P. americanus* from which it can be distinguished by its shining leaves. What was thought to be this was seen in flower by Norris Inlet, June 24, 1901, although its usual time of flowering is in September and October. It remains green all winter, even the floating leaves not decaying in the fall, but becoming embedded in the ice during the winter.

### 36. WHITE-STEMMED PONDWEED

POTAMOGETON PRAELONGUS Wulf.

This is one of the rarer pondweeds of the lake and is only infrequently seen, so that not much is known of its distribution or habits. Some was dredged up at the Weedpatch August 28, 1900. On September 29 of the same year some was found washed up on shore at the depot grounds. On May 30, 1901, some was noted sending up flowerbuds from a patch of *P. amplifolius* in the north end of the lake. On November 9, 1904, some was noted washed up green at shore near the icehouses. It is one of the species found in rather deep water, and from occasional bits seen, it is evident that it remains green all winter.

### 37. CLASPING-LEAVED PONDWEED

POTAMOGETON PERFOLIATUS L.

This is not a common Potamogeton at the lake and, like *P. praelongus*, is known chiefly from occasional plants, or fragments seen mixed in with other pondweeds. It is rather common in Eagle Lake near Warsaw. Some plants were found in Lake Maxinkuckee, growing in sandy bottom in shallow water in the northwest corner of Outlet Bay. A good patch was also found, in 1904, near the icehouses. In form this is one of the most regular and attractive of the pondweeds, the broad wavy close-set dark green leaves in two ranks giving it the appearance of a full plume, quite different from the broad open plume of *P. robbinsii*. It is not as showy

in the water as *P. robbinsii*, as it stands erect and is usually seen only at an angle. It is quite fragile and easily torn and tattered by handling. It remains green all winter.

### 38. EEL-GRASS PONDWEED

**POTAMOGETON COMPRESSUS L.**

Quite common; more abundant between 10 and 16 feet, but ranging from 2 to 26 feet.

One of the less conspicuous pondweeds with a much flattened stem and rather narrow grass-like leaves. The whole plant is immersed, and it prefers rather deep water. This plant propagates by the formation of peculiar fan-shaped winter buds in which the 2-ranked flat leaves are closely appressed. A bud was found washed up April 13, 1901, much crooked as from heliotropism. Many were raked up during the winter. On May 29, 1901, a bud, very crooked, was noticed growing. The leafy stem springs from the apex of the bud and roots from axils of old leaves.

### 39. FRIES' PONDWEED

**POTAMOGETON FRIESII Ruprecht**

Widely distributed in water from 8 to 24 feet; more abundant between 12 and 16 feet. Frequently encountered in dredge hauls; a little found in a 12-10 foot haul on half section line 22, dragging from a shore bar toward a lake bar, and still more was found in a haul in from 14 to 12 feet of water. It occasionally bears winter buds some of which were obtained March 27, 1901. It does not grow in patches, but occurs scattered among other plants. Some was found up Aubeenaubee Creek during a seining trip September 3, 1900.

### 40. SMALL PONDWEED

**POTAMOGETON PUSILLUS L.**

A small insignificant species likely to escape notice. More common in the southeastern portion of the lake in water ranging from 10-24 feet deep. It was also probably somewhat frequent along shore near the Inlet in shallow water; some very small Potamogetons were observed there but they were thought to be depauperate forms at the time. It is doubtless an inhabitant of shallow water at times, as the flowers and fruit are known and described in the manuals. It also propagates extensively by propagating buds.

### 41. FILIFORM PONDWEED

POTAMOGETON FILIFORMIS Pers.

This, like *P. pusillus*, is a small, inconspicuous form that would generally escape notice on account of its small size. It was noted in flower down by Norris Inlet June 24, 1901, and had been seen in flower in the northern part of the lake some time before. Scattered plants grow throughout the lake bottom in water ranging from 2 to 24 feet in depth.

### 42. FENNEL-LEAVED PONDWEED

POTAMOGETON PECTINATUS L.

This is one of the most common pondweeds in the shallow water near shore. It was frequent to a depth of 10 feet and was occasionally dredged up in 16 feet of water. It was noted everywhere along the beach growing in either sandy or muddy bottom and in rather dense patches by itself or among Chara. Among the numerous places where it was noticed may be mentioned Long Point, McSheehy's pier, the Barnes cottage, off the Depot grounds, and east of there, by the green boathouse, by Norris Inlet, etc., and a fine patch grew at the head of the thoroughfare above the wagon bridge. The plants frequently grow out in long straight rows from shore, the different stems coming up in line from a white strong rootstock.

The individuals of this species which grow close to shore die down during the winter. In deeper water, though much of it retains its form during the winter, a little handling or raking shows that the plants have decayed and come apart at a touch; certain bits, however, perhaps tips of the stems, seem to remain green and alive and can be found detached now and then.

The fennel-leaved pondweed bears a peculiar propagating tuber consisting of a series of gall-like starch-containing objects, arranged one in the axil of the other, and each bearing a rather long curved beak-like bud. These do not seem to be wintering-over buds; they are formed even in midsummer by portions of plants which have been broken off. These buds are, however, seen most frequently during autumn and winter. Bulbs were observed on broken off bits October 27, December 1, 1904, and later. They were frequently observed on fragments washed ashore, or on broken pieces seen under the ice during the winter.

More than any other of the pondweeds of the lake, this species becomes the place of attachment of various sorts of organisms. Throughout the summer the plants are in places almost encrusted

with the attached little blue-green or brown hemispheres of Rivularia. Vorticella often finds a resting place on the leaves. Various slender algæ, particularly minute plants of Œdogonium, thickly clothe the plants near shore, and in late autumn and winter, when the diatoms are at their best, these plants are often covered so thickly as to be almost unrecognizable, with fuzzy growths composed of various species. Gathering the plants at such times is one of the easiest ways of collecting diatomaceous material in quantities. The plants, covered with a heavy growth in winter, form a favorite haunt of various aquatic animals, such as may-fly larvæ and beach fleas.

The plants were observed coming up thick and green at Knapp's pier May 25, 1901.

### 43. ROBBINS' PONDWEED

**POTAMOGETON ROBBINSII** Oakes

*Potamogeton robbinsii* is a fairly common weed in the lake, growing either in deep or shallow water in rich muddy bottom. It was dredged in water from 20 to 23 feet deep. Down towards the Inlet it is found in water from 12 to 16 feet deep, and off the icehouses it occurs plentifully in some place near shore in about 3 feet of water.

Although Robbins' pondweed never shows above the surface (we have not even seen it in flower or fruit at the lake) it is by no means inconspicuous for all that. It usually lies nearly prostrate on the bottom, and the 2-ranked widely-spread leaves, standing out almost perpendicularly on each side from the main stem, give the effect of a scattered mass of graceful plumes lying in the bottom. The whitish or yellowish cast of the plumes, due to a coating of lime on the old leaves, makes them all the more conspicuous against the dark bottom through the clear water. This plant, the graceful *P. amplifolius*, and the rank *Megalodonta beckii* and Myriophyllum which stand up through the water like scared cats' tails, add more than any of the other plants of the lake to the charm of the subaquatic landscapes and make one long for a camera that will take under-water pictures.

*P. robbinsii* retains its form through the winter; the lower leaves assume a brown and somewhat deadish look, but the tips are firm and of a lively purplish green.

This plant propagates largely by buds which could hardly be called winter buds as they are often formed as early as the middle of July and from then on through the winter. These buds are

probably formed in the axils of the leaves. They are the shape of a closed fan, the thick flat leaves (quite unlike the thin wavy vegetative leaves) being packed with reserve food and closely closed together. The plants also put out abundant roots just a little below the apex during the winter and it is very probable that this detaches itself and becomes a new plant.

In the spring the fan-shaped buds unfold, grow rapidly and produce new plants.

## Family 11. Naiadaceæ. Naias Family

### 44. SLENDER NAIAS

**NAIAS FLEXILIS (Willd.) Rost. & Schmidt**

The Slender Naias is fairly common in shallow water of the lake near shore, especially in sandy bottom. Among the numerous places it was noted may be cited, the east shore of Long Point from the Point itself down to Green's pier, in patches south of the pond below Farrar's, abundantly off shore at Overmyer's field, at the spring by the green boathouse near the Inlet, and in scant patches a good way out in the water along the east side of the lake.

Most of the Naias seen in the lake is short and dwarfed. The zone of growth is a rather narrow belt around near shore. Some of the plants are quite reddish in color. In some places they form carpets, softer and more fluffy in appearance than the Chara carpets. Nowhere else, however, do the plants form such extensive patches or reach such large size as they do at Lake Tippecanoe, where this plant gets almost 2 feet high and forms a conspicuous feature of the subaquatic landscape.

Staminate plants were difficult to find in the lake, though pistillate plants were quite common, and the minute ovate cylindrical seeds were common along shore. The Naias along shore remained green as late as October 28. It completely died during the winter. The patches come up thick and bright, probably from seeds, late in the spring.

A stout Naias was rather common in the lake in muddy bottom in about 9 feet of water and also near shore by the icehouses at a depth considerably greater than that in which the slender short form grows. This plant is much coarser than the near-shore form. Some of those plants grow at the Weedpatch as well as near the icehouses. They differ from the slender form in habit, as they remain green all winter. This may be the *N. flexilis robusta* of Morong.

The coarse Naias was found in considerable quantities in the stomachs of coots, and apparently forms an important article of

their diet. In 1906 seeds of Naias were found in the stomach of a painted turtle, and in 1907 it was again observed that the coots fed to a considerable extent on this plant.

## Family 12. Scheuchzeriaceæ. Arrow-grass Family

### 45. SEASIDE ARROW-GRASS

TRIGLOCHIN MARITIMA L.

Not rare in the grassy plains near the tamarack bog west of the lake. The plants were observed in flower May 22, 1901.

### 46. MARSH ARROW-GRASS

SCHEUCHZERIA PALUSTRIS L.

Rare and local. Found in flower in Hawk's marsh, May 20, 1901.

## Family 13. Alismaceæ. Water-plantain Family

### 47. AMERICAN WATER-PLANTAIN

ALISMA SUBCORDATUM Raf.

Not especially abundant. Most of the plants found were in a roadside ditch east of the lake, and some was also found on Long Point flat, between the road and Outlet Bay.

The airy pyramidal panicle of this species has an attractive appearance after the plants have ripened, somewhat suggesting old witch grass. The pecularities of structure of flower, fruit and seed has suggested a probable relationship to the crowfoots.

### 48. BROAD-LEAVED ARROW-HEAD

SAGITTARIA LATIFOLIA Willd.

The broad-leaved arrowhead was rather common along the shore of the lake. Occasionally it grew in sandy places, as at Long Point, and here the plants were rather small, with narrow leaves. It preferred to grow in deep rich mud, and here the plants were robust, with large broad leaves. Among the places noted where it grew was the Outlet, the Inlet, the shore of Outlet Bay, and the stretch of shore north of the icehouses. Plants were common in the marshy tract near Culver, and here, August 18, 1906, were seen magnificent large flowers, the paper-white glistening thin perianth, and the contrasty green globules of the pistillate, and waxy yellow center of the staminate, blossoms showing to fine advantage. The plants were observed with seeds about ripe September 28, 1900, near Winfield's.

During the winter of 1900-1901 purplish-skinned tubers about the size of walnuts were frequently found along the shore of the lake, and upon allowing them to sprout they proved to be propagating offshoots of this plant. The interior was rich yellow in color, and of a pleasant sweetish taste devoid of the prickly taste characteristic of so many of our aroids. It is not known how large a crop of tubers a plant would yield or whether any use could be made of them. The plants had sprouted up well by May 24. There was a large robust patch along a ditch beside the road near Ferrier's lumber yard. The leaves of these were peculiarly blotched with white splashes, some more than others, but nearly all thus marked to some extent. Other plants along the shore of the lake near the Merchants' pier were splashed with purple blotches on the upper sides of the leaves. Selection among the most strongly marked plants of both of these series would probably result in handsome and variegated plants. Even the unmarked plants are highly worth a place at the borders of ornamental ponds. The Chinese use a plant very similar to our broad-leaved arrowhead as a house plant simply for foliage effects.

### 49. GRASS-LEAVED SAGITTARIA

**SAGITTARIA GRAMINEA Michx.**

There was a patch of this plant along the east side of Lost Lake below the Bardsley cottage, and some in the large lake near Norris Inlet, and down along the outlet.

The plant varies considerably in appearance and behavior according to location. The patch in Lost Lake grew in 2 or 3 feet of water, and the lower leaves formed attractive close rosettes, closely resembling those of Eriocaulon. These plants blossomed but rarely. They propagated by stolons, and the leaves stayed green under the water all winter. In the winter of 1904, much was pulled up in Lost Lake and washed ashore. It was probably pulled up by muskrats. The plants bear spherical tubers which that animal probably uses for food.

The plants along shore of the lake near the old ice office and in front of the Assembly grounds bloomed quite profusely in 1906 and in succeeding years. Both circles of the perianth segments were conspicuous, crisped and crinkled, and of a delicate rosy hue, so that each blossom looked like a double flower. They were exceedingly attractive, and well worthy of cultivation.

## Family 14. Vallisneriaceæ. Tape-grass Family

### 50. DITCH-MOSS

**PHILOTRIA CANADENSIS (Michx.) Britton**

The ditch-moss is fairly common in the lake in shallow water. In rich muddy bottom it forms a rank, thick growth, while in sand it grows more sparsely and not so large. Among the places where it was noted growing was in shallow water between the gristmill and elevator, at the Merchants' pier where it grew quite rank, by the green boathouse near Norris Inlet, by the icehouses, near Farrar's, in front of the Assembly grounds, near the head of the thoroughfare between the lakes, etc. In recent years it has begun growing in immense dense patches at Long Point near Chadwick's. This appears to be a new location for it. It also forms dense tall masses in Culver Inlet in the Academy grounds.

This plant is remarkably variable in form, as regards leaf arrangement and leafiness, and bud variations in this respect are quite common. Although the leaves are usually in 3's and rather remote on the stem, there are sometimes branches in which the leaves are closely crowded in whorls of 5 or 6 making a dense cone. This may function at times as a propagating bud but it does not appear to be a usual winter bud form as they often form early in the season and sometimes lengthen again, apparently, before winter. It seems to be really a different form of the plant, as some plants once seen in a river were all of this dense form. We have notes of this having been found in flower as early as June 24. The blossoms, dainty rose tinted objects on an exceedingly slender, hair-like long tube, are quite common during the autumn. Although plants near shore appear to die down, the deeper water patches remain green all winter.

Although this water-weed is a bright, clean-looking, attractive plant, one of the most ornamental in the lake, nothing appears to feed on it. It is said to have become a great nuisance in the streams and rivers of Europe where it is known in places as "water-pest". Where it grows in great masses it might be raked out and used as compost, though in drying out it shrivels almost to nothing, leaving very little substance for the amount of material handled.

Plants noted in the autumn of 1913 had the leaves well coated with a deposit of lime.

### 51. TAPE-GRASS; EEL-GRASS; WILD CELERY

VALLISNERIA SPIRALIS L.

During 1900 and 1901, eel-grass was noted as rather common in the lake, usually growing in small scattered patches. It grew rather tall and rank in muddy bottom, and dwarf plants grew thinly on sand. Among places where it was observed were: the Weedpatch, a rather thick patch along the east shore of Long Point as along by McSheehy's, Duenwig's and Darnell's, along the depot grounds; in front of the Palmer house, by Farrar's, a long broken patch from the Assembly grounds pier to Kreutzberger's pier, and at the head of the thoroughfare. It grew in the thoroughfare between the lakes and was rather common in Tippecanoe River into which the outlet of the lakes flows. It was found growing down to a depth of 9 feet.

It is a favorite food of the coot and ducks; the rootstock puts out a delicate white stolon in autumn as a starter for the next year's growth. It appears to be this portion that the ducks are especially fond of. Soon after the water-fowl arrive, torn up plants of this species are washed up in great rolls along shore, they probably having been pulled up by these birds. During the first years of the survey but few flowers and no fruit were observed. The patches nearly all disappeared before the ducks left, and the plants hardly seemed to be holding their own. Of late years this species appears to be rapidly gaining and spreading. Blossoms of both sexes became very abundant. In 1906 from July 30 to September 6, the surface of Outlet Bay was frequently densely covered by the staminate blossoms which in places formed a regular scum. The same phenomenon was noted in succeeding years (1907, 1908, 1909 and 1913). The blossoms would frequently be gathered in clumps around floating objects, especially around the pistillate flowers. Considerable patches of the pistillate plants were observed in places with their conspicuous light-colored curious spiral stems as they withdrew into deeper water after being fertilized. The fruits are becoming common objects in the lake. They are peculiar, elongate, obtusely triangular green pods, very mucilaginous and with a sprightly acid taste.

In the autumn of 1906, a very narrow but strikingly dense and long patch was found growing in water five or six feet deep near the Merchants' pier. Its luxuriant growth and small area excited our interest, and, upon dredging it up, it was found to be growing in an old bait-can which had sunk at that place.

Most of the leaves, especially the long ones, appear gradually to die in late autumn, first turning reddish and then bleaching out to a dead white. Some green leaves can be raked up all winter, however. The green leaves late in the season are frequently coated with colonies of a small white Vorticella and, oddly enough, the whitened leaves are similarly coated with a green Vorticella.

The little mollusk Ancylus is frequently found on the leaves of this plant, especially near the base. The only other place it was found was occasionally attached to the outside of the shell of Viviparus.

The increase of this, as well as other plants in the lake, is probably due to the more active hunting of water-fowl, which gives the plants a better opportunity to thrive.

## Family 15. Gramineæ. Grass Family

### 52. BROOM BEARD-GRASS

**SCHIZACHYRIUM SCOPARIUM (Michx.) Nash**

The broom beard-grass, generally known throughout the state as broom-sedge, is usually found only on barren sandy slopes. It is a coarse rough tussocky grass. It hardly attracts attention during the summer, but in late autumn its scattered clumpy growth, the harshness of its outline, and the sereness of its brown relieved only by the feathery tufts of its plumed seed, scattered scantly along the stem, all unite to make the regions where it grows especially desert and desolate. There were a few areas on the slope about the lake where it grew. The hill near shore south of McOuat's was almost covered with it, and some grew south of the Plank cottage, a little grew by Murray's, and some south, along the railroad.

### 53. FORKED BEARD-GRASS

**ANDROPOGON FURCATUS Muhl.**

This grass differs considerably in appearance and habits from the preceding. It is a tall, rather handsome grass, with a stiff wiry culm, the inflorescence on diverging narrow spikes like those of the crab-grass, only on a larger scale. Coulter, in his report on the plants of the state, says that it is "a common form on prairie soil, either moist or dry, where it furnishes a large amount of hay." In the neighborhood of the lake it grows in small scattered clumps in open places in dry soil and is not abundant enough to be made use of. It occurs both east and west of the lake.

### 54. INDIAN-GRASS; WOOD-GRASS

**SORGHASTRUM NUTANS (L.) Nash**

This tall handsome but rather coarse grass grows in scattered clumps in rather open places about the lake. The oat-like appearance of the panicle, and the bright shining yellow of the transparent glumes through which the stamens show, make it an easily recognizable and attractive grass. In our area it never forms continuous patches.

### 55. SLENDER FINGER- OR CRAB-GRASS

**SYNTHERISMA FILIFORME (L.) Nash**

Rather common in dry sandy soil but not so conspicuous as the next on account of its small size. It flowers in August and September.

### 56. LARGE CRAB-GRASS

**SYNTHERISMA SANGUINALE (L.) Dulac.**

Too common in cultivated fields about the lake. It is not troublesome in cornfields and meadows, but in low cultivated crops such as gardens, and particularly in potato fields, the wiry prostrate stems which root at the nodes soon form a very tough compact sod, difficult to remove from the soil. It begins blossoming late in summer, and continues putting out spikes of blossoms until killed by frost.

### 57. BARNYARD GRASS; COCKSPUR-GRASS

**ECHINOCHLOA CRUS-GALLI (L.) Beauv.**

This is a well-known grass throughout the state, usually quite common in rich moist ground. Its favorite habitat is the flat marshy shores of rivers and creeks, and the corners of neglected barnyards where the seepage from manure piles keeps the ground moist. In the vicinity of Lake Maxinkuckee this plant is confined mostly to a narrow belt along shore where it is one of the most common of the beach plants. Very little is found any distance from the lake on account of the dry sandy nature of the soil.

The Cockspur Grass never covers extensive areas, even over flat moist places, but prefers narrow edges along streams. In favorable situations it forms a very leafy rank growth and would probably furnish considerable forage or hay. An enterprising western seedsman boomed it extensively as "Billion dollar grass", a new and wonderful "introduction from Japan", but the boom seems to have

subsided. One of the chief difficulties with the grass is that it is an annual, producing a single crop to the sowing, and would have to be handled much like millet.

### 58. SALT-MARSH COCKSPUR-GRASS

ECHINOCHLOA WALTERI (Pursh) Nash

This is not so common as the preceding, only a few plants having been found along the southwestern shore of the lake, intermixed with the other species. It is fairly common along the shore of Yellow River near Twin Lakes. This species is generally more robust and of a deeper purple color than *E. crus-galli*, and usually has much longer awns. On account of its more robust habit, it would make a more promising pasture or meadow grass than the other unless its roughness and beardiness proved a serious drawback.

### 59. WITCH-GRASS; TUMBLE-WEED

PANICUM CAPILLARE L.

While fairly common in places, this grass is not so abundant in the neighborhood of the lake as in many other parts of the state. It is rather frequent along the beach, especially by the railroad bridge at Culver. It was found also on the first and second terraces of the beach at Long Point, and along the shore by Scovell's and Arlington. It was common in cultivated grounds east of the lake. Most of the plants found in the vicinity of the lake were small and dwarfed, and it does not form a conspicuous feature of the landscape.

The old witch-grass thrives most luxuriantly in rich black soil, either in tilled ground or in meadows and pastures where the sod has been killed out. A luxuriant patch has a peculiar airy fineness about it which gives it an unique charm. Before it has ripened, the rich purple of the fine spray-like heads gives the effect of a distant haze to landscapes near at hand. A very fine effect of this sort was observed along the Vandalia railroad several miles above Culver, where there was a large patch. When ripe and dead, a dense patch, hiding the ground beneath with its mist-like fineness, gives the appearance of a cloud; to walk through it gives a sense of insecurity,—it is almost like walking on air. When each of the tiny sprigs holds a minute drop of dew or fog on a gray morning, the effect is quite indescribable.

Well developed plants in rich ground form great globular masses somewhat like the winged pigweed, the cultivated Kochia, or the

Amaranth. Other tumble-weeds of the plains, except the witch-grass globes, are much finer and more airy. These, after ripening, break off at the base and scud before the autumn winds like frightened rabbits. The sight of one of these delicately formed globes rolling before the fitful autumn blasts, scattering seed as it goes, is another revelation of the attractive and surprising features of this plant. In some parts of the state, especially the flat rich prairies along the middle of our western boundary, this species forms great masses like snow-drifts against fences or hedges, and fills up open ditches.

### 60. TALL SMOOTH PANICUM

**PANICUM VIRGATUM L.**

A rather coarse, leafy grass growing in clumps or tussocks. The amount of material in a single clump suggests that it might make considerable forage where abundant enough. Its tussocky habit of growth, however, is somewhat against it. It is noteworthy for the deep red color of its pollen. The plants first come into flower about the latter part of July.

It was not originally common at the lake, only a few clumps having been noted along the road below the Duenweg cottage at Arlington. It appears to be increasing considerably of late years, as numerous clumps now grow along the road between the lake and Culver. In the particular plant examined the sterile flowers were rudimentary.

### 61. BARBED PANIC-GRASS

**PANICUM MICROCARPON Muhl.**

One of the broad-leaved panicums growing in the sandy soil of open woodlands, fairly common in the dry soil west of the lake. This plant is small and compact at the beginning of the flowering season. It continues to grow all the season, putting out new panicles from the sheaths of successively lower leaves so that in the end we have a very diffuse spraggly plant with empty panicles from which the seed have been shed, ripening grain in all stages of development, flowers and buds all at the same time. The grass is too small and scattered to be of any importance as pasturage.

### 62. SCRIBNER'S PANIC-GRASS

**PANICUM SCRIBNERIANUM Nash**

In general habit much resembling *P. microcarpon;* blossoming all season and becoming quite diffuse late in autumn. Found in open sandy soil west of the lake.

### 63. VELVETY PANIC-GRASS

PANICUM SCOPARIUM Lam.

Not rare in dry open ground on the west side of the lake between Long Point and Arlington. Collected in flower June 26, 1901. One of the inconspicuous grasses of the region.

### 64. YELLOW FOXTAIL; PIGEON-GRASS

CHAETOCHLOA GLAUCA (L.) Scribn.

Rather common in waste places, and along the shore of the lake at the railroad bridge at Culver.

### 65. GREEN FOXTAIL-GRASS

CHAETOCHLOA VIRIDIS (L.) Scribn.

Somewhat common in waste places, and along the railroad. Through many parts of the state this is one of our most vexatious and troublesome weeds. The seeds germinate almost any time during the summer. We found it in flower along the railroad June 26, which is unusually early. Where most abundant it usually springs up in cornfields and potato patches after cultivation has ceased, and makes the harvesting of these crops difficult. In general it is not so prominent in the weedy autumn fields as formerly, its place having been taken by ranker, broad-leaved weeds.

### 66. HUNGARIAN GRASS; MILLET

CHAETOCHLOA ITALICA (L.) Scribn.

This is frequently cultivated, and occasionally escapes. It does not usually persist very long, however. A patch at Long Point attracted various birds and seed-eating mammals to that place. Some of the 13-lined gophers, which had previously been confined largely to the Gravelpit along the railroad, found the place attractive and made their homes there in 1906. A few snow buntings or snowflakes appeared to light by chance and, finding good feeding in this patch of millet, brought others from somewhere, the flock gradually increasing until there were 25 or 30 birds. They had not been noted in the vicinity previously.

Besides the Long Point patch, some was also noted east of the lake.

### 67. SMALL BUR-GRASS

CENCHRUS CAROLINIANUS Walt.

This is undoubtedly the most pestiferous weed in the neighborhood of the lake. It is frequent along the lake shore and common along the railroad, but is in neither of these places so abundant as

to be a great nuisance. It reaches its maximum abundance in the sandy fields along the east side of the outlet of Lost Lake, and here it is abundant enough at times to make passage through the fields quite vexatious. The grass comes up in spring, handsome and inviting, and suggests good pasturage, and the small grain within the bur is pleasant in taste and texture, somewhat resembling rice; but even at the best, little good can be said of this plant, and the principal problem is its extinction. The burs become conspicuous about the middle of July, but it is after they have ripened that they are especially obnoxious.

### 68. WILD RICE

ZIZANIA AQUATICA L.

With the possible exception of the reed, Phragmites, the wild rice when well developed, is one of the most handsome of our native grasses. Its tall stately appearance, the rich golden yellow of its widely spreading staminate flowers which droop gracefully around the sides of the panicle, contrasting with the stiff erect pyramidal heads of pistillate flowers, make the first sight of these plants one to be long remembered. Each looks like a vegetable fountain, with a straight silvery jet in the center, the outer circle of spray toward the base sparkling in the sunlight. It is not very abundant in the vicinity of the lake. A few tall stately plants, representing the species at its best, were observed near Norris Inlet in 1900, but none has been seen in recent years, and it is probable that the wild fowl gathered all the seed. It is fairly common at Twin Lakes, several miles to the north, and around pools in the tamaracks west of the lake.

What was taken for a dwarfed form of *Z. aquatica* was observed in the neighborhood of Winfield's, also along the thoroughfare between the lakes, and along the outlet for nearly its whole length. It was not noted during the earlier years of the survey, but was first seen in 1906. In 1907, 1908, and 1909, increasing quantities were seen and it was becoming quite common, indicating that it was of recent introduction and was gaining ground. In some places it was badly affected by ergot. Unfortunately, none of this dwarf grass was collected. It may possibly have been *Zizaniopsis miliacea* Dœll & Aschers.

Wild rice is valuable as an attraction to wild ducks and it would be well worth while to sow an abundance of seed in both the Inlet region and on Green's marsh, where it would be likely to thrive. It would add greatly to the appearance of these marshes, beside furnishing food and cover to ducks and geese.

### 69. WHITE GRASS

HOMALOCENCHRUS VIRGINICUS (Willd.) Britton

Not common; a few patches in moist shady places.

### 70. RICE CUT-GRASS

HOMALOCENCHRUS ORYZOIDES (L.) Poll.

Common in wet open places, as along the south shore of Outlet Bay. It here formed dense tangled masses, conspicuous on account of the pale green color. The lax stems support themselves by clinging to each other and to neighboring plants by means of minute sharp hooks which are especially numerous about the nodes. These tangled patches are very difficult to get through, as the plants catch hold of the clothing and skin with great tenacity and are able to scratch quite severely. In degree of scratchiness this plant rivals the tear-thumb. However, as it grows chiefly in unfrequented places, it can hardly be regarded as a serious nuisance. Its tangles and seed probably furnish protection and food to wild fowl.

### 71. REED CANARY-GRASS

PHALARIS ARUNDINACEA L.

A few plants were found along the thoroughfare between the lakes in the vicinity of the wagon bridge. Somewhat past flower, June 17, 1901.

### 72. HOLY-GRASS

SAVASTANA ODORATA (L.) Scribn.

Scattered in moist meadow-like places about the lake. Noted in the neighborhood of Culver, by Lakeview Hotel, and in Green's marsh. This grass blossoms quite early in the season, and the rich yellow of the stamens shining through the translucent glumes, catches the eye at a distance and makes it an unusually attractive grass. The whole plant possesses a delightful fragrance. On this account it is sometimes called vanilla-grass. It remains in blossom for a considerable time. It would probably prove to be a desirable grass in meadows.

### 73. PORCUPINE-GRASS

STIPA SPARTEA Trin.

This tall tufted grass formed a few dense clumps in the sandy open stretch on Long Point. The greatly lengthened awns, which are fairly straight when green, have the faculty of becoming much twisted and bent while ripening or drying, and perhaps aid in the dispersal of the seed. A few, carelessly thrown down on a blanket,

wove themselves through and through it in all sorts of directions and were extricated with some difficulty. The seed was nearly ripe by June 28.

### 74. POVERTY-GRASS

**ARISTIDA DICHOTOMA Michx.**

A small depauperate grass growing scantily in poor soil at Long Point back of Chadwick's and near the Arlington hotel.

### 75. ARROW-GRASS; BROOM-SEDGE

**ARISTIDA PURPURASCENS Poir.**

Common in sandy soil along the railroad south of the lake.

### 76. NIMBLEWILL; DROPSEED-GRASS

**MUHLENBERGIA SCHREBERI Gmel.**

A handsome grass, with close purplish drooping racemes, growing in dry places. At Lake Maxinkuckee it was quite common in open places. There was a good patch along the railroad by Arlington and in Green's woods opposite. Where plentiful enough it is a good pasture grass.

### 77. SATIN-GRASS; WOOD-GRASS

**MUHLENBERGIA MEXICANA (L.) Trin.**

This very pretty, much-branched grass appears to be rare in the immediate vicinity of the lake, although it is fairly abundant in the low grounds about Plymouth, Ind. The only plants seen near the lake were in a thriving clump by the icehouses, along the railroad track. The seed had evidently dropped from wild hay used in the packing of ice.

### 78. WILD TIMOTHY; MARSH MUHLENBERGIA

**MUHLENBERGIA RACEMOSA (Michx.) B. S. P.**

Not very common. There were a few scattered patches in the Inlet marsh. A soft, diffuse grass, very good for hay or pasture where abundant enough.

### 79. WOOD OR WOODLAND DROPSEED

**MUHLENBERGIA UMBROSA Scribn.**

Not rare; scattered through the woodlands about the lake. Collected at the edge of the bank along the east side of Long Point. It generally forms too scanty growth to be of much importance as pasture.

### 80. TIMOTHY

PHLEUM PRATENSE L.

This, the best known and most common of our meadow grasses, is common about the lake, scattered almost everywhere in open places. In Hawk's marsh, as is very usual with this species in wet places, the scales of the head grow out into long leaf-like projections giving the appearance of the grain sprouting in the head.

### 81. MARSH FOXTAIL

ALOPECURUS GENICULATUS L.

This is a rather common grass in woodland ponds in the northern part of the state, not usually abundant anywhere, but widely distributed. This plant grew rather abundantly in a pond in the Assembly grounds opposite Davis's.

The heads resemble those of a minature timothy and the leaves frequently float on the surface of the water. The conspicuous long filaments of the plant when in flower, and the heavy white glaucous coating of the stem and leaves, make it a noticeable object. It was found in blossom in May. Our examples represent the subspecies *aristulatus* Torr., which is now regarded by some as a distinct species.

### 82. SHEATHED RUSH-GRASS

SPOROBOLUS VAGINAEFLORUS Torr.

An insignificant, starved-looking grass. Found growing scantily in the sand back of Arlington, and rather abundant on the railroad between the icehouses and the depot. The small secondary panicles formed in late autumn are concealed within the sheaths of the leaves.

### 83. LONG-LEAVED RUSH-GRASS

SPOROBOLUS ASPER (Michx.) Kunth.

A good patch of this grass was found in scattered tussocks on the dry slope east of the depot, in the autumn of 1904. They had not been seen in previous years, and bore the appearance of having been introduced, either by the railroad or in a grass mixture used in seeding down the grounds. The species is a tall coarse grass, putting out new panicles from the sheaths of the lower leaves after the first have ripened.

### 84. WOOD REED-GRASS

CINNA ARUNDINACEA L.

A common, rather coarse grass found in swampy woodlands throughout the state, conspicuous for the large amount of seed

borne in a loosely spreading, drooping panicle. Common in the low wet woods along the south shore of the lake, by Overmyer's. Found in flower about the middle of June.

### 85. RED-TOP

ARGOSTIS ALBA L.

One of the most handsome and valuable of our grasses, usually growing in scattered patches among sedges and wild grasses of various species and forming in places the most valuable part of "prairie-hay." This species is not very common about the lake. A few patches, however, were seen in the prairie country west of the lake, and a few specimens were obtained at the edge of Green's woods by Lost Lake. Where there are unbroken patches it turns the whole area occupied a purplish red which shows for considerable distances.

### 86. THIN-GRASS; UPLAND BENT-GRASS

AGROSTIS PERENNANS (Walt.) Tuckerm.

A rather inconspicuous, but handsome symmetrical grass. Not rare at the lake, but scattered. Most frequently seen along shady woodland paths.

### 87. ROUGH HAIR-GRASS

AGROSTIS HYEMALIS (Walt.) B. S. P.

A very thin inconspicuous grass, common through dry woodlands. It quite closely resembles the preceding. It was plentifully scattered through Green's woods by Lost Lake, and was also noticed and collected southwest of the lake. It is too small and scanty to be of any value for pasture.

### 88. BLUE-JOINT GRASS

CALAMAGROSTIS CANADENSIS (Michx.) Beauv.

This grass is fairly common in the low flats mixed in with other grasses and with sedges, its tall heads projecting considerably above the tops of the sedges. It is not so abundant as at near Plymouth, where it forms large continuous patches in places. It was scattered in Green's marsh and in the sedgy marsh below Overmyer's. It was quite abundant, mixed with sedges, far down the outlet, and formed almost the entire flora of the center of a pond in Walley's woods. It is one of the most valuable of the prairie grasses, and where abundant enough, is cut for hay.

89. BOG REED-GRASS

CALAMAGROSTIS INEXPANSA A. Gray

Not very common about the lake. A few plants were seen along the railroad west of Green's marsh and by the railroad bridge across the thoroughfare. Some was also collected in the swamp below Farrar's. A tall handsome grass with a narrow erect panicle.

90. COMMON WILD OAT-GRASS

DANTHONIA SPICATA (L.) Beauv.

A short, unimportant grass, growing scantily on sterile soil. It ripens early in the year. Small scattered patches were found east of the lake, and some was collected at Long Point. It ripens and dies down toward the latter part of July.

91. TALL MARSH-GRASS

SPARTINA MICHAUXIANA Hitchc.

A coarse, tall grass, quite leafy at the base but too tough when old for hay or pasture. It is not usually found in large patches, but grows in narrow belts in swamps or moist places. At Lake Maxinkuckee it grows in scattered clumps along the south shore of Outlet Bay between the road and the lake, and by the marsh south of Farrar's.

92. PRAIRIE CHLORIS

CHLORIS VERTICILLATA Nutt.

A coarse, tussocky grass. Late in the autumn of 1904, several clumps of this species were found scattered in the sward of the depot grounds. They were of recent introduction and had apparently been brought there in lawn-grass seed. Not previously reported for the state.

93. TALL GRAMA-GRASS

ATHEROPOGON CURTIPENDULUS (Michx.) Fourn.

Only one small scanty patch seen in the neighborhood of the lake. This was found growing on a bank on the east side of Lost Lake outlet. This grass seems quite peculiar in distribution. The only other place where we saw it was on a bank on the east side of Eagle Lake at Warsaw, in a precisely similar situation.

94. WIRE-GRASS; YARD-GRASS; DOG'S-TAIL GRASS

ELEUSINE INDICA (L.) Gaertn.

Not very common about the lake, only a few plants having been found by the railroad bridge at Culver. It is generally a pretty

common grass in cities in yards and lawns. It forms a flat carpet-like sward and, when in blossom, is an attractive grass.

### 95. COMMON REED-GRASS

PHRAGMITES PHRAGMITES (L.) Karst.

The most handsome and stately of our grasses, not common in the immediate vicinity of the lake. There was a small patch in the springy flat by Norris Inlet, and a few plants scattered along the thoroughfare. Large patches were found in the tamaracks west of the lake.

This was once a common plant through parts of the state, forming dense patches on the flat marshes. It is now rapidly disappearing before the draining of the country.

Among all our plants, the reed holds peculiarly a place of its own. It is a plant of small economic importance, and one with which the commercial world has little to do. It has at times been made into a sort of rough wattle to protect plants from frost, and sometimes the plume-like heads are collected and dyed, as pampas grass is dyed, for ornament, but beyond this it has no relation to the world of trade. It is somewhat surprising in this day when wild gardens, especially water gardens, and parks with ponds are in vogue, that it has not come into favor. Perhaps because it requires a large area to show up at its best. It does not fit in well with trees or shrubbery but needs as a setting square miles of level prairie and arching sky, where it can loom and lord it above the humbler sedges and grasses. And yet a little patch even in cramped quarters and among shrubs and trees is not at all bad. If one wants wildness, here it is with a vengeance—the most like a jungle of anything that can be devised in a region such as this.

The Reed is a plant of wide distribution, being found not alone in this country but in Europe and Asia as well. It may not have been the identical plant which figured in Greek mythology, although it may well have been, and no feature of landscape could be more easily peopled with creatures of the imagination than a clump of reeds.

Taking the word reed in a broad sense, and including several species of grass bearing a general similarity to our own, it is remarkable what a large place in the world of literature and art is occupies by a plant used to no great extent for the prime needs of man—food or shelter. This arises from the fact that the reed, through its use in primitive wind instruments, became the type of all æolian music, the fife and flute, and the symbol of joy and the dance.

Today there are few forms of vegetation so easily peopled by creatures of the imagination as the thicket of reeds with their tall erect stems densely grown, and broad waving blades. Here is a picture* of our own times, describing vividly the reeds:

"All the while the river never stopped running or took breath, and the reeds along the whole valley stood shivering from top to toe.

"There should be some myth (but if there is I know it not), founded on the shivering of the reeds. There are not many things in nature more striking to man's eye. It is such an eloquent pantomime of terror, and to see such a number of terrified creatures taking sanctuary in every nook along the shore is enough to infect a silly human with alarm. Perhaps they are only a-cold, and no wonder, standing waist deep in the stream. Or perhaps they have never got used to the speed and fury of the river's flux, or the miracle of its continuous body. *Pan* once played upon their forefathers, and so by the hands of his river, he still plays upon these later generations down all the valley of the Oise; and plays the same air, both sweet and shrill, to tell us of the beauty and the terror of the world."

The passing of the reed marks, too, the passing of a simpler age of vast regions of primitive nature, of tinkling cowbells and grazing herds over unbroken prairies.

### 96. SMALL TUFTED LOVE-GRASS; TUFTED ERAGROSTIS

**ERAGROSTIS PILOSA (L.) Beauv.**

This does not appear to be common. There is one plant in our collection and its identification is not certain.

### 97. PURSH'S LOVE-GRASS

**ERAGROSTIS PURSHII Schrad.**

Rather common in various places along the beach in sand. Usually found in dry sandy soils forming diffuse spreading clumps.

### 98. STRONG-SCENTED LOVE-GRASS

**ERAGROSTIS MAJOR Host**

A common grass throughout the state, frequently coming up in cultivated grounds in autumn after cultivation has ceased. Its purplish-silvery flattened spikes, which are borne in abundance, make it a handsome grass. Recognizable by its sharp penetrating odor. In August, 1906, Hawk's field was almost entirely covered

* Robert Louis Stevenson, "Inland Voyage."

with a heavy growth of this grass. In 1908, a large field was seen near Walkerton, Ind., which looked as if entirely sown with this, and the sheen of the spikelets gave the whole area a dull silvered look.

### 99. SMOOTH CREEPING LOVE-GRASS

**ERAGROSTIS HYPNOIDES (Lam.) B. S. P.**

A delicate little grass, each plant insignificant by itself, widely spreading and forming mats over the ground. It grew most abundantly on the bottoms of dried-up ponds in open places. Found southeast of the lake, also in a shallow pond near Zechiel's.

### 100. TALL EATON'S GRASS

**SPHENOPHOLIS PALLENS (Spreng.) Scribn.**

Not especially common in the region of the lake. A few plants were found in flower north of Green's marsh, June 17, 1901.

### 101. ORCHARD-GRASS

**DACTYLIS GLOMERATA L.**

Not common in the region of the lake. A few scattered plants were observed near the icehouses where seed had probably been scattered from hay. It was quite conspicuous by May 18 (1901), and in flower by June 5. It was also found in the depot grounds in 1904. Plants which had been cut earlier in the season were in flower in October. Although it has an excellent reputation both as a hay crop and for pasture, very little seems to be sown in the state. Rather tussocky in habit of growth.

### 102. ANNUAL MEADOW-GRASS; LOW SPEAR-GRASS

**POA ANNUA L.**

Scattered about the lake in moderately dry situations. In flower at the east shore of Lost Lake by Bardsley's cottage May 6, 1901. One of the earliest plants to blossom in spring, where it winters over, and one of the latest to bloom in autumn. At Washington, D. C., where it is common in parks, especially at the bases of trees, it is often found in blossom on the first warm days of early spring, and forms a dense sod in shady places, where it is quite striking when fully in bloom, forming a continuous silvery mat.

### 103. FALSE RED-TOP; FOWL MEADOW-GRASS

**POA TRIFLORA Gilib.**

Occasional in moist places about the lake. Collected in the low flat woods near Overmyer's field June 26, 1901.

### 104. JUNE-GRASS; KENTUCKY BLUE-GRASS

POA PRATENSIS L.

One of the best known and most popular grasses of the state for lawns and pasture. It is rather common about the lake but not so abundant as in places where the soil is more suitable. It was most abundant on the hill north of the icehouses and along shore southwest of the lake. Bluegrass sod began to look green in the neighborhood of the lake by April 8, 1901, and the grass began to blossom by June 7. This grass grows to large size and very thickly, forming excellent pasture along Yellow River near Plymouth, north of the lake.

Bluegrass sod is frequently infested with cutworms which cause the heads to die out some time before they are ready to ripen.

### 105. WIRE-GRASS

POA COMPRESSA L.

Not very common about the lake. Found on shore by Lakeview Hotel, September 29, 1900, and seen in flower along the railroad June 14, 1901. This is a fairly common grass throughout the state but usually grows in small patches, and very rarely forms a thick sod, the growth usually being quite scanty. It makes good pasture where abundant enough. It is rather difficult to mow on account of the wiry, but yielding, character of the flat stems, and its habit of closely hugging the ground.

### 106. NERVED MANNA-GRASS

PANICULARIA NERVATA (Willd.) Kuntze

In moist places about the lake. Found in Farrar's woods, going out of flower, June 15, 1901.

### 107. FLOATING MANNA-GRASS

PANICULARIA SEPTENTRIONALIS (Hitchc.) Bicknell

A tall, but not particularly striking, grass, usually growing in small patches at the edges of mucky or sedge-bordered open ponds, in about a foot or 18 inches of water. The blades of the lower leaves float on the surface and the base of the stem is usually flattened and expanded. Found along the eastern shore of Lost Lake, at the edge of a pool along the railroad, near Green's marsh, and in Walley's swamp.

### 108. SLENDER FESCUE-GRASS

FESTUCA OCTOFLORA Walt.

Scattered, in dry places. Found nearly ripe on Long Point, June 13, 1901.

### 109. NODDING FESCUE-GRASS

FESTUCA NUTANS Willd.

Occasional in dry soil about the lake. Found at Long Point and southwest of the lake. Too much scattered to be of any importance.

### 110. CHEAT; CHESS

BROMUS SECALINUS L.

This very common and well known grass, which frequently proves such a nuisance in wheatfields, is common about the lake, especially along the railroad. There are several other species of cheat found in the sandy soil about the lake, but when found they were dead ripe and not in condition to collect.

### 111. PURPLISH WHEAT-GRASS

AGROPYRON BIFLORUM (Brignoli) R. & S.

Only one patch seen in the region of the lake. This was in a dooryard in Culver where it had been probably introduced in lawn-grass seed.

### 112. SQUIRREL-TAIL GRASS

HORDEUM JUBATUM L.

Previous to about 1900, this grass was unknown to many regions in the northern part of the state, and the 6th edition of Gray's Manual gave its range as "sandy seashore, upper Great Lakes and westward." At about the time mentioned above some influence was rapidly at work bringing about its dispersal and it soon became a familiar object in lawns, waste places, roadsides, etc., and there were some fears entertained that it might become a nuisance. Like the prickly lettuce and sweet clover, however, which had preceded it several years, it soon reached its limit or contented itself with occupying waste places and not encroaching on cultivated ground. Its large heads, with long silky, sometimes purplish, awns make it a pretty and conspicuous grass.

Some was found on June 24, 1901, in head along the street, where it had been recently introduced.

### 113. NODDING WILD RYE

ELYMUS CANADENSIS L.

A stout handsome grass growing in fairly dense patches in low rich ground in various places about the lake. There were good patches along the railroad between Long Point and Culver, along the shore between the Culver railroad bridge and depot, and by Lakeview Hotel. It also grew on the beach south of the Inlet and near Norris's. Scattered pretty generally along the west and south sides of the lake.

### 114. BOTTLE-BRUSH GRASS

HYSTRIX HYSTRIX (L.) Millsp.

Not very abundant, but widely distributed in rather moist rich places. Scattered, in the eastern part of Farrar's woods, where it was seen dead ripe, November 14, 1900.

## FAMILY 16. CYPERACEÆ. SEDGE FAMILY

This large and well-marked family is remarkably well represented in the region about the lake, the great variety of soil and moisture offer favorable habitats for all sorts of sedges, including those that prefer dry situations, woodlands, dunes, or moist ground.

Moreover, the flat lake plains or "prairies" are *par excellence* the situations adapted to sedge growth and over these great areas sedges of many sorts, but especially of the genus Carex, form the predominant, even almost the exclusive type of vegetation. Of the sedges, especially those of the genus Carex, there was so great an abundance and variety all coming into fruit about the same time, and that at a time when fish-spawning, bird migration and other important activities were at their height, that not nearly all seen could be collected. All, or nearly all of the species of sedges listed, are represented by herbarium specimens. Many others such as *C. tuckermani*, *hystricina*, *cephalophora*, *hirtifolia*, *sterilis*, *wildenovii*, and so on were provisionally identified in the field, but were not collected. It is probable, indeed, that the great majority of the 81 forms listed for the state by Coulter, are to be found in the neighborhood of the lake.

### 115. LOW KYLLINGA

KYLLINGA PUMILA Michx.

A dainty little sedge, so inconspicuous as to be easily overlooked, found growing in moist places. It is delightfully fragrant, both when green and after being dried. It was found in low places

along the road on Long Point, where the ridge of the point slopes down to Green's marsh west of Chadwick's. Found in flower October 8.

### 116. LOW CYPERUS

CYPERUS DIANDRUS Torr.

This pretty little sedge is one of the most common and constant of the beach plants, growing on the sandy shore near the water's edge. A more or less broken stretch extends from Long Point to about Green's pier. This patch is broad and thick in front of the Barnes cottage. Toward the south end of the lake it is common by Farrar's cottage, south of Farrar's pond, and along the springy flat by Overmyer's. It is fairly abundant by Norris Inlet and on the beach south of it. It is quite scanty or only occasional on the east side, but begins again on shore in front of the Military Academy, from which it extends more or less continuously to the Culver railroad bridge. It also grows on the slopes of the low ice ridges facing the lake.

### 117. AWNED CYPERUS

CYPERUS INFLEXUS Muhl.

One of the prettiest of the sedges but very small and inconspicuous. Only a few plants were found. These were in the birch swamp along the railroad by Walley's, in the bottom of excavations from which ballast had been taken for the railroad, and where the sand was moist. It was also found at Fletcher's Lake.

### 118. STRAW-COLORED CYPERUS

CYPERUS STRIGOSUS L.

The Straw-colored Cyperus is quite common throughout the state in rich low ground in open places, sometimes growing in considerable patches. It never or rarely becomes a nuisance, as its near relative, the nut-grass, sometimes does. The widely-spreading infloresence with straw-colored spikelets makes it a conspicuous and attractive plant. It usually grows along the edges of ponds, ditches and streams. At Lake Maxinkuckee it was common along the lake shore, extending more or less interruptedly from Long Point to below Arlington. Another broken stretch occurred from Overmyer's field to beyond Norris's. Along the east shore it was absent. It began again about the Palmer house, and was abundant at Lakeview Hotel where there was considerable on the flat beach east of the hotel. It was also found along the beach near the depot, and at the railroad bridge.

### 119. SLENDER CYPERUS

CYPERUS FILICULMIS Vahl

This tall wiry-stemmed sedge is not conspicuous, in spite of the fact that it is one of the tallest species of the genus. It is found rather scattered in the neighborhood of the lake, especially in the grass along the railroad in the region of Murray's. It grows in dry sterile soil. Over in the dune region where hardly anything else would grow, it helped form a scanty growth over the shifting sand.

Its usual period of flowering is from June through August, but along the railroad where the herbage is usually kept mown down or burned over, it was found in flower as late as September 27.

### 120. KNOTTED SPIKE-RUSH

ELEOCHARIS INTERSTINCTA (Vahl) R. & S.

The knotted spike-rush, the most conspicuous species of the genus, is not rare at Lake Maxinkuckee. It is quite local in distribution, however, and is found in dense patches where it occurs. There are a few small patches along shore near Overmyer's field and near the Inlet. Besides this it occurs nowhere else except in 2 large patches, one between Winfield's and the depot and one in Lost Lake below the Bardsley cottage. In each of these cases the patch extends from shallow water near shore into long cape-like extensions into the water. The plant, though it bears abundant seed, seems to propagate chiefly by rootstocks which accounts for its occurrence in dense patches and its absence as isolated scattered plants. The plants were up well and beginning to show conspicuously above the surface of the water by May 30. They bear a marked general resemblance to the stout scouring-rush, Equisetum. In autumn the whole patches assume a beautiful golden color. They were in their autumnal glory on October 21, 1900, and the cones were full of seeds. They quickly succumb to frost and lop over into the water.

### 121. ANGLED SPIKE-RUSH

ELEOCHARIS MUTATA (L.) R. & S.

This spike-rush is rare at Lake Maxinkuckee, only 1 small patch having been found, intermixed with bulrushes, in the vicinity of Norris Inlet. At Eagle Lake, Kosciusko County, it was fairly common. This plant grows in water of about a foot in depth, and is never found on shore much beyond the water's edge.

### 122. BRIGHT GREEN SPIKE-RUSH

ELEOCHARIS OLIVACEA Torr.

Some of our specimens collected appear to be this species. It is, in general, a coast species but has been reported for the state in Gibson and Lake counties.

### 123. BLUNT SPIKE-RUSH

ELEOCHARIS OBTUSA (Willd.) Schultes

Common about the lake on wet sandy shores. Patches were found at Green's pier, by Overmyer's, on the flat east of Lakeview Hotel and at Long Point. It was also found at Fletcher's Lake.

A form identified as *E. obtusa jejuna* was abundant in a kettle-hole in Green's clover field. Found in fruit October 24, 1900.

### 124. CREEPING SPIKE-RUSH

ELEOCHARIS PALUSTRIS (L.) R. & S.

This is one of the most common spike-rushes in the vicinity of the lake. It grows in moist sandy shore at various places—such as at Long Point and near Norris Inlet. It grows out for some distance into the water, the plants in water where the growth is not thick standing in straight rows as if in drills along the underground rootstock. The plants showed up well above the water by May 28, and were in blossom by June 6, 1901.

The creeping spike-rush is exceedingly variable in size and general appearance.

The form known as *E. palustris glaucescens*, a very stout tall spike-rush, is fairly common about the lake, and was obtained in Green's marsh, along the shore of Lake Maxinkuckee south of Green's, and at Lost Lake. As the forms occur at the lake they are quite distinct without any tendency to vary into each other.

### 125. NEEDLE SPIKE-RUSH

ELEOCHARIS ACICULARIS (L.) R. & S.

This is the most minute and slender of our spike-rushes, the dense short clumps covering the ground where they grow like a minute bright-green growth of hair. The needle spike-rush grows in a greater variety of situations and at a greater distance from the lake than the other species, and varies considerably with the situation in which it is found. Some grew along the lake shore south of Arlington hotel, and in the swamp below Farrar's. It was still green, but being washed out by the choppy waves, at the edge of Lost Lake on November 2, 1901. On April 2, 1901, it

was noticed growing on the bottom of the outlet, a considerable distance below the lakes; these plants were very long and slender. On May 29 of the same year it was seen in flower in Green's marsh. In the tamarack west of the lake it grew in large dense patches, the plants being very short.

### 126. HAIR-LIKE STENOPHYLLUS

STENOPHYLLUS CAPILLARIS (L.) Britton

A slender grass-like sedge found growing scantly on the sandy soil north of Lost Lake. It is a rather inconspicuous plant, and easily overlooked.

### 127. SLENDER FIMBRISTYLIS

FIMBRISTYLIS AUTUMNALIS (L.) R. & S.

Much like *Stenophyllus capillaris* and found growing with it in the sandy soil north of Lost Lake.

### 128. SLENDER COTTON-GRASS

ERIOPHORUM GRACILE Koch

This species is found nowhere about the lake except in Hawk's marsh. Here it grows in considerable abundance, and appears to be increasing in density of growth from year to year.

With the possible exception of the tall tickseed sunflower, which grows over great areas to the exclusion of everything else, and covers for a brief season great patches with continuous stretches of unbroken gold, this patch of cotton grass is one of the most striking bits of scenery of the country.

There are several species of plants, which in the density of growth and abundance of blossom give their color to the whole landscape. There are the blue vervains which in rolling moist clayey places tone the whole area to a sober blue, and there are the level moist flats, in some places changed to a dirty white by blossoms of boneset, or in others almost unbroken delicate pink by the steeple bush (Spiraea) or others yellow with swamp goldenrods; but the cotton grass rivals and outshines them all, both in its conspicuousness and the continuance of its season of splendor.

The cotton grass nowhere forms continuous patches, but the plants grow singly, scattered among the sphagnum and sedges, which they overtop. One small patch west of the center of the marsh is almost dense enough to give the appearance of continuity. Generally, however, the plants are far enough apart to give the outline of each individual head.

While still in blossom in July and August the cotton grass is

not at all conspicuous. It is not until the latter part of August, or the earlier portion of September, when the bristles of the head begin to develop and show themselves, that it reaches its stage of attractiveness; then the large white silky heads, each at the top of a tall slender stalk, appear, when looked at from a level, to be poised in the air above the marsh. Few bits of nature, except it be the delicately poised leaves of the aspen, bring to mind so forcibly and continually a sense of the reality and restlessness of the air. The heads of the patch are somewhere at all times swaying or bobbing, and of several attempts to photograph them, none was quite satisfactory.

As the marsh in which these plants grow is surrounded by an almost impenetrable thicket and is itself much like a wet sponge to walk on, the splendor of this attractive patch is unknown to most of the inhabitants of the vicinity or the people who visit the lake. The only place where any view at all satisfactory can be had of it is from one of the hills in Hawk's field which overlooks the marsh, and here the view is too distant to give an adequate notion of the attractiveness of these plants at close range.

*Eriophorum gracile* retains its attractiveness until the snow comes to be its rival. If the plants are collected late in August or early in September before the seeds ripen, the bristles remain tight, and it makes an attractive dried bouquet, quite as attractive as pampas grass, and contrasting with it in its compact cottony ball. The bristles are usually snow-white but sometimes are a rich tawny. The heads can be collected ever after rains have given them a bedraggled look, as after drying out they easily can be fluffed up.

In addition to the patch at Hawk's marsh, some was seen in a tamarack near Fletcher's Lake.

### 129. TALL COTTON-GRASS

ERIOPHORUM ANGUSTIFOLIUM Roth

Not particularly abundant in the neighborhood of the lake. A number of plants were seen in the tamarack west of the lake on May 22, 1901, but none was seen nearer the lake. This cotton grass does not form as nearly compact patches as *E. gracile* but the plants are scattered among other sedges. The bright white of the delicate drooping tassels takes the eye at a considerable distance and the effect is more striking than that of most flowers—the appearance being that of great snowflakes lodged here and there among the knee-high grass. This sedge is in its glory in the early part of the season—in the latter part of June or during July—and during the latter part of the summer. In the autumn these tassels

look worn and bedraggled. The species has a wide range, from the far north in Alaska south into Georgia, but is comparatively little known, and its charms attract the sight of but few as it grows in the remote marshes. In 1907 we saw some in a tamarack bog in the neighborhood of St. Paul, Minn.

### 130. WATER CLUB-RUSH

SCIRPUS SUBTERMINALIS Torr.

Rare in the neighborhood of the lake. Its occurrence is attested by a single herbarium specimen.

### 131. WEAK-STALKED CLUB-RUSH

SCIRPUS DEBILIS Pursh

A low rush, looking considerably like a miniature bulrush, usually growing at the water's edge in wet soil. A few plants grew along the west shore of Lost Lake on the border of the quaky shore. It formed fairly large patches at Bass Lake, along the shore in wet sand.

### 132. THREE-SQUARE; CHAIR-MAKER'S RUSH

SCIRPUS AMERICANUS Pers.

This is the most common bulrush about the lake. With the exception of a rather large patch in a flat springy field near the Military Academy and back of the row of Lombardy poplars fringing the road in that region, this plant does not form large patches, nor extend far from shore either into the water or back on the land, but it forms a rather narrow fringe along the shore of the lake, growing on the wet sandy beach or out in the water to the depth of about 18 inches or 2 feet. Patches occur on shore about the Military Academy grounds. From the Culver railroad bridge it fringes the shore with few interruptions to Long Point. There are only a few scattered plants along the east shore of Long Point. Below Green's it begins again and extends, with a few unimportant interruptions, to Norris Inlet and in front of Norris's. Plants grow on shore back from the lake a little way on the springy hill by Overmyer's and on another springy hill beyond Norris's. There are no patches along the east shore of the lake from Norris's to near the Military Academy grounds. Like the other common bulrush of the lake, and like the various species of Eleocharis, this plant spreads by means of rootstocks and grows out in the water in straight rows. In the autumn the part above water gradually dies and turns brown, but the portion under water remains green all

winter. The part above water remains during most of the winter, but gradually breaks off or is removed when the ice melts in spring. The muskrat frequently uses this plant in the construction of its winter houses.

The plants were nearly dead by September 28, 1900. By May 5, 1901, the young stalks of the year showed up from the bottom as green short stubble; by May 16, the plants were projecting above the surface of the water; nine days later flower-buds began to show, and by the first of June, the plants, though only about 6 inches high, were in blossom.

This plant forms extensive patches at Bass Lake where the water remains shallow a long distance from shore.

### 133. AMERICAN GREAT BULRUSH; MAT-RUSH

SCIRPUS VALIDUS Vahl

The great bulrush is the most aquatic species of the genus about the lake. In habits and choice of habitat it quite closely resembles *S. americanus*, and both are found in similar situations except that the great bulrush will grow out in deeper water, and prefers a soft marly soil, while the three-cornered rush prefers more sand. Like *S. americanus*, the great bulrush is found along shore from the Culver railroad bridge to the north shore of Long Point. It is rare or absent along the east shore of Long Point. Below Green's it begins again and extends with occasional interruptions to Norris's. There is none along the east shore of the lake, but it begins again where the road comes down to the lake near the Military Academy grounds. Opposite the ice-houses, opposite Farrar's and opposite Overmyer's field, it grows for a considerable distance out in the lake. By Overmyer's field it grows back from shore on a springy flat, while in the Inlet marsh it grows back from shore for a considerable distance. In favorable locations it grows in water 7 or 8 feet deep, the plants projecting above the water 4 feet, the entire length of these plants being 11 or 12 feet. On shore it rarely grows more than 7 or 8 feet high and is usually about 6. Bulrushes are common about the edges of Lost Lake, and continue more or less interruptedly down the Outlet, patches occurring here and there almost down to the Outlet mouth.

The bulrush stems furnish the muskrat with material with which to build its house. Masses of filamentous algæ frequently grow attached to the base of submerged Scirpus stems; this was especially well marked in the region of the Inlet, where various algæ, notably the rank Schizomeris, formed dense skirts about the bulrushes, much as mosses and Porella grow about the bases of shrubs

in woodland ponds. At Eagle Lake, sponges were very common about the bulrush stems, forming collars entirely around the stem at various depths below the surface of the water, but this did not occur in Lake Maxinkuckee, the forms of sponge in this lake either growing in flat mats over stones or in long loose strings among the pondweeds. Various insects lay their eggs in great patches around the bulrush stems just at the water surface and the patches off the ice-house were coal black from the layers of eggs deposited on them. The eggs may be those of some species of damsel-fly, but we were unable to see any insect depositing them. The little steel blue damsel-flies of the lake congregate in great numbers on the rushes, forming long series along one side and presenting a peculiar appearance. It is up the stems of these plants that most of the damsel-fly nymphs crawl to the air, and from which they emerge into the adult form and take their first flight.

There are two well marked forms of the great bulrush—a slender compact dark green form bearing comparatively few seeds, and a more loosely built glaucous form, easily crushed between the fingers and bearing an ample cluster of spikelets. The firm, dark-green form is the one most common about lakes, especially in sandy firm soil, and is almost exclusively the form found at Lake Maxinkuckee. The soft glaucous form is common along stagnant pools and canals. A patch of this form was found down the Outlet and others on the north side of Long Point. At Twin Lakes both forms are quite common, growing side by side and quite distinct, the glaucous form growing more in compact round patches.

Occasional plants both of *Scirpus validus* and *S. americanus* grow in a sort of open corkscrew spiral. This form was not common at Lake Maxinkuckee though quite abundant in some other lakes visited.

### 134. DARK-GREEN BULRUSH

SCIRPUS ATROVIRENS Muhl.

This plant does not form extensive patches and does not grow at the edge of the lake, as do the species just mentioned. It is more common about the edges of small pools and in wet meadows. A few clumps grew along the road south of Outlet Bay between the road and lake in the tangled jungle-like mass of vegetation. It was found also in low ground near Norris Inlet, and in marshy places on the east side. It was in blossom by June 16, 1901, by Lakeview Hotel, and dead ripe south of Outlet Bay by Sept. 15, 1900. The plants at this place had been bitten off by stock and on the culm near the top had produced peculiar bulbs, probably an

effort to reproduce vegetatively in lieu of seeds. In 1904 a good deal was found scattered in a flat north of the ice-ridge pond on the east side, and south of Aubeenaubee Creek.

### 135. REDDISH BULRUSH

SCIRPUS LINEATUS Michx.

A scirpus considerably resembling the next, which is more common and better known. The spikelets are cylindrical and narrow, and rather inconspicuous. This plant is fairly common in low places about the lake but not on the shores of the lake itself. By June 11, 1904, it was still very short, but in bloom wherever found.

### 136. WOOL-GRASS

SCIRPUS CYPERINUS (L.) Kunth

Common throughout the greater part of the country at the edges of pools and in wet meadows. It rarely grows in large continuous patches, but forms small clumps or single tussocks. Rather common in the low flat between the road and lake south of Outlet Bay. It was also abundant in a marsh west of the dunes. This is the handsomest of the plants belonging to the genus Scirpus, though not so showy as several members of the genus Eriophorum in which it has sometimes been placed. It is a tall, stately plant, the small spikelets on long slender drooping pedicles, becoming fuzzy with gray brown bristles, make a large handsome head.

### 137. COMMON HEMICARPHA

HEMICARPHA MICRANTHA (Vahl) Pax.

A very little sedge, growing in small tufts a few inches high, the fruit usually 2 minute cone-like spikes placed side by side. It grows in wet sand and was found along Yellow River a few miles north of the lake and at Fletcher's Lake. None was found in the immediate vicinity of Lake Maxinkuckee. It was probably present, but overlooked.

### 138. DULICHIUM

DULICHIUM ARUNDINACEUM (L.) Britton

A rather homely, inconspicuous sedge, frequently well intermixed and hidden by the bulrushes near the water's edge. At Lake Maxinkuckee it grew in the swamp along the edge of the lake between Farrar's and Overmyer's. It was also seen in the tamarack west of the lake. It reaches its fullest development, however, in the drained sphagnum swamp in Walley's woods, about half of which it almost completely covers.

### 139. WHITE BEAKED-RUSH

RYNCHOSPORA ALBA (L.) Vahl

We have specimens of this species in our collection, probably from the swampy flat north of Lost Lake. A rather inconspicuous rush-like plant.

### 140. WATER BOG-RUSH

MARISCUS MARISCOIDES (Muhl.) Kuntze

A rather homely rush-like plant found generally near the water's edge and often hidden among the bulrushes with which it often grows. Only 1 small patch was found, growing along the western shore of Lost Lake.

### 141. LOW NUT-RUSH

SCLERIA VERTICILLATA Muhl.

Fairly common in the flat ground north of Lost Lake. The white achenes or nutlets are quite conspicuous when ripe, and when viewed closely, exhibit under magnification an interesting and attractive sculpture.

### 142. STELLATE SEDGE

CAREX ROSEA Schk.

A common sedge in dry woodlands such as at Long Point and in parts of Farrar's woods. A slender, rather inconspicuous sedge, with a small few-seeded spike, the perigynea radiating at maturity. Some of our specimens were smooth instead of rough above, and may have been *C. retroflexa* Muhl., which has been by some regarded as a variety of this. Fruits ripening about the middle of June.

### 143. SOFT FOX SEDGE

CAREX CONJUNCTA Boott

Occasional in moist open places among other sedges, forming clumps. Collected in Green's marsh on the second of June, 1901, when the heads were well formed.

### 144. FOX SEDGE

CAREX VULPINOIDEA Michx.

Common, but rather scattered in low sedgy flats, as between the road and the south shore of Outlet Bay and in the low grounds west of Green's marsh; found also by the icehouses. One of the most common and best known of the sedges with flat perigynea and lenticular fruit. The fruit was well formed by the middle of June.

145. LESSER PANICLED SEDGE

CAREX DIANDRA Schrank

Not rare in Green's marsh and various other parts of Lost Lake plain. Heads well formed by June 2, 1901.

146. LARGE-PANICLED SEDGE

CAREX DECOMPOSITA Muhl.

Not rare in marshy places. Found in Farrar's woods in a swamp by Lost Lake and in Green's marsh. Fruit was well formed by June 17, 1901.

147. AWL-FRUITED SEDGE

CAREX STIPATA Muhl.

This, and a few other closely related and very similar species, represent a familiar form among the sedges, which grow in low open flats. It appears to be common. Obtained south of the road by Outlet Bay on June 7, 1901.

148. BLUNT BROOM SEDGE

CAREX TRIBULOIDES Wahl.

Rather common in open places at the edges of swales and prairies, and at the borders of swamps. Collected with fruit fairly well developed in Farrar's woods June 17, 1901.

149. BEBB'S SEDGE

CAREX BEBBII Olney

A specimen identified as this was collected in Farrar's woods on June 17, 1901.

150. STRAW SEDGE

CAREX STRAMINEA Willd.

This is a common sedge, belonging to a pretty well marked group having the fruit in rounded or pointed, small head-like spikes, with several heads in series on the fruiting culm. It is usually found in dry open places. A form of this species approaching the subspecies *mirabilis* was collected north of Green's marsh June 17, 1910.

151. BROAD-WINGED SEDGE

CAREX ALATA Torr.

Not very common. A few plants found north of Green's marsh. The fruit was well developed by June 17.

### 152. HAY SEDGE

CAREX FOENEA Willd.

We have no notes on this sedge except the fact that it occurs in our collection.

### 153. BRISTLE-STALKED SEDGE

CAREX LEPTALEA Wahl.

A tall sedge growing rather scattered among the sedges and grasses of low flat marshes. Not conspicuous, but rather pretty. The spikes are rather small, but attractive on account of the color contrast between the pale or whitish perigynia and green subtending scale. Color effects of any sort are rather infrequent among sedges, the entire plant except the scales of the staminate flowers and the yellow anthers and white pistils being usually about the same shade of green, but here we have the monotony somewhat relieved with well marked difference in shade.

Collected in flower over by the tamarack May 22, 1901, and noted in blossom north of the lake June 18.

### 154. PENNSYLVANIA SEDGE

CAREX PENNSYLVANICA Lam.

One of the most familiar sedges to be found in open woodlands and one of the earliest plants to bloom in spring. It usually grows in scattered tussocks in dry woodlands, but sometimes the tussocks grow close together forming small patches where it forms a firm mat over the ground. On account of the curled touseled character of the leaves, which become brownish when old, it is in some places known by the suggestive name of dog's hair grass.

The fruit is inconspicuous and scant.

April 6, 1901, nearly in blossom by Farrar's. April 19, nearly in flower west of the lake; April 25 fully in flower by Chadwick's; April 26 some fully in blossom in Farrar's woods; April 30 in blossom everywhere. It ripens early in the summer. Nearly ripe fruit was collected June 17.

### 155. WHITE BEAR SEDGE

CAREX ALBURSINA Sheldon

This sedge is remarkable for its very broad whitish leaves. It never grows in patches, but is usually found singly and scattered in deep shade of rich woodlands. The fruit is scarce and inconspicuous. It was found in various places about the lake, principally in the deep woods on the east side.

156. MEADOW SEDGE

CAREX GRANULARIS Muhl.

Like the majority of sedges, this species prefers flat, open moist soil like that at the edges of the natural meadows or lake plains. Specimens were collected southwest of the lake, June 26, 1910.

157. GRAY SEDGE

CAREX GRISEA Wahl.

A dry-ground woodland sedge. Collected south of the lake on June 26, 1901.

158. GRACEFUL SEDGE

CAREX GRACILLIMA Schwein.

Rather common in moist shady places. Collected in Farrar's woods, almost dead ripe on June 17, 1901.

159. RIBBED SEDGE

CAREX VIRESCENS Muhl.

A sedge of dry woodlands, growing in somewhat similar situations as those where *C. pennsylvanica* thrives. Specimens collected in Farrar's woods, June 17, 1901.

160. HIRSUTE SEDGE

CAREX COMPLANATA Torr.

A sedge much like this, but with spikes too small to agree with descriptions of the typical form, was rather common in Farrar's woods. It was obtained in fruit on June 17, 1901.

161. BROWN SEDGE

CAREX BUXBAUMII Wahl.

Specimens of this sedge were obtained in low ground along the railroad on June 17, 1901.

162. TUSSOCK SEDGE

CAREX STRICTA Lam.

A common sedge in Green's marsh, and forming much of the growth back of Green's field east of Lost Lake outlet. A rather tall wiry sedge, frequently covering great areas of flat ground in the northwest. Formerly not used except for packing, it has recently become of some economic importance as the raw material from which "Crex" carpets and mattings are made.

163. NODDING SEDGE

CAREX GYNANDRA Schwein.

Collected June 11, 1901, at the edge of Farrar's pond.

164. WOOLLY SEDGE

CAREX LANUGINOSA Michx.

This appears to be a common sedge in the low flats about the lake, it and *C. stricta* forming the main mass of the dense sedge growth in Green's marsh and about Lost Lake. It propagates extensively by rootstocks and bears fruit but rarely. The spikes are small and inconspicuous and are covered with a dense brown velvety growth of fuzz. It and *C. stricta* together form the bulk of "prairie hay" used at the lake chiefly for filling in the ice-houses, and in general use for packing.

This sedge was up bright and green by April 13, 1901, along the railroad between the lakes, north of Green's marsh, and also north of Lost Lake. It bore well formed fruit by June 8.

165. AWNED SEDGE

CAREX ATHERODES Spreng.

Common among other sedges in Green's marsh. Obtained with well developed heads on June 10, 1910.

166. BEAKED SEDGE

CAREX ROSTRATA Stokes

Occasional in moist places. Specimens were collected along the railroad on June 17, 1901.

167. BRISTLY SEDGE

CAREX COMOSA Boott

In shallow water, edge of Lost Lake.

168. HOP SEDGE

CAREX LUPULINA Muhl.

Common in moist places about the lake, growing well in the shade. Specimens with well formed fruits were obtained in Farrar's woods by the pond on June 11 and June 17, 1901.

## Family 17. Araceæ. Arum Family

169. JACK-IN-THE-PULPIT; INDIAN TURNIP

ARISAEMA TRIPHYLLUM (L.) Torr.

Common in moist rich woodlands. It was found in flower east of the lake on May 13, and in Farrar's woods May 25, 1901. On

September 9, 1906, much of the dead-ripe fruit was observed in the woods east of the lake. It varies greatly in size and general appearance, some of the plants being small with a very dark brown spathe. These may represent the species *pusillum*. On account of their oddity and handsomeness, the Jack-in-the-pulpit, especially the striped forms, is well worthy of cultivation in wild-flower gardens. The cells of this plant, as indeed most of our aroids, contain bundles of numerous needle-like crystals or "rhaphides" of oxalate of lime, and it is probably due to the pricking of these needles that the intense acrid taste of these plants is due.

### 170. GREEN DRAGON

ARISAEMA DRACONTIUM (L.) Schott

Not so abundant nor widely distributed as the other, usually confined to the banks of creeks or borders of ponds. Most of the plants found were in the low woods by Overmyer's or by swamps in Farrar's woods. It was in flower by May 25. The fruits, like red ears of corn, were conspicuous along Yellow River, north of the lake, in the autumn of 1907.

### 171. GREEN ARROW-ARUM

PELTANDRA VIRGINICA (L.) Kunth

Not particularly abundant about the lake but pretty well scattered along the shore at various places. There were several plants in Lake Maxinkuckee at the source of the Outlet, some in front of Inlet marsh, one plant between the Inlet and Norris's, a few in the upper end of Lost Lake, and some in the swamps between Overmyer's and Farrar's. It was quite common in the thoroughfare between the lakes. The dark-green calla-like leaves are quite attractive. The plants began leafing out by May 3, 1901, and some of the leaves were fully developed by May 17, and by June 24 some were in flower. The flower is rather inconspicuous with a bulb-shaped green base, tipped by a delicate whitish-green spathe undulate along one side. The ornamental projection of the spathe soon drops off, leaving the bulbous portion, which by making a sharp turn on its stem, buries itself under the surface of the water, where it ripens. Ripe fruit was found October 25, 1904.

The seeds are covered by a gelatinous material and are said to be a favorite food for wild geese.

### 172. SKUNK CABBAGE

**SPATHYEMA FOETIDA (L.) Raf.**

Confined to mucky springy places about the lake. Its distribution is rather peculiar throughout the country. Wherever one finds mucky or loamy ground of a springy nature—and other peculiar conditions familiar to every one—he is likely to find the skunk cabbage. The plants are thus confined to suitable soil, and often in wholly isolated patches. It is not likely that the large heavy seeds are transported by birds. They are, indeed, too hard for most animals to attempt to eat, though some were once found in what appeared to be a mouse's nest. At the lake the skunk cabbage is found in Overmyer's low woods, in low springy ground along Culver Creek northeast of the lake, and in Busart's and Zechiel's ponds in low woods. There was also a good patch in the flat west of Lakeview Hotel.

With the exception of chickweed and speedwell, plants which bloom continuously and can be found in bloom every day in the year in sheltered situations, the skunk cabbage is by far the earliest blossom of the year, although in some seasons it has a hard race with the silver maple.

The skunk cabbage suffers somewhat from a bad name not wholly merited. Its odor is somewhat garlicky, to be sure. Any one who will take the pains to compare the odor of a freshly caught skunk with a skunk-cabbage blossom that has really had opportunity to become smelly, will admit that the comparison of the odor of the blossom to that of the animal is altogether too obvious. But we have other plants that smell worse even when farther away. The stink-horn is a notorious example.

The skunk cabbage spathes are perfectly formed, and even have their color developed, in autumn. By digging up the plants about Thanksgiving time and unfolding the leaves the perfect flowers can be seen. Some were obtained in Busart's swamp in the autumn of 1904. Under favorable conditions the plants may even blossom before New Year's. Some were found fully in bloom two weeks before Christmas.

This plant might rank even among our popular blossoms if it were not handicapped by a suggestive name. A name heard in Virginia was "Quick Will", probably referring to the earliness with which the blossoms appear in spring. A fanciful, but by no means inappropriate, name given to these plants in the south is "Midas' Ears." One could hardly imagine a name more fitting, or do better than follow the seer who first applied it. For if we choose, we can

find, as many have found, in the first peeping out of the ground of this first prophet of spring a sense of delighted surprise. Let those who choose be simply reminded of skunks, but to those who will it otherwise there comes a message of new-born spring, and memories of an ancient tale; when the rough and boisterous winds of March play their wild flute music on dead sedge stems, or pipe their shrill strains among the tall ghosts of last year's reeds, we can find these Midas' Ears pricked up intent and expectant, to the music of beloved Pan.

The individual plants bear several blossoms, so that the flowering season extends almost into June, making the season much longer than that of most of our plants. The blossoms vary greatly from diminutive deep purple spathes through greenish more or less pied and striped with lurid splotches of red, much resembling a seek-no-further apple, to a bright, clear greenish yellow. The hoods vary greatly in shape from short to those with exceedingly long projecting peaks. The flowers, if not close fertilized, are probably cross-fertilized by the bugs and spiders that take shelter within them and crawl among them.

The fruit is a peculiar head containing large globular seeds embedded in spongy tissue. It is to be found during the latter part of summer.

At the market in Washington, D. C., among the negroes' stalls, these plants are frequently found for sale during their blossoming season as "swamp lilies" and we have heard that they were at one time on sale in the New York markets as "rare orchids from the Philippines."

### 173. SWEET FLAG; CALAMUS-ROOT

ACORUS CALAMUS L.

Not common; a few plants along shore near Chadwick's, one east of Lakeview Hotel, and a few near the grist-mill. The plants were up well, the spadices showing by April 23, 1901, and it was in full blossom by June 2. The flower cluster, a green inconspicuous object, projecting laterally from what closely resembles an ordinary leaf, is a curious object. The pungent aromatic rootstock is in good repute as a stomachic.

## Family 18. Lemnaceæ. Duckweed Family

### 174. GREATER DUCKWEED

SPIRODELA POLYRHIZA (L.) Schleid.

Abundant in the neighborhood of Norris Inlet, forming, with other duckweeds, an extensive scum over the surface. It was also

common in ponds and ditches in Green's marsh. The sheltered waters near the Inlet seem to be its favorite location. Most other parts of the lake are open to too much disturbance by winds and waves for it to thrive. It is occasionally found in sheltered places among the rushes along shore, as north of Long Point and the ice-houses, Winfield's and Overmyer's. These are probably stray plants that have been blown and drifted from the main colony. The numerous holes in the Inlet marsh are also covered by this plant.

In 1909, the duckweed scum was not so extensive at the Inlet as formerly, but there was considerable in Aubeenaubee Bay directly across the lake, and near the Academy grounds. A season of south winds had probably drifted the mass across the lake.

We have no note of having found this plant in blossom. With the other duckweeds it sinks to the bottom in late autumn and remains green all winter, reappearing again with the thawing of the ice.

### 175. IVY-LEAVED DUCKWEED

LEMNA TRISULCA L.

Not especially common at the lake. Found on the lake shore east of Farrar's, in a driedup pond southwest of the lake by the boathouse near the Inlet, and most abundantly in the immediate neighborhood of the Inlet, where it may be found at all seasons when there is no ice; found also occasionally along shore among cattails and rushes in the neighborhood of Winfield's. On October 24, 1900, an immense mass of this species was found drifted in Lost Lake near the middle of the western shore. This formed a thick tangled scum extending out some distance from shore and also making great masses in the bottom. It was also frequently found growing and thriving well in wet places among dead leaves in the water, and it appears to hibernate in such places.

This little plant, with its elongate semi-transparent green fronds, and peculiar manner of branching, is one of the most attractive of the duckweeds. Each frond gives rise to a side-shoot on each side at its center, resulting in a very regular but intricate and complicated branching system where conditions are favorable, the fronds tilting at all angles to avoid interference. It grows much more vigorously under leaves in shallow water than in unprotected situations and hardly looks like the same plant, being much more robust but retaining the same general habit.

Not found in flower or fruit. It hibernates in the bottom and remains green all winter.

### 176. MINUTE DUCKWEED

LEMNA PERPUSILLA Torr.

One of the smallest of the Lemnas; abundant in Norris Inlet, intermixed with *Wolffiella floridana;* some collected there November 18, 1904.

### 177. LESSER DUCKWEED

LEMNA MINOR L.

Not particularly common in the lake. Most of the plants are found in the great mass of duckweeds near Norris Inlet, the plants of *L. minor* scattered more or less among the Spirodela. It was also found near Farrar's and at Overmyer's springy flat. In 1906 it was quite common in the Inlet, back among the weeds. Along the Kankakee marshes almost pure growths of this plant cover great areas with an almost unbroken scum.

Found abundantly in blossom by Norris Inlet, June 13, 1901. The blossoms are minute white specks like bits of dust.

### 178. COLUMBIA WOLFFIA

WOLFFIA COLUMBIANA Karst.

Not particularly abundant at the lake. There is, indeed, a considerable amount down by Norris Inlet, but it is so intermixed with other duckweeds, which are more conspicuous and abundant, that it does not make much of a show. At Eagle Lake, Kosciusko County, and at Twin Lakes, it covers the entire water surface near shore for a considerable area, making an almost unbroken scum. This is one of the most minute of flowering plants, the entire plant being not much larger than a pin-head. It was noticed in blossom several times. On October 9, 1900, the plants were in blossom quite freely. We got a tubful in which many were in bloom. They were found in flower also on October 21 of the same year. At Put-in-Bay, Lake Erie, some were noted in blossom about the 19th of July. The flowers appear like minute white dust specks.

According to Forbes* Wolffia is not unimportant as a food supply for certain species of fishes, forming in some cases 95% of the stomach contents of the Buffalo-fish, *Ictiobus bubalus*, 8% of the food of the carp sucker, *Carpiodes carpio*, and the larger portion of the food of the mud-minnow, *Umbra limi*.

Plants occasionally drift among the bulrushes along shore at various parts of the lake, as near Winfield's, where they hold their own for some time in the shelter of the rushes, but they do not appear to increase much.

Nat. Hist. Surv. Ill., III, Ichthyology.

### 179. DOTTED WOLFFIA

WOLFFIA PUNCTATA Griseb.

With the other species, but not so common; characterized by smaller size and numerous brown pigment cells. It is the smallest of our flowering plants, though there is a still smaller species, *Wolffia microscopica*, found in Asia.

### 180. FLORIDA WOLFFIELLA

WOLFFIELLA FLORIDANA (J. D. Smith) Thompson

Rather common at Norris Inlet among other duckweeds. On account of its slenderness and submerged growth, and its habit of hiding among other duckweeds and among algæ, it is easily overlooked. The plants usually cohere to form star-shaped bodies. It often grows thickly tangled in the tops of Ceratophyllum. South winds frequently drive this with other duckweeds from their accustomed haven, and one finds stray bits at various places on shore. On various occasions a few bits were found at Overmyer's spring, a few south of Winfield's, and some near Farrar's, but they do not appear to thrive or multiply in these places. This duckweed remains green all winter and can be seen under the clear ice. Plants were thus observed on December 20, 1904, floating along the under side of the ice over the Inlet.

In 1906 and again in 1909 when the Inlet was visited, this plant appeared to be growing less common, as if disappearing.

## FAMILY 19. XYRIDACEÆ. YELLOW-EYED GRASS FAMILY

### 181. SLENDER YELLOW-EYED GRASS

XYRIS FLEXUOSA Muhl.

A rather remarkable and peculiar plant, the flowers aggregated into dense heads on the tips of long slender scapes. Not common. A few scattered plants were found in the wet sandy marsh near the birch swamp along the railroad south of the lake. The plant begins blossoming in early July.

## FAMILY 20. ERIOCAULACEÆ. PIPEWORT FAMILY

### 182. SEVEN-ANGLED PIPEWORT

ERIOCAULON SEPTANGULARE With.

Not common in Lake Maxinkuckee; only a small patch of plants found on shore near the Assembly grounds. The basal rosettes of leaves look much like those of *Sagittaria graminea*, and grow

close to the ground at the bottom of the water. It was quite common at Bass Lake near the ice-houses, forming extensive patches of scattered plants. On August 14, 1906, these plants were in blossom and the sober gray puff-like little heads of flowers floating on the surface of the water formed an unique and pleasing sight. They did not look like flowers or aggregations of flowers as usually understood; the stems were hidden underneath the water, and they seemed to have simply popped out of the water to cause a sensation of surprise.

## Family 21. Commelinaceæ. Spiderwort Family

### 183. VIRGINIA DAY-FLOWER

COMMELINA VIRGINICA L.

Not at all common. The first plants found in the lake region were in sandy soil along the west side of the thoroughfare joining the lakes. It had the appearance of having been recently introduced. It was, however, probably native.

### 184. REFLEXED SPIDERWORT

TRADESCANTIA REFLEXA Raf.

Fairly common, but scattered in sandy soil. Most abundant along the railroad. The leaves were up well by May 11, 1901, and it was in flower along the railroad track by June 3, 1901.

## Family 22. Pontederiaceæ. Pickerel-weed Family

### 185. PICKEREL-WEED

PONTEDERIA CORDATA L.

Common along the edge of the lake, especially where the bottom is somewhat muddy. It grows from shore out to where the water is about ten inches deep. Noted in numerous places along shore, such as at Long Point, south of Farrar's, from in front of the ponds and marshes to beyond Norris's. There was none along the east side, but it began again in front of Culver Academy grounds. There was some north of Winfield's and some by the ice-houses.

An interesting and attractive plant, the dark-green delicately veined smooth leaves growing in tropical luxuriance, and the dark blue flowers with spots of gold in the center, are very pleasing. In some places along shore the cattle had browsed off the leaves and stems. The plant succumbs early to frost, the leaves soon rotting down after being frozen.

186. WATER STAR-GRASS

HETERANTHERA DUBIA (Jacq.) MacM.

Rather abundant in the lake off from the ice-houses, and in the thoroughfare between the lakes. The long form growing in water closely resembles some of the narrow-leaved species of Potamogeton. Fragments break off, drift ashore, and take root in the mud. These form a short and entirely different looking plant with bright attractive yellow flowers which, sparkling up from the mud-bank, draw attention to the plant.

## FAMILY 23. JUNCACEÆ. RUSH FAMILY

187. COMMON RUSH; BOG RUSH; SOFT RUSH

JUNCUS EFFUSUS L.

Not particularly common; the only patch in the vicinity was in a low flat by Farrar's. Over this small area the soft rush grew abundantly, each plant forming a large clump. These large tufts, dark green throughout the entire year and drooping gracefully in every direction, made the flat a pleasing picture, especially during the barren portion of the year. The internal structure of the stems, consisting of stellate cells, is beautiful and interesting. The plants were in blossom by May 25, 1901.

188. TOAD RUSH

JUNCUS BUFONIUS L.

Not very common, and confined to flats where there is considerable moisture and more or less sand. In general appearance it resembles a diminutive form of the familiar yard rush, *Juncus tenuis*. It clings closely to the ground and is a rather inconspicuous plant. In the lake plain of Lake-of-the-Woods, a few miles north, it covers almost the entire area in places with a dense growth. At Lake Maxinkuckee it occurred along the road south of Outlet Bay, and in the flat marsh north of Lost Lake.

189. SLENDER RUSH; YARD RUSH

JUNCUS TENUIS Willd.

The most common and familiar of our rushes. Like the "yard grass", *Polygonum aviculare*, it seems to thrive best in well-trodden ground. It grows most luxuriantly about the haunts of man and in this respect acts much like an introduced plant. Its favorite habitat is along the edge of footpaths. It usually droops over the pathways more or less and, in later summer after a rain, the pods

burst and the ripened seeds hang out in conspicuous gelatinous masses like minute frog-spawn. It is possible that these seed masses are distributed by passing men and animals.

In flower June 7, 1901, along the road south of Outlet Bay. Collected also at Long Point June 7.

### 190. SHORT-FRUITED RUSH

JUNCUS BRACHYCARPUS Engelm.

Not common. Scattered plants were found at the edge of moist sandy stretches along the railroad near the birch swamp.

### 191. CANADA RUSH

JUNCUS CANADENSIS J. Gay

Not particularly common. Some plants were collected in the Long Point region June 17, 1901.

### 192. SHARP-FRUITED RUSH

JUNCUS ACUMINATUS Michx.

In moist sandy places, especially where the sand is almost continually saturated. Not very abundant in the neighborhood of the lake.

### 193. STOUT RUSH

JUNCUS NODATUS Coville

Scattered, like the others, in low moist sandy places. Not particularly abundant.

### 194. COMMON WOOD-RUSH

JUNCOIDES CAMPESTRE (L.) Kuntze

A hairy, grass-like plant forming tufts in both moist and dry situations at the edge of woodlands and in light shade. It blossoms early in spring. Rather common, but not abundant about the lake. It was noted in Farrar's woods and along the railroad near the Winter-berry marsh. Noted in blossom May 2, 1901.

## Family 24. Liliaceæ. Lily Family

### 195. WILD LEEK

ALLIUM TRICOCCUM Ait.

A lover of deep rich woods, where it frequently grows in patches. The broad flat handsome leaves have some little resemblance to those of the dog-tooth violet, but without their mottling. The greenish inconspicuous flowers are followed by a 3-lobed ovary,

each lobe containing a seed much resembling a shot in appearance and hardness. The bulb has a faint delicate flavor, more like the thought of an onion than an actual onion. The odor clings to the breath with remarkable persistency. Its very faintness perhaps, makes it more tantalizing and unendurable, and few morsels of which one can partake are followed by such lasting regret.

April 6, 1901, remains of this plant found in woods northeast of the lake. April 19, well out in leaf.

### 196. NODDING WILD ONION

**ALLIUM CERNUUM Roth**

This onion prefers open sunny places. It is not abundant in the region of the lake. The only plants seen were a few on the bank at the southeast corner not far from Norris's. The large umbel of gracefully drooping rosy pink blossoms makes this a very attractive plant when in bloom. Its bulb has an honest well pronounced onion flavor, and a marked pungence of taste, which, while inferior to that of the cultivated onion, the

> "Rose among roots, the maiden-fair
> Wine-scented and poetic soul
> Of the capacious salad bowl,"

is much more satisfactory in after effects than the flavor of the wild leek.

### 197. WESTERN RED LILY

**LILIUM UMBELLATUM Pursh**

This lily, which deserves the name of Tulip lily, from its habit of looking upward like a tulip, is one of the most attractive of our native plants. The long-clawed erect vivid perianth-segments resemble flames. The individual flowers are more showy than those of either of the 2 other species with nodding flowers, *L. canadense* or *L. superbum*, but the blossoms are not borne in so great abundance.

A few plants were found south along the railroad, in sand, in blossom about July 4. It is rare in the neighborhood of the lake, but is fairly common about Plymouth and along the Pennsylvania railroad near Bourbon, Indiana.

### 198. WILD YELLOW LILY

**LILIUM CANADENSE L.**

The common yellow lily of the state, generally known as the wild tiger lily, usually growing in moist meadows. It is becoming much

less common than formerly on account of the breaking up of the ground. It will thrive in grassy unpastured meadows for a long time, but pasturage or cultivation soon kills it out. Not common about the lake.

The magnificent turks-cap lily, *L. superbum*, which frequently bears large panicles of flowers, should be found in the vicinity of the lake, but so far has not been observed.

### 199. YELLOW ADDER'S-TONGUE

ERYTHRONIUM AMERICANUM Ker

Common in rich woods east of the lake. The leaves were up by April 12, 1901, and large flower buds almost ready to open by April 19. It was nearly out of flower by April 30. The bulbs are deeply buried, and each bulb seems to be more deeply buried than its predecessor of the year before. The leaves are usually beautifully mottled, but some patches or individual plants have them with a plain, somewhat silvery luster. The flowers have a pleasing fragrance. In some parts of the country these plants are known as "wild tulips."

### 200. WHITE ADDER'S-TONGUE

ERYTHRONIUM ALBIDUM Nutt.

Rather common, but not nearly so abundant as the other. A patch was found in blossom on the east side of the lake on April 30, 1901. It usually begins blossoming considerably later than the other species. One of the prettiest of our wild flowers, but not conspicuous.

### 201. STAR-OF-BETHLEHEM

ORNITHOGALUM UMBELLATUM L.

It was somewhat surprising to find this plant, which is usually associated with closely settled homesteads and old gardens, in close proximity of the lake. A few plants were found in flower along the road east of the lake, June 5, 1901.

### 202. STAR-GRASS; COLIC-ROOT

ALETRIS FARINOSA L.

This was noted as not at all common; found in dry soil along the railroad track in 1901. In 1909, it was noted as fairly common in flat moist sandy places along the railroad.

## Family 25. Convallariaceæ. Lily-of-the-Valley Family

### 203. ASPARAGUS

**ASPARAGUS OFFICINALIS L.**

A fairly common escape along the railroad, growing in small patches. Noted in flower May 18, 1901.

### 204. FALSE SPIKENARD

**VAGNERA RACEMOSA (L.) Morong**

A familiar and attractive plant growing in shaded woodlands. The white raceme of flowers is attractive and fragrant, and the unripe berries white in color, thickly freckled with red, are pretty. The ripe berries, consisting of a scarlet pulp enclosing a large white ivory-like seed, are aromatic, and, to a degree, edible. Found in flower by Vajen's May 28, 1901, and in Farrar's woods June 4. Abundant on Long Point where it was collected in blossom June 10. The fruit ripens in autumn at a time when the stem and leaves die down.

### 205. STAR-FLOWERED SOLOMON'S SEAL

**VAGNERA STELLATA (L.) Morong**

This species is much less common than the preceding and is usually found in rather dense patches on shady banks. Although the flowers are larger than those of the related species it is not so attractive a plant. The unripe berries are green with meridional areas of purple, and the ripened berries are black. Found in flower May 14, 1901, in Overmyer's woods and collected in blossom on the north side of the lake May 18.

### 206. FALSE LILY-OF-THE-VALLEY

**UNIFOLIUM CANADENSE (Desf.) Greene**

One of the daintiest and most attractive of our wild flowers, the erect slender stem bearing 2 or 3 leaves and surmounted by a panicle of creamy fragrant flowers, considerably resembling those of *Vagnera racemosa*. The flowers are followed by pink-freckled berries also resembling those of the above mentioned plant. Scattered especially in tamaracks and peat-boggy places. Collected in the tamarack west of the lake May 22 and again on June 2, 1901. In flower in Hawk's marsh, May 2, 1901.

### 207. LARGE-FLOWERED BELLWORT

UVULARIA GRANDIFLORA J. E. Smith

Though not very conspicuous, the long bell-shaped blossom, drooping gracefully from the peduncle, makes this a very attractive plant. The 3-angled capsules, which become erect as they ripen, are pretty and interesting. Rather abundant in rich woods southwest of the lake, and in Farrar's woods. In flower May 14, 1901.

### 208. HAIRY SOLOMON'S SEAL

POLYGONATUM BIFLORUM (Walt.) Ell.

Rather common, growing in scattered patches in open sunny places. It thrives best in rich leaf mould. Plants were collected in woods southwest of the lake. Observed in blossom May 14 and May 20, 1901.

### 209. SMOOTH SOLOMON'S SEAL

POLYGONATUM COMMUTATUM (R. & S.) Dietr.

Not very abundant about the lake. Only 2 patches noted, one by McSheehey's pier on the bank and one on the north side of the lake on the bank between the Culver railroad bridge and depot. This plant grows best in leaf mould and protected places such as fence corners, where it forms small patches. In suitable soil it grows very rank and large, and is a graceful plant, though neither its blossoms nor bluish berries are attractive. Found in blossom through May and June. The berries at Long Point were badly pecked, probably by birds, but it was not observed that they took any.

## FAMILY 26. TRILLIACEÆ. WAKE-ROBIN FAMILY

### 210. INDIAN CUCUMBER-ROOT

MEDEOLA VIRGINIANA L.

Not very common; a patch of scattered plants was found in Farrar's woods. It does not blossom the first summer. Both the sterile plants terminating with a handsome whorl of leaves, and the slender erect fertile or mature plants with a large basal whorl and a smaller terminal whorl, are attractive and interesting plants, though the odd yellowish blossom which turns down under the leaves is quite inconspicuous. It blossomed at the lake in early June.

### 211. PRAIRIE WAKE-ROBIN

**TRILLIUM RECURVATUM** Beck

Rather abundant, scattered through moist rich shady woodlands. Most of the plants seen were in Culver's woods. An inconspicuous and rather homely plant, though the leaves are sometimes prettily blotched. Well in flower on May 3, 1901. Found also in Overmyer's woods.

### 212. ILL-SCENTED WAKE-ROBIN

**TRILLIUM ERECTUM** L.

Not particularly common. A few plants were found, nearly out of blossom along Overmyer's creek May 31, 1901. This species demands somewhat richer situations than most of the others and is usually found in deep woodlands in rich mould. Like the other species, especially *T. grandiflorum*, it is rapidly disappearing with the clearing out and pasturing of woodlands. The rather large flowers, noteworthy for the large, conspicuous, colored ovaries, are usually hidden beneath the leaves by the curling downward of the flowerstalk.

## Family 27. Smilaceæ. Smilax Family

### 213. CARRION-FLOWER

**SMILAX HERBACEA** L.

Rather common about the lake; noted on the hill by the icehouses, by the pawpaw grove on the east side of the lake, on the west shore of the lake, south of the lake, and far down the outlet. The shoots come up in late spring, at first looking somewhat like asparagus sprouts, and grow with remarkable rapidity, reaching the height of six or eight feet in a few weeks. The whole aerial portion of the plant, stem, leaves, and buds, appears to be formed in an incredibly short space of time. The green blossoms closely compacted into globular heads are interesting and curious, but of a disagreeable odor. They are followed by dense balls of black berries which are rather conspicuous in autumn after the leaves have fallen. Early in spring the leaves are frequently handsomely flecked with brown. Early in autumn the leaves turn yellow and the plant dies. In blossom June 13, 1901.

### 214. GREENBRIER; CATBRIER

**SMILAX ROTUNDIFOLIA** L.

Common in thickets, but not so abundant as the other species. It remains green late in autumn. It was still green after hard frosts in 1906.

215. HISPID GREENBRIER

SMILAX HISPIDA Muhl.

Quite common about the lake; some on the beach on the flat place east of Lakeview hotel, some large vines in the low woods below Farrar's, some in the low ground north of Overmyer's field and some on the west shore of the lake not far from Scovell's. In sheltered woods the leaves remain green far into the winter, making verdant bowers in the barren woodlands quite conspicuous in the deciduous forests surrounding the lake. Although endogenous in structure, the wood of the stem is perhaps not equalled in hardness by any of our native woods. We have nothing that will approach it for prickliness and the bristles are very hard and brittle.

## FAMILY 28. AMARYLLIDACEÆ. AMARYLLIS FAMILY

216. YELLOW STAR-GRASS

HYPOXIS HIRSUTA (L.) Coville

Quite abundant, scattered through the grass in sandy moist ground. May 12, 1901, in flower along the railroad. May 22 in flower almost everywhere in sandy ground, especially near the birch swamp.

## FAMILY 29. DIOSCOREACEÆ. YAM FAMILY

217. WILD YAM-ROOT

DIOSCOREA VILLOSA L.

Not very common. A small patch on the south shore of the lake, in a swamp across from Murray's west of the railroad, and in a swale in Zechiel's woods across the railroad from the birch swamp. The thin veiny heart-shaped blossoms are inconspicuous but the pistillate ones are followed by papery 3-angled pods which droop in graceful racemes, which persist not only through the winter but until worn away by the weather.

These pods, which are of a fine silky texture and quite various in shape, elongate or rounded and of various shades of brown, are, in the wintry season, among the prettiest things outdoors. The plant is worthy of cultivation on trellisses for the attractiveness of its fruits.

## FAMILY 30. IRIDACEÆ. IRIS FAMILY

218. LARGER BLUE-FLAG

IRIS VERSICOLOR L.

Common in marshy open places, especially in the Inlet region, north of Lost Lake, and along the outlet. It sometimes grows

abundantly along the edges of marshes, excluding everything else. There are large patches near Norris Inlet and along the outlet.

### 219. POINTED BLUE-EYED GRASS

**SISYRINCHIUM ANGUSTIFOLIUM Mill.**

Quite abundant, growing in clumps, scattered among grasses in moist places. Abundant in Green's marsh, and along the railroad. In flower May 18, 1901. A well-known plant with very pretty flowers which last only a day, to be followed by others.

## Family 31. Orchidaceæ. Orchid Family

### 220. SHOWY LADIES'-SLIPPER

**CYPRIPEDIUM REGINÆ Walt.**

Dr. Hessler* reports this as rare "in low grounds on the southern extremity of Lake Maxinkuckee." We have not found it and it is probably extinct by this time. There are several localities about the lake favorable for its growth.

This is the most beautiful and remarkable of our native flowers, and is not excelled by many, if any, of the tropical orchids. It was formerly quite common in the northern part of the state in suitable places, its favorite location being the mucky edges of wooded bogs, or springy river valleys. On account of the drainage of such places and the close gathering of these plants wherever found, they are becoming rare and in many places extinct.

### 221. SHOWY ORCHIS

**GALEORCHIS SPECTABILIS (L.) Rybd.**

Rare in rich woods in leaf mould. Only one plant collected. One of the most beautiful of our native plants. The exquisite pale pink of the hood, perfect white of the lower half of the blossom, and the crystalline appearance of the whole plant and the faint delightful odor of the blossoms, make the whole plant a real gem, and the finding of it a memorable event. It is hardly a misfortune that it does not thrive under cultivation. Its best setting and one to which it is able to do full justice is dense shadowy forests, ancient and venerable oaks, and acres of odorous mold.

### 222. YELLOW-FRINGED ORCHIS

**BLEPHARIGLOTTIS CILIARIS (L.) Rydb.**

Not rare, and apparently becoming more common. In 1900, a few plants were noted along the east side of Lost Lake outlet, in

* Proc. Ind. Acad. Sci., 1896, 128.

swampy ground back of Green's field. In 1906, there was a fine patch of over a hundred plants, growing pretty closely together, and gleaming out of the tall ferns and sedges like a small bonfire. The plants were also quite common in Hawk's marsh but usually more scattered. They grow in the sphagnum, intermingled with ferns and sedges. Gray regarded this as "our most handsome species". In our opinion it does not excel, even if it equals, the splendid white flowered *B. leucophaea*. In 1908 and 1909 the yellow fringed orchis patches were still existing both by the Lost Lake outlet and in Hawk's marsh, but in the latter year the patch by the outlet had diminished somewhat in size. A plant was also found in the birch swamp.

### 223. RAGGED OR GREEN-FRINGED ORCHIS

**BLEPHARIGLOTTIS LACERA (Michx.) Farwell**

A few plants grew in the marshy bay east of the Lost Lake outlet and back of Green's in the same region where the yellow fringed-orchis was so abundant. It is, on the whole, rather rare in the neighborhood of the lake. It is rather common along the railroad near Plymouth, Ind.

Although not so showy as the preceding species the racemes of whitish green, peculiarly fringed blossoms of this orchid have a charm of their own, their pose and shape reminding one of a swarm of greenish insects about to alight.

### 224. GRASS-PINK; CALOPOGON

**LIMODORUM TUBEROSUM L.**

This very pretty orchid was rather abundant in a marshy stretch along the railroad near the birch swamp. The attractive purplish pink blossoms scattered through the grasses, showed up finely on July 4, 1901. It is quite abundant along the railroads at Plymouth, Ind.

### 225. NODDING LADIES'-TRESSES

**IBIDIUM CERNUUM (L.) House**

The most common and most hardy of our orchids, usually pretty abundant in sandy moist places, among grass. It also grows in mucky or peaty soils. It was common in the low ground near the outlet where the yellow fringed orchis abounds. It was also found in Walley's woods, and in the tamaracks west of the lake. There was a fine patch in the marshy natural ampitheater by Lakeview Hotel. It reaches its greatest abundance, however, along both

sides of the railroad some little distance north of the birch swamp, and near the winter-berry swamp by Walley's. Here in the height of its flowering season it grows so thickly as to turn the sward white in places. It was equally abundant far to the north along the railroad near Plymouth, and to a great distance southward, the ground along the same railroad being white with it below Logansport. It usually comes into blossom about the last of August, and remains in blossom until about the end of September. By about the 14th of October it is nearly out of flower, the tips of the spikes still fresh and white but the lower parts brown.

Although not so dainty as its near relative, *I. gracile*, this is an attractive and charming plant, well-developed spikes with a marked spiral being exceedingly pretty. It has a faint delightful fragrance, and the flowers under slight magnification exhibit a beautiful crystalline appearance.

### 226. FEN ORCHIS; LOESEL'S TWAYBLADE

LIPARIS LOESELII (L.) L. C. Rich.

Not common. A few plants grew in the vicinity of Norris Inlet, and some in Hawk's marsh.

### 227. PUTTY-ROOT; ADAM-AND-EVE

APLECTRUM HYEMALE (Muhl.) Torr.

Not common. A few plants were found in rich mould in the heavy forests east of the lake; noted in flower June 5, 1901. One of the homeliest in blossom of all the orchids, the dingy flowers without the charm belonging to most members of the family. The mechanics of fertilization, however, as is usually the case in this group, are interesting. The strongly plaited leaves which remain all winter are handsome, and make up for the plant's ordinary appearance at blossoming time. To come upon a clump of these plants in the barren winter is always a pleasant surprise, and brings a sense of discovery. The name "Adam-and-Eve" is said to be due to the fact that two plants are always supposed to be found growing near each other. The mealy mucilaginous corm is one of the queer things that boys pretend to like the flavor of.

### 228. SMALL CORAL-ROOT

CORALLORRHIZA ODONTORHIZA (Willd.) Nutt.

Rather rare about the lake, in mould in rich dry woods. An interesting and attractive plant belonging to that rather small group of phanerogams, including Indian pipe, beech drops and cancer-root, which are destitute of green color.

## Family 32. Saurace.e. Lizard's-tail Family

### 229. LIZARD'S-TAIL

SAURURUS CERNUUS L.

A rather common plant throughout the state, usually growing in rich wet soil at the edge of creeks. Flowers odorous, the whole plant with a spicy fragrance. In the lake region there was a patch in the low woods next to Overmyer's field.

## Family 33. Juglandaceæ. Walnut Family

### 230. BLACK WALNUT

JUGLANS NIGRA L.

There were very few black walnut trees west of the lake. We have notes on one tree southwest of the lake, which was observed in blossom May 25, 1901, and from which blossoming sprays were collected May 27. On the east side it was quite common along the road and in the forests back from the lake, where it frequently attained large size. In certain years, notably in 1906, the trees bore quite heavy crops of fruit. There were also several trees near the cemetery west of the Outlet.

### 231. BUTTERNUT; WHITE WALNUT

JUGLANS CINEREA L.

Rare on the west side of the lake. There was a fine large tree in a field by the Busart road which usually yielded a good crop of excellent nuts. It was not uncommon in the rich woods of the east side, but not abundant. It was quite common farther north, in rich woods along Yellow River.

### 232. BITTER-NUT; SWAMP HICKORY

HICORIA CORDIFORMIS (Wang.) Britton

The bitternut is quite rare in the vicinity of the lake. There are a few scattered trees on the east side, somewhat back from the lake in the large forests. Some of these trees are of quite large size. One small sprout-like tree of this species was found south of the lake in Farrar's woods. This species can be distinguished from the other hickories of the region, even in the dead of winter, by its peculiar narrow yellowish bud scales. After the nuts lie on the ground over winter they lose something of their intense bitterness, though they are always far from sweet.

### 233. SHAG-BARK; SHELL-BARK HICKORY

**HICORIA OVATA (Mill.) Britton**

The shagbark or shellbark hickory is rather rare in the vicinity of the lake, and none of the trees seen was very large, all being second-growth, the tallest probably not more than 30 or 40 feet high, and most had not grown beyond the period of smooth bark. On the south side of the lake two trees were noted in Overmyer's field and one in Busart's field. The nuts of these trees were quite small. The trees were considerably more abundant on the east side; there were several about a small pond near Chandler's, and a small tree near Van Schoiack's bore quite large and excellent nuts.

The shagbark hickory tree varies greatly in the general character of its fruit. Quite likely it is not in reality more variable than other trees in this respect, but as the fruit is an object of particular interest variations are more quickly noted. Every farmer's boy who lives in a country where hickories are abundant has his favorite tree. The highest quality of hickory nut has a thin paper-like shell and bright yellowish kernels. On some trees, monstrosities in the shape of 3-cornered nuts bearing an extra segment to the kernel, are not especially rare.

The shoots of this species leaf out rather late in spring. When the buds first unfold the great bud scales of translucent pinkish green, turn back, forming a rather striking spectacle, especially on vigorous young shoots. The tender shoots of the year's growth lengthen rapidly, soon attaining the full size for the season, and spend the rest of the year ripening the wood.

The long strips of bark, which are easily removed from old trees, burn and crackle with remarkable brilliance and vigor, scattering about flaming particles as if they were richly charged with oil. In fact they burn much like some of the mineral coals, and used to be a favorite fuel, used between the finer kindling and the wood proper. Hickory wood is itself one of the best of the woods for fuel, and, in the early days, green hickory was the only wood to be thought of for use in the smoking of meats.

In sweetness of sap the hickory is altogether without a peer: the best of the maples are far inferior to it. It does not seem to be free flowing enough to make the tapping of trees feasible, but from the end of hickory logs it oozes out in a thick sugary syrup, and sometimes in white powdery masses of perfectly sweet froth like frosting on cake. It is a wonder the sapsucker, which often taps sugar trees, has not discovered the hickory. The insects have, and hickory which dies or is cut with the sap still in it, is soon, if

not protected, bored full of larvæ burrows and converted into powder.

It is to the tough pliable wood of this and other hickories that we look for axe-handles, and at one time home-made scrub brooms, and splint bottomed chairs. It was the shoots of hickory that furnished the hickory whistles, braided bark lash whips, and long strands of hickory bark furnished a ready means of tying up things. This species blossoms during May; the tree by the Inlet was nearly out of flower by May 25, and the nuts ripen with frost.

### 234. MOCKER-NUT; WHITE-HEART HICKORY

HICORIA ALBA (L.) Britton

Somewhat common on the west side of the lake; there were a few fair-sized trees on Long Point, none of great size. The nuts vary considerably in appearance and flavor; all agree in being rather short and quite thick-shelled. The kernels are not so oily and rich as those of the shellbark hickory, and are covered with a rougher, browner coat. Among the trees that yielded nuts of especially good quality was one on Long Point near Chadwick's, one in Green's field south of the marsh, one along the railroad back of Murray's, and one in Busart's field near the Busart road. One of the trees between Overmyer's and the Inlet has an unusually large number of leaflets. There was one fine tree on the main street in Culver.

The buds had begun to swell considerably by April 22, 1901. The leaves, especially when they come out in spring, but more or less throughout the summer, emit a pleasant resinous odor, making this the most fragrant of the hickories. The trees were in blossom by May 17. In autumn the leaves turn a rich clear golden color, making the tree quite conspicuous. By October 4, 1900, the trees were shedding leaves quite profusely, and by October 11 the leaves were dead, many from all of the trees, and nearly all from some of the trees, shed. Children were observed with baskets and sacks of the nuts on October 29, 1904.

### 235. SMALL-FRUITED HICKORY

HICORIA MICROCARPA (Nutt.) Britton

Rather common on the west side of the lake. There are a few trees at Long Point, one in Green's yard, and one in the yard below Arlington.

This is generally known in the northern part of the State as Black Hickory. The nuts are various in form, some being more

or less elongate and flattish, others globose, flattened laterally. The tree in Green's yard had the nuts in the hulls markedly pear-shaped, and another on the road beyond Romig's had them more globose. The hulled nut is usually shouldered at the distal end and sharpened proximally.

The small nuts, though quite sweet, are lacking in nutty flavor, and the small boy gathers them last and not enthusiastically, the shagbark being first, then the big king-nut where found, then the mocker-nut, and finally the little "black hickory". The leaves come out about the latter part of April. Trees were in blossom by May 13, and the leaves were rich golden, preparatory to dropping by October 31.

## Family 34. Myricaceæ. Bayberry Family

### 236. SWEET FERN

COMPTONIA PEREGRINA (L.) Coulter

Only one rather small patch of this plant was found in the vicinity of the lake; this was in sandy ground along the railway about half-way to Delong. The patch was discovered by Dr. Scull of Rochester, Indiana. It was quite common along the road on the way to Bass Lake. Specimens were collected at the first patch mentioned on November 11, 1900.

## Family 35. Salicaceæ. Willow Family

### 237. WHITE OR SILVER-LEAF POPLAR

POPULUS ALBA L.

A few trees near Culver in an old yard. A rather handsome tree, but too much inclined to send up shoots from the roots, forming tangly thickets. Young trees closely trimmed into a pyramidal form and forming dense cones, so much unlike the habit of the natural tree as to be hardly recognizable, were noticed in a door-yard north of Plymouth, Indiana. These close-cropped trees were quite ornamental. The trees at the lake were in blossom by April 9, 1901, and were shedding ripened seeds by May 18, not six weeks later.

### 238. BALM OF GILEAD

POPULUS CANDICANS Ait.

A few trees planted at the Vajen cottage on the east side. By April 27 the staminate catkins were in bloom. By April 30 the flowers were all gone. The trees were well leaved out by May 10, 1901.

### 239. SWAMP OR DOWNY POPLAR

POPULUS HETEROPHYLLA L.

Confined to the borders of woodland ponds where it grows in shallow water to about 2 feet in depth. In the region of the lake it grows to the height of 40 or 50 feet. In some ponds its bark is the favorite habitat of the bearded lichen, *Usnea barbata*, which frequently hangs from it in large masses and bears large peltate circular apothecia. The only place about the lake where this poplar is found is about the birch swamp. At Twin Lakes it is quite common about ponds. The birch swamp trees were in flower by April 23 and shedding ripe fruit by May 16, 1901, a period of a little over three weeks. The leaves come out late in spring.

### 240. LARGE-TOOTHED ASPEN

POPULUS GRANDIDENTATA Michx.

Not especially common. A clump of tall trees on the high bank overlooking the lake just a little north of Murray's, and some quite tall trees south of the lake by the Busart road, also a clump on the west shore of the Outlet on a high bank. These trees are quite brittle and where protecting trees are removed, break off easily in high winds. In exposed places a clump of these trees is usually plentifully intermingled with tall stubs of trees which have been blown down, and these, on account of their soft wood and quickness of decay by a sort of dry rot, are favorite places for the nest cavities of the smaller woodpeckers and chickadees. The trees by Murray's were noted in flower April 23, 1901, both pistillate and staminate flowers collected. By April 26 they were out of flower, and by May 16, the fruit was ripe and some of the trees just leafing out. In the autumn the leaves ripen to a golden yellow and are shed in a short time. They were yellow and falling by Murray's on the 25th of October.

### 241. AMERICAN ASPEN; QUAKING ASP

POPULUS TREMULOIDES Michx.

Rather common in the region of the lake; more abundant in rather moist sandy places, as about the edges of shallow upland ponds. It also grows in the high and dry upland. Common, forming a circle about ponds in Walley's woods, and growing on a bank near Walley's large pond. Noted in flower April 6; seeds ripe by May 16.

Not in one or a few, but in many ways, not in a single season,

but throughout the entire year, the aspen tree is one of peculiar charm. It is one of the few trees whose leaves appear in spring with a distinct freshness and newness. Most of our leaves come out rusty or scurfy or red and wait until the protecting fuzz of winter wears off before they grow into the green of summer, but the aspen puts forth young leaves of the brightest, freshest green imaginable at the very first, and more than any other tree of the wood, gives a distinct sense of newness to the world.

It would be wasting words to attempt to describe the incessant dancing of its leaves during the summer. It, even more than the trembling of the reeds, is "an eloquent pantomime of terror" and, as in related species, "taking to man's eye" as early as the days of Homer, and commemorated as a type of variableness in one of the lines of Scott. The church fathers, perhaps always on the look-out for symbols, or inventing fairy tales to help keep in memory the landmarks of faith, invented the tale that it was the wood of this tree of which the cross was made.

In form and feature, too, it is the most picturesque of trees. Not alone the details of the snow white bark and fresh clear green are restful to the eye, but the very outline of the tree, its silhouette against the sky, has a distinct personality and has an atmosphere of its own, like one of Corot's paintings.

In the autumn, it is remarkable how, in protected situations, it retains its leaves with their summer verdure. In this respect they almost equal the tamarack, and the broad leaves still fluttering and glancing long after the maples have reddened and shed, and after the oaks are naked or rustling and sere, one may lie beneath the green aspens, and, closing the eyes to everything but the white trunks, the green leaves and the sky, and be transported from late October to the midst of June.

When at last the leaves prepare to fall, they turn to the purest gold. And after the leaves have fallen and the trees are bare, nothing fits in so well with the gray days of late autumn—the days of mist and whirling snow; they mingle and melt into the scene as if they were themselves the embodiment of the days.

But they are not wholly barren for long, if ever at all, for early in winter their catkins peep out of sheaths as if impatient of the far-off spring. There is a real furriness about those gray catkins that the pussy willows, still snugly hidden, can not approach at their best, and the bud scales about them are odorous with balsamic fragrance. No other tree that we know is so entertaining in the depths of winter. With the first touch of

spring the catkins lengthen, and when abundant, give the tree almost as much solidity as foliage. They blossom out and disappear before the leaves are put out. The fruit on the pistillate trees ripens shortly afterward.

### 242. COTTONWOOD; NECKLACE POPLAR

POPULUS DELTOIDES Marsh.

Common, but not abundant in the neighborhood of the lake. There were a few rather small trees at Long Point, some on the shore east of the depot and some in Overmyer's flat woods. There is a large tree near the shore by Edwards' cottage on the east side of the lake.

One of the most rapidly growing of our trees, reaching a large size in a few years, and in time reaching a size hardly equalled by any other of our native trees. The soft light wood is not of great value. The plants grow well from cuttings and are occasionally planted for shade trees. In dry uplands the tree is one of the first to shed its leaves in autumn, these sometimes gradually turning yellow and falling, one by one, beginning in August. In moist situations the leaves remain green rather late. The leaves are much subject to gall-formation. Deciduous branchlets, which are readily shed during the winter, leaving oval concavities, are common. The pistillate trees are often nuisances from the great amount of cottony seed they shed in early spring.

In spite of all its faults, the cottonwood is the most vocal and companionable of trees. No wonder that it was extensively used in yards as a shade tree. Not a whole forest of common trees could be more in evidence, and every little restless movement of the air all night long becomes transformed into a sound. There were whisperings and flutterings, sudden stirs as if every leaf awoke at once, whispered sighs, sounds like the gentle clapping of hands, and a pattering like the sound of rain upon the roof. One looked out in the morning surprised to find the world dry. And all of the sounds were of a cheerful domestic sort, not the howling and wailing like that of the pines which suggest the "howling wilderness" but the gentler sound of summer woods.

### 243. BLACK OR SWAMP WILLOW

SALIX NIGRA Marsh.

A tree that appeared to be this species was quite common along marshy edges of the lake shore. It is the largest willow of the region, the trees attaining a height of 20 or 30 feet and a diameter

of about a foot or 18 inches. Common in low ground between the lake and Culver, near the ice-houses, along by the thoroughfare, and, formerly, occasional along the south shore of Outlet Bay to Long Point. There are a few trees in the rushy flat by Farrar's, and some on the ice ridges. It was quite irregular as to time of flowering, many trees in full bloom May 13, a few blossomed 10 days later, and on May 28 a tree on the south shore of Outlet Bay was just coming into flower. By June 6 the seeds were ripe and being shed rapidly, covering the surface of the lake at places. Shortly after leafing out, the trees at Long Point were attacked by a red, black-spotted leaf-beetle, which laid eggs on the leaves, which soon hatched into blackish larvæ. The larvæ soon defoliated the trees. The lake surface near the trees was covered for a few days with the adult beetles.

### 244. PEACH-LEAVED WILLOW

**SALIX AMYGDALOIDES** Anders.

Somewhat common along the lake shore in low places and in the moist flats near the grist-mill. In flower May 13, 1901.

### 245. SHINING WILLOW; GLOSSY WILLOW

**SALIX LUCIDA** Muhl.

The most beautiful willow of the region and recognizable at a considerable distance by its large handsome glossy leaves. Occasional among other willows along low stretches of the shore.

### 246. SANDBAR WILLOW; RIVER-BANK WILLOW

**SALIX INTERIOR** Rowlee

A common willow growing on wet sand in the form of long slender switches. Found at Long Point, by Farrar's, and all along the ice-ridge by Norris Inlet. Unlike most of the willows these shed their leaves rather early in autumn. The clump on Long Point had shed nearly all its leaves by September 28, 1901, and by October 1 they were the most naked of all trees. It was in blossom by June 14, but only the staminate catkins were observed. On June 14 they were infested badly with long, smooth caterpillars.

### 247. WHITE OR COMMON WILLOW

**SALIX ALBA** L.

Rare about the lake. There was one tree on the flat at Long Point and another small tree by Murray's. The tree grows rapidly

from cuttings, and is quite handsome. In places it is a favorite tree for planting. When the forests of early spring are still barren this, one of the earliest of trees to come into leaf, shows green for a long distance. It was conspicuously green by April 26, 1901.

### 248. HEART-LEAVED WILLOW

**SALIX CORDATA Muhl.**

A rather common shrub in low ground. It was formerly quite abundant in Green's marsh but has been mostly cleared away. It was in blossom about the end of April.

### 249. SILKY WILLOW

**SALIX SERICEA Marsh.**

Not common. A few bushes were found at Long Point, intermixed with the other willows at that place. Collected April 29 and 30, 1901.

### 250. BEAKED, LIVID OR BEBB'S WILLOW

**SALIX BEBBIANA Sarg.**

Common in flat marshy places. It used to be quite abundant south of Outlet Bay and in Green's marsh, where, with Cephalanthus, it formed a pretty dense thicket. It was also common near Farrar's. The pistillate catkins were in flower along the road at this place April 12, 1901, and the next day both pistillate and staminate blossoms were out in good shape. By May 10 some seeds had ripened, and by May 12 the greater number were fully ripe, covering shrubs with tufts of cotton. The flowers of this willow offer considerable attraction to honey bees, and large numbers were seen hovering about the catkins. On April 15 they were particularly abundant.

Along with the closely related *S. discolor*, both "Pussy willows" in the popular sense, this species is very attractive on account of the silky catkins which begin to show in early spring as white "pussies", gradually becoming rich red-golden beneath from the growing stamens, and finally wholly surrounded by a halo of golden anthers, each terminating a long stiffish filament. The pussy willows, though native to swampy places, thrive fairly well in moderately dry situations, and would have considerable value as ornamental shrubs, especially in parks. The twigs force well in the early spring when placed in vases in a warm room, and are frequently seen in florists' shops.

251. DWARF GRAY WILLOW; SAGE WILLOW

SALIX TRISTIS Ait.

This little shrub which grows in clumps in the form of slender straight switches about 18 inches or 2 feet high is rather common in dry sandy soil along the road by the lake between Murray's and Farrar's. It also grows along the railroad southwest of the lake. It was in flower April 22, 1901, and continued blossoming until May. The seeds ripen in May shortly after the blossoming season is over. The small sessile catkins are so densely crowded on the switches that they come out before any leaves show. The pistillate catkins are a silky gray, the staminate a reddish golden.

252. BOG WILLOW

SALIX PEDICELLARIS Pursh

Not common. A few plants were found in the quaking marsh near Norris Inlet. The seeds were almost ripe May 31. A low shrub from 1 to 3 feet high, the smallest willow found within the state. This and other dwarf willows extend up into the arctic and some, including this, are found also in northern Europe. Here in the same locality we have among the willows a species which barely reaches the height of 3 feet, and another attaining a height of 30 feet.

## FAMILY 36. BETULACEÆ. BIRCH FAMILY

253. AMERICAN HORNBEAM; WATER-BEECH

CARPINUS CAROLINIANA Walt.

Not very common. It prefers low moist woods. There was a tree east of Lakeview Hotel, some on the Overmyer hill, some along the western shore of the lake, one on the shore between Kreutzberger's and the depot, and a number in the low woods between Farrar's and Overmyer's. It was noted in flower May 24, 1901, and the tree east of Lakeview Hotel was heavily loaded with fruit on September 29, 1900. The hop-like racemes of fruit, when well developed, are peculiar and attractive. The broad bracts probably act as wings in the distribution of the small seed. The wood is heavy, white, and very hard.

254. IRON-WOOD; HOP-HORNBEAM

OSTRYA VIRGINIANA (Mill.) Willd.

Rather common about the lake, especially on the east side on steep banks near the lake. There was one tree in the Caffeen yard

on Long Point, one on the north shore of the lake between the railroad bridge and depot, and several on the hill by Overmyer's field. It was nearly in flower on the east side and leafing out well April 30, 1901. The wood, after drying out, is exceedingly hard. In autumn the fruits, which are composed of hop-like clusters of whitish or yellowish green little sacs, each containing a seed, are often abundant enough to make a conspicuous object at some little distance. There are interesting points of resemblance between them and the fruits of some of the sedges, although the structure is in reality considerably different.

In the summer of 1909 a remarkably peculiar little tree of this species was found on Yellow River at Plymouth, Indiana. One half of each leaf was wholly white while the other half was green with white splotches and veins. The white portion of each leaf was so placed that, if the half of the right of the midrib of the first leaf were white, the left of the next would be white, the right of the third, and so on.

### 255. HAZEL-NUT

#### CORYLUS AMERICANA Walt.

Common in open woods and at the edges of forests on both sides of the lake. Found south of the lake (Farrar's woods), southwest of the lake (east of Lost Lake outlet), on Long Point, east of the lake, and on the ice-ridge below Farrar's. Abundant along roads a mile or two west of the lake. It does not seem usually to bear abundantly near the lake, though in 1906 the crop along the roads just mentioned was exceptionally heavy. Weevils occasionally injure the nuts, and it is said that bluejays sometimes make raids on patches and entirely strip them of fruit. September 18, 1900, fruit was found ripe in the clump east of Lost Lake outlet. April 5, 1901, some were fully in flower by the grist-mill and by Green's orchard, in a gully north of the Gravelpit. This species has a long period of flowering; on April 7, on bushes in Farrar's woods some of the catkins had blossomed and dried up, some were just in blossom, some were just half in bloom, the proximal half golden and loose, the distal half still compact, and some catkins were still firm and compact. By April 11, most were out of flower. By April 27, the leaf buds showed green and three days later the bushes were pretty well leaved out. Young seedling hazel plants usually have conspicuous brown blotches in the middle of the leaf, making them very attractive, but these do not appear on later leaves.

256. RIVER BIRCH; RED BIRCH

BETULA NIGRA L.

An isolated clump of trees along the railroad southwest of the lake in the direction of Walley's. A few large trees were found a good way down the outlet, on a bank some little distance from the stream. It is common along Yellow River to the north. At Bass Lake it is fairly common, and a row planted along the edge of the road makes a picturesque bit of scenery. At Lake-of-the-Woods the old lake plain is thickly covered by them, those on the west side growing in short squatty clumps, those on the east side all tall neat trees with branchless trunks for some distance, and all leaning toward the lake, forming pretty vistas. The trees near Lake Maxinkuckee were in flower and leafing out on May 2, 1901. The seeds germinate in June and July, and were found sprouting in great numbers along the Yellow River in 1909 where they covered the ground. The cotyledons are linear-oblong.

257. SOUTHERN YELLOW BIRCH

BETULA ALLEGHANENSIS Britton

The only locality near the lake where this species grows is an old tamarack northeast of the lake, near the Odd-fellows' cemetery at Maxinkuckee. Not common in the state. A few trees were noted in a swamp near Lake-of-the-Woods. The leaves and twigs have the flavor of aromatic winter-green.

258. LOW BIRCH

BETULA PUMILA L.

A low bog-shrub with obovate coarse-toothed leaves, not much like the other birches in general appearance. A few bushes were seen in the marsh near the grist-mill, and it was quite abundant in the tamarack west of the lake.

## Family 37. Fagaceæ. Beech Family

259. AMERICAN BEECH

FAGUS GRANDIFOLIA Ehrh.

Quite common on the east side of the lake near Maxinkuckee, in rich woods, the trees quite large, and some years bearing an abundance of fruit. A tree by Rector's was quite heavily loaded with

nuts in 1907. A few small trees on the west side, one in Farrar's woods, and one in the low woods by Overmyer's field south of the lake.

The beech was formerly one of the most important mast trees in northern Indiana, and hogs were turned out to feed on the delicious nuts. In some parts of the state it was very rare to find a beech of large size that was not hollow. The nuts, although rather slow to gather, are excellent eating, both raw and roasted.

The young beech has an individuality of its own. It holds its leaves, which fade to an almost papery whiteness, until winter, making the tree a conspicuous object for a considerable distance among the barrenness everywhere. One such tree was noted in the woods on the east side.

The trees on the east side were out finely in blossom May 24, 1901.

### 260. RED OAK

#### QUERCUS RUBRA L.

Not common. There was one large tree on Long Point which has since disappeared, and several on the east side, where it is more common. The wood which is not very durable when exposed to the weather, and which was once considered of little value, is coming more into general use in the manufacture of furniture. It takes a beautiful finish and makes exceedingly handsome furniture. A tree on the east side was past blossoming May 28, 1901, and acorns were ripe, Long Point, October 25, 1904. Acorns were abundant in 1906. The acorns are noteworthy for their bitterness.

### 261. PIN OAK; SWAMP OAK

#### QUERCUS PALUSTRIS DuRoi

Fairly common in low flat woods southwest of the lake. Trees occur at the edges of ponds in Walley's woods, between the wagon road and Green's marsh south of Outlet Bay, on the east side of the ice-ridge, at a pond near Daggets', etc. In flower May 16, 1901. On October 13, the trees down by the birch swamp were in handsome autumnal coloration,—just beginning to get red around the edges.

As usually seen in forests this tree branches rather irregularly and is by no means a particularly handsome tree; the older stems die, leaving short spurs like pins driven into the tree, whence its common name. Once in a while one sees a tree on a roadside or in the open of more shapely form.

Planted in the open, as along streets, its grows with remark-

able regularity, so much different from its ordinary habit in forests as to be hardly recognizable, and quite unusual for an oak. One who has seen them can never forget the remarkable row along Connecticut Avenue, Washington, D. C., beyond the old Rock Creek bridge. These trees, though quite small, bear an abundance of acorns. The small acorn is rendered attractive by narrow longitudinal stripes of greenish alternating with the brown. Some of the trees have the branchlets gracefully drooping.

In its native condition, the pin oak shows to best advantage along the banks of wild, winding rivers with marshy shores, such as the Kankakee below Baum's Bridge, where it was noted growing in great abundance and to a splendid degree of development. The contour of some of the trees seen was unlike that noted in any other species, or indeed, in the same species seen elsewhere. The branches sloped downward from their origin in stiff straight lines, there was no suggestion of drooping such as one finds in weeping trees, and the lines were straight as if laid down with a carpenter's rule, but stood at just such an angle as to make the branches appear like a succession of shed roofs. The leaves, delicately tinted around the edges with the first touches of autumn and glistening as if varnished, all seemed to form one continuous sheet or surface like the shingles of a roof. A peculiarity of the roofs was of course their narrowness from side to side, and one forked branch which stood out from all the rest like an inverted Y made a particularly pleasing and permanent impression.

### 262. BLACK-OAK; QUERCITRON; YELLOW-BARKED OAK

**QUERCUS VELUTINA Lam.**

The most common oak about the lake, especially on the west side where it formed over 27% of the forest at Long Point. Common also on the east side. The trees, which grow chiefly in the dry sandy soil are rather small and stunted. There are larger trees on the east side. A rather unhandsome oak, with exceedingly heavy wood. The timber is of no value except for firewood. Leaf-buds began to show green about April 26, 1901, and the trees were in blossom everywhere by May 6. The acorns began to fall September 28, 1900, and soon were falling rapidly. Both the inner bark and the bitter kernel of the acorn of this tree are deep yellow.

It is quite probable that *Q. coccinea,* which much resembles this tree and is most readily distinguished by the fact that its inner bark is reddish gray instead of yellow, is present in the lake region, but we secured no specimens, though they were looked for everywhere.

### 263. WHITE OAK

**QUERCUS ALBA L.**

Rather common about the lake, forming 35% of the forest at Long Point, and reaching large size in the heavy forests east of the lake. Common also in Walley's woods and north of the lake.

Forest trees often show considerable individual variation as to time of leafing, blooming, etc. The leaves, which come out furry and pink, began coming out May 3, 1901; one tree in Chadwick's yard which was much behind the majority, began leafing out May 28, 1901. On May 6, trees in Green's woods were in blossom. Acorns began falling September 18, 1900, and on September 25, 26 and 28 they were falling almost constantly. Some were observed sprouting on September 28. They germinate almost as soon as they fall. On October 17, 1907, leaves were falling and the trees were purplish in color. On November 8, 1906, the leaves were falling rapidly; the fallen leaves were a soft violet color, and the purple mass made by the trees which still retained them contrasted beautifully with the rich brown of the black oaks. The white oak saplings hold their leaves through the winter until the new leaves begin to appear in spring, so that in some parts of the country they are called "push oaks". The old trees shed their leaves in autumn and are barren through the winter.

Although the white oak is not frequently planted for either shade or ornament, it is one of the comparatively few trees nearly everybody has a distinct impression of and considerable acquaintance with apart from its being a portion of the forest. There is a strength and dignity belonging to it that is found in no other tree. Its habit of sending out rather low massive branches adds to its impressive appearance and makes it more striking than even the bur oak, which attains larger size and greater height.

In the autumn of 1913 a moderate-sized tree near the Bardsley cottage bore a good crop of acorns, all or nearly all of which contained two embryos each and sent out two sprouts on germinating.

### 264. BUR OAK; MOSSY-CUP OAK

**QUERCUS MACROCARPA Michx.**

Not very common in the immediate vicinity of the lake. Noted east of Lakeview Hotel, in woods northeast of the lake, along the north shore west of the depot, several west of the lake toward the tamaracks, one on the Military Academy grounds. Just to the

north of the lake region is a large flat area of ground noted for its fertility known as Bur-oak flats, the railway station of Burr Oak commemorating the former abundance of this species in that region.

The trees were just leafing out and in flower northeast of the lake May 28, 1901, and the acorns were ripe on the tree in the Academy grounds August 29, 1906. A good many leaves had been shed by October 3.

The bur oak is the largest and most valuable of our oaks, and is usually found growing in rich, moist loamy ground. It bears much the same relation to the white oak that the big king nut does to the shag-bark hickory. The acorns vary greatly in size and development of fringe on the cup. They average the largest in size of our acorns and are free from all traces of bitterness, but not so sweet as those of the white oak, having a raw-starch taste. Trees sometimes come into bearing when small, and bear large crops. The acorns of the tree on the Military Academy grounds are small, and have not much of a fringe to the cup.

### 265. SWAMP WHITE OAK

**QUERCUS BICOLOR Willd.**

In moist ground at the borders of ponds on both sides of the lake. Scattered through Farrar's woods and at the ice-beach pond on the east side; common around ponds in Busart's and Zechiel's woods. This is said to get very large, larger than the white oak, but most of the trees we have seen are small. A handsome tree with leaves whitish underneath and acorns on long stout stems, frequently two or three acorns to the peduncle.

### 266. CHESTNUT OR YELLOW OAK; CHINQUAPIN OAK

**QUERCUS MUHLENBERGII Engelm.**

Only one small tree was found on the west side of the lake near the Meyer cottage. Rather common on the east side back in the forests. Some of the trees on the east side are very neat and handsome. As Mr. Blatchley has pointed out, this species varies greatly in shape of leaf, some leaves being broad and others very long and narrow. All the trees about the lake belong to the broad-leaved form. The acorns are sweet and small, and begin to germinate as soon as they drop. They are edible to some extent when they first drop, but become quite hard on drying.

## Family 38. Ulmaceæ. Elm Family

### 267. AMERICAN ELM; WHITE ELM

ULMUS AMERICANA L.

Common about the lake, especially in low flat forests. It formed about 8 per cent of the trees on Long Point, and is common in Overmyer's woods. In flower everywhere April 11, 1901. The seeds showed conspicuously on the trees 16 days later, and a good many seeds shed prematurely were floating on the lake April 28 and 30. By May 21 many ripe seeds were seen along shore in rows, washed up on the north shore of Long Point. By June 7, the seeds had sprouted and formed thick rows of seedlings a half inch high at various places on the lake shore, especially north of Long Point. The young seedlings of the previous year had been noticed on shore by the Inlet October 8, 1900. Leaves noted falling September 27, 1900.

The seeds of the elm grow and mature quickly after blossoming, usually showing conspicuously within a few days after the trees are in bloom, and they are ripe in about six weeks. Few trees are so prodigal in seeds. They often cover the surface of woodland ponds and spring up in innumerable multitudes in rows along the edges of rivers and lakes, but very few survive. It is a favorite park and street tree, and often in parks its seeds cover the ground until they can be swept up in windrows. In seeding habits it bears a remarkable resemblance to the silver maple. Individual trees show a remarkable variety of growth, some drooping, others pretty stiffly erect. The winter spray shows unusual symmetry of the alternating buds which spring out from the horizontal sides of last year's branches. The typical tree has a feathery appearance, the smallest branches being fine and pendulous, the favorite place for the oriole to suspend its nest. The lumber of the elm is of little value on account of its weakness and very marked tendency to warp.

### 268. RED ELM; SLIPPERY ELM

ULMUS FULVA Michx.

Not very common about the lake but a few scattered trees are found on both sides. There were a few trees in the low woods by Overmyer's. Noted in flower May 11 and seeds ripe May 28, 1901. No large trees were seen. The large mucilaginous flower buds which are conspicuous in early spring form the favorite food of various birds and squirrels, and in cities the house sparrows often almost entirely strip the trees. The wood is strong and very light,

not much subject to warping, and much superior to that of the white elm.

### 269. HACKBERRY; SUGAR-BERRY

**CELTIS OCCIDENTALIS L.**

Not especially common; a large tree noted full of fruit October 25, 1904, on the east side, by the Maxinkuckee road, and a young tree by the pawpaw grove, farther down. More trees were noted near a woodland pond back beyond Van Schoiack's. Trees along Yellow River, where it was rather common, had the leaves mottled by quadrate white patches, which gave them a peculiar appearance.

The tree is of very little value as a timber tree and irredeemably homely. The berries which resemble small wild cherries in appearance have an insipid sweetish pulp and remain on the trees all winter. In early spring they offer great attraction to the birds, and trees in parks at Washington, D. C., used to be thickly covered by grackles, cedar-birds, etc., which feed on the fruit.

## FAMILY 39. MORACEÆ. MULBERRY FAMILY

### 270. RED MULBERRY

**MORUS RUBRA L.**

Rather common northeast of the lake and occasional on the east side. Noted in flower May 28, 1901. Remarkable for its heterophylly, the leaves of young trees being much lobed and divided, those of middle age being two or three-lobed, somewhat resembling the leaf of sassafras in outline, and the leaves of old trees being entire. The fruit which varies considerably in size is all pretty much alike in flavor, rather insipidly sweet, considerably like figs. It is superior to that of most Russian mulberry trees, but is little used. It affords considerable food for birds.

### 271. RUSSIAN MULBERRY

**MORUS ALBA TARTARICA L.**

Once planted for ornament or fruit, this plant propagates readily by seed scattered by birds and seedlings. Trees eight feet high are now fairly common about the lake. Young seedlings are frequently observed coming up in bunches as if every seed in a "berry" had germinated. Trees were leafing out and showing flower buds May 9, 1901, and were shedding leaves rapidly October 25, 1900. The fruit is quite variable but usually of poor flavor, much inferior to that of the white mulberry, *M. alba*. It continues ripening for a long time and forms a great attraction for birds.

## Family 40. Cannabinaceæ. Hemp Family

### 272. HOP

HUMULUS LUPULUS L.

Not common; a tangle of vines grew in a thicket on the shore of the lake in front of Green's. They did not seem to be doing very well, and were probably escapes from cultivation. A number of thrifty hop-vines bearing a good crop of hops were found in woods along the outlet near its mouth, which were probably native. Wild hops grow in considerable abundance and quite thriftily in rich black moist soil in various parts of the state.

### 273. HEMP

CANNABIS SATIVA L.

A patch along the railroad near the ice-houses, and a rather extensive patch southeast of the lake, in somewhat open woodland bordering the east side of Inlet marsh. In autumn the birds collected in considerable numbers about the patch in the woods, to procure seed. Coming up and leaved out by the ice-houses May 13, 1901. It is not known how the seed was introduced. Within recent years, farmers settling in the neighborhood of the extensive flat prairies of rich black soil near Walkerton, Indiana, observing these swamps thickly overgrown with tall nettles, tried raising hemp on them; the fields seen in 1909 were bearing heavy crops, and the venture seemed eminently successful.

## Family 41. Urticaceæ. Nettle Family

### 274. STINGING OR GREAT NETTLE

URTICA DIOICA L.

Not common; found occasionally in waste places. In some parts of the state it grows abundantly in broken up, flat, mucky prairies.

### 275. SLENDER OR TALL WILD NETTLE

URTICA GRACILIS Ait.

Common west of the lake, toward the tamarack, and in a gully east of the lake.

### 276. CANADA NETTLE; WOOD NETTLE

URTICASTRUM DIVARICATUM (L.) Kuntze

Quite abundant and unusually tall, in low woods by Overmyer's field; also in a gully east of the lake. A low, rather inconspicuous

plant, capable of inflicting quite painful stings when carelessly touched.

277. RICHWEED; CLEARWEED

PILEA PUMILA (L.) A. Gray

Not common about the lake, a few scattered plants growing occasionally near shore; it grew in cracks in the stone breakwater near the Caffeen cottage, on shore near Overmyer's field, on a flat miry place near Overmyer's spring and near Long Point. In many parts of the state it forms a rank tall growth in rich black ground. Noteworthy for the translucent clearness of its stems; in this particular it excels even the wild touch-me-not, Impatiens. Beekeepers accuse it of producing bitter honey.

278. FALSE NETTLE

BOEHMERIA CYCLINDRICA (L.) Sw.

A rather common weed about the lake; noted near shore at Long Point and along the southwest shore of the lake.

## Family 42. Santalaceæ. Sandalwood Family

279. BASTARD TOAD-FLAX

COMANDRA UMBELLATA (L.) Nutt.

Rather common in grassy places along the railroad, especially below Murray's. In flower May 12, 1901. It appears rarely to set fruit. It remains in blossom for a considerable length of time. Some plants were collected May 23.

280. NORTHERN COMANDRA

COMANDRA LIVIDA Richards

Apparently rare; its presence is evidenced by an herbarium specimen but we have no notes. The region is probably near the southern limits of its range.

## Family 43. Aristolochiaceæ. Birthwort Family

281. WILD GINGER

ASARUM CANADENSE L.

Occasional in rich woods east of the lake. The leaves were just beginning to unfold April 11, 1901, and flowerbuds were large and well developed by April 30; it probably bloomed shortly after that. A well-known odd plant with a long aromatic rootstock terminated

by two large leaves, between which is produced the peculiar dingy flower with three long pointed sepals.

### 282. VIRGINIA SNAKEROOT

ARISTOLOCHIA SERPENTARIA L.

A few plants seen near a pond, but in dry ground, in Busart's woods, autumn of 1906. Introduced into cultivation along with ginseng, Hydrastis, etc., at Plymouth, to supply the drug trade.

## Family 44. Polygonaceæ. Buckwheat Family

### 283. RED SORREL; FIELD SORREL

RUMEX ACETOSELLA L.

Frequent; some on the hill north of the ice-house, along shore south of Winfield's, in Overmyer's field, in fields west of the lake and on a hill near shore near McOuat's on the east side. Some leaved out May 3, 1901. In flower May 25.

In many parts of the state one of our worst weeds, often forming great patches in pastures and meadows to the exclusion of everything else, and quite difficult to eradicate. There is a general belief that it indicates acidity of the soil, and that it can be killed out by liming. It does not wholly die down during the winter, but the leaves assume rich red tints.

### 284. TALL DOCK; PEACH-LEAVED DOCK

RUMEX ALTISSIMUS Wood

Scattered in marshy places south of the lake, as in the sedgy marsh below Farrar's, and beyond the Busart road, along shore in front of Overmyer's field, and in the great flat beyond Norris Inlet. The stalks in fruit are sometimes over eight feet high. One of the common names is Wild Rhubarb.

### 285. CURLED OR NARROW DOCK

RUMEX CRISPUS L.

Not very common about the lake, as it does not affect sandy soil, but prefers heavy clay. Some plants were noted along shore near the depot grounds and others were seen east of the lake. Well out in leaf April 27, and in flower June 12. One of the first plants to shoot up in spring. In wet clay grounds one of the most annoying of weeds, very difficult to eradicate, and bearing large crops of seed. It is one of the best of our pot-herbs, the young leaves making "greens" of excellent quality.

### 286. BROAD-LEAVED OR BITTER DOCK

**RUMEX OBTUSIFOLIUS L.**

Growing in about the same soil and conditions as *R. crispus*, but not generally so abundant. Found on the beach between the depot grounds and Kreutzberger's pier and on the Palmer House grounds. Leaves well up and large April 9, 1901; during mild winters they remain green all winter. In flower June 12. The seeds frequently germinate in late autumn; some young seedlings were seen October 20, 1907.

### 287. KNOT-GRASS; DOOR-WEED

**POLYGONUM AVICULARE L.**

Not common; a few plants seen. It prefers a heavier soil than that found about the lake, and in many parts of the state is one of the most common plants about dooryards forming a dense sod. The more it is trampled upon the more it seems to thrive, and it grows where nearly everything else has been trampled out. This and *P. erectum* grow together and both species are at times eaten by cattle with apparent relish.

### 288. ERECT KNOTWEED

**POLYGONUM ERECTUM L.**

In general appearance and habits much like *P. aviculare* but much larger. Not very abundant; found at Long Point and on the east side of the lake. Like *P. aviculare* it grows in well trodden dooryards, but, unlike it, it is often found on plowed ground. It is quite susceptible to mildews in damp seasons; in such cases a thick patch some distance away has a peculiar appearance much resembling a dense patch of white blossoms. Found in flower east of the lake June 5, 1901, and at Long Point June 17. It continues in blossom until late in autumn.

### 289. SLENDER KNOTWEED

**POLYGONUM TENUE Michx.**

Not very abundant, and local in its distribution. Obtained September 29, 1900, by Lakeview Hotel, in dry sand. An example of pronounced xerophytic habit; the leaves much reduced so that it considerably resembles Bartonia of the Gentianaceæ, which is found in similar situations.

### 290. VIRGINIA KNOTWEED

**TOVARA VIRGINIANA (L.) Raf.**

Not abundant about the lake; found growing in woods and shaded situations.

### 291. WATER PERSICARIA

**PERSICARIA AMPHIBIA (L.) S. F. Gray**

A few plants noted at Norris Inlet in 1909. The leaves floating on the water give the plant much the aspect of *Potamogeton natans*. The racemes of rose-colored blossoms are rather short, and the stem long and strong, rooting at the nodes.

### 292. SWAMP PERSICARIA

**PERSICARIA MUHLENBERGII (S. Wats.) Small**

Common along the south shore of Outlet Bay and near the Outlet; a large patch in the pond below Farrar's, and some on the sedgy flat southwest of the lake.

The dense rose-pink spikes of this species, projecting up from the surface of the water at the edge of the lake, make this species one of the most attractive of water plants, and it is well worth planting for its ornamental value. The blossoms make quite handsome boquets. It is quite likely that wild ducks, which often stray into flat marshes in search of smart-weed seed, find patches of this plant desirable feeding grounds.

### 293. DOCK-LEAVED OR PALE PERSICARIA

**PERSICARIA LAPATHIFOLIA (L.) S. F. Gray**

Fairly common along the lake shore in moist places, by the Monninger and Meyer cottages, south of Green's, north of Long Point and east of Norris Inlet.

### 294. PENNSYLVANIA PERSICARIA

**PERSICARIA PENNSYLVANICA (L.) Small**

A rather common, homely weed along the lake shore and other moist places, continuing in blossom as late as October 31. Some of the plants seen were badly affected by plant lice.

### 295. LADY'S THUMB; HEARTWEED

**PERSICARIA PERSICARIA (L.) Small**

A rather coarse, large-leaved smartweed usually common in waste places and cultivated grounds. A few plants found along the

road south of Outlet Bay. In flower June 21, 1901. Continues in blossom until late in autumn.

### 296. SOUTHWESTERN PERSICARIA

**PERSICARIA PERSICARIOIDES (H. B. K.) Small**

Apparently rare. A herbarium specimen was collected by Dr. Scovell. The lake region is considerably out of its usual range.

### 297. MILD WATER PEPPER

**PERSICARIA HYDROPIPEROIDES (Michx.) Small**

Frequent in low places near the lake; a small patch on a low flat between the road and south shore of Outlet Bay. Noted in blossom in September and October.

Some smartweed, perhaps this, made great patches of pink covering acres of extent in the Kankakee marshes, where it was said to form the principal food of the mallard duck. In the old channel of the outlet, a mile below the lakes, there was a continuous bed, bordered on both sides by sedges, making a winding stream of rosy among the green; a remarkable and interesting spectacle.

### 298. SMART-WEED; WATER PEPPER

**PERSICARIA HYDROPIPER (L.) Opiz**

Common about the lake; an abundant weed; because of its greenish blossoms not so handsome as many of the species.

### 299. DOTTED OR WATER SMART-WEED

**PERSICARIA PUNCTATA (Ell.) Small**

Common in moist places about the lake. Noted in blossom October 10 and still continuing in bloom October 30, 1900.

### 300. BUCKWHEAT

**FAGOPYRUM FAGOPYRUM (L.) Karst.**

Occasional escapes from cultivation were seen about the lake. Where it has been grown, this plant, unless removed by clean cultivation, is likely to persist as a weed, although it never becomes particularly troublesome.

### 301. ARROW-LEAVED TEAR-THUMB

**TRACAULON SAGITTATUM (L.) Small**

Growing at Long Point and on both sides of the Outlet. Hardly as common as one might expect. Common in many parts of the

state in low shaded situations, where it clambers over brush with its stiff prickles, forming dense tangles, the terror of the barefoot boy. Usually known as "sawgrass."

### 302. HALBERD-LEAVED TEAR-THUMB

**TRACAULON ARIFOLIUM (L.) Raf.**

Not nearly so common throughout the state as *T. sagittatum*, to which it bears a general resemblance in habit and scratchiness. At Lake Maxinkuckee a small patch was found in the low woods along the creek in Overmyer's woods.

### 303. BLACK BINDWEED

**TINIARIA CONVOLVULUS (L.) Webb & Moq.**

Not uncommon in open places, cultivated fields and occasionally along shore. Found in blossom along the road by Green's June 20, 1901, and on Long Point November 23, 1904.

## Family 45. Amaranthaceæ. Amaranth Family

### 304. GREEN AMARANTH

**AMARANTHUS RETROFLEXUS L.**

Rather common, scattered in waste places. It prefers rich cultivated ground. Frequently found along the shore, as at Long Point and the depot grounds. Exceedingly variable in size. In favorable locations the plants reach a height of four or five feet. Among the pebbles of the shore at the depot grounds were perfect and fruiting plants two inches high or less. According to Britton it sometimes reaches the height of over nine feet.

### 305. SLENDER PIGWEED; SPLEEN AMARANTH

**AMARANTHUS HYBRIDUS L.**

An occasional weed of waste places, not nearly so common as the preceding, probably of more recent introduction. Some reddish or purplish plants were found in waste places near Culver.

### 306. PROSTRATE AMARANTH

**AMARANTHUS BLITOIDES S. Wats.**

A member of the introduced railroad flora, found along the railroad in front of the Assembly grounds in 1900, later on farther south, by the icehouses, etc. A prostrate mat plant bearing a superficial general resemblance to purslane.

## Family 46. Chenopodiaceæ. Goosefoot Family

### 307. LAMB'S QUARTERS

**CHENOPODIUM ALBUM L.**

Rather common; found in flower along the railroad by the icehouses June 21, 1901. Very abundant in a field north of the lake, excluding nearly everything else. Frequently used as a pot-herb. The form collected at the lake was the subspecies *viride* (L.) Moq.

### 308. MAPLE-LEAVED GOOSEFOOT

**CHENOPODIUM HYBRIDUM L.**

Not especially abundant; found growing in waste places. Leaf unusually thin for the genus.

### 309. FEATHER GERANIUM; JERUSALEM OAK

**CHENOPODIUM BOTRYS L.**

During 1900 and 1901 only a few scattered plants were seen along the railroad in front of the Assembly grounds and by Winfield's. In 1906 and succeeding years it was found quite abundant, forming considerable patches in a sandy field north of Lost Lake. An interesting and pretty plant of low growth, compact and slender but bushy habit, with thick whitish narrow leaves which fall off early in autumn, leaving a wandlike skeleton, ghostly in effect. The whole plant has a pleasing fragrance.

### 310. WINGED PIGWEED

**CYCLOLOMA ATRIPLICIFOLIUM (Spreng.) Coult.**

A new arrival at the lake, having been first seen in the immediate vicinity in 1909, though in 1906 it was found along a road several miles west of the lake. It is common on the sand dunes about Knox, Indiana. The plants at Culver were growing in a row along the edge of a vacant lot at Culver, where the sod was broken, leaving naked sand. The plants both here and at Knox formed almost perfect balls of light green, which, among the barren sand at the latter place, showed up conspicuously. They are almost as handsome as the closely related and well known *Kochia scoparia* which is coming into general use in flower gardens, but they do not have the splendid autumn foliage of the latter. Some of the inhabitants of Culver called them "Kansas tumbleweed." The form is admirably adapted to rolling over ground and it was probably by this means that they reached the lake.

### 311. HALBERD-LEAVED ORACHE

ATRIPLEX HASTATA L.

Another recent arrival at the lake and not an old resident of the state. It first appeared in cities, from which it spread along railroads. It was seen in Plymouth in 1900, and in Fort Wayne about the same year. None was found at the lake at that time. In 1906 it was seen along the railroad by the icehouses, and in 1909 was common about Culver.

### 312. RUSSIAN THISTLE

SALSOLA PESTIFER A. Nelson

Another new arrival at the lake. In 1906 a single plant was noted in barren sand at the end of a slide at the Assembly grounds. It is hardly more than holding its own. In 1907 there were two plants at the same place, and in 1909 only one or two plants were on the same spot. The plants turn quite bright red in the late autumn. This plant made its first appearance at Fort Wayne in 1909, when a row was found at the foot of a billboard near the St. Mary's river. So far it has not proved to be a particularly bad weed in the state.

## Family 47. Phytolaccaceæ. Pokeweed Family

### 313. POKE-ROOT; POKE-BERRY

PHYTOLACCA AMERICANA L.

One plant found on the shore; common in woods beyond Busart's field south of the lake, also plentiful on the east side of the lake some distance back, also common around Hawk's marsh. It seems to prefer burned over clearings. The plant continues blossoming all summer until killed by frost, and is one of our best examples of plants with an unlimited inflorescence. The root is said to be poisonous and is used in making home-made poultices. The young shoots are sold by negroes on the Washington market for greens. The berries are a favorite food of many birds.

## Family 48. Corrigiolaceæ. Whitlow-wort Family

### 314. SLENDER FORKED CHICKWEED

ANYCHIA CANADENSIS (L.) B. S. P.

Not very common. A slender inconspicuous plant, easily overlooked, usually growing in light sand in partial shade of open woodlands, among the leaves. Found on the bank in Overmyer's woods and in Green's woods.

## Family 49. Aizoaceæ. Carpet-weed Family

### 315. CARPET-WEED

**MOLLUGO VERTICILLATA L.**

A common weed throughout the state in sandy ground, forming in places a mat over the ground. At Lake Maxinkuckee it was found east of the Lakeview Hotel, in sandy fields by Hawk's marsh, in sandy fields east of the lake, and very abundantly in Green's field east of Lost Lake outlet. It was common in sand along the railroad, and formed a part of the sand dune flora among the dunes southwest of the lake. It continues blooming until killed by frost. Seen in blossom along the railroad as late as October 25.

## Family 50. Portulacaceæ. Purslane Family

### 316. SPRING BEAUTY

**CLAYTONIA VIRGINICA L.**

Not especially common about the lake. Found growing in open rich woodlands. Noted in flower on the east side, by Vajen's, from April 11 to April 30, 1901.

### 317. PURSLANE

**PORTULACA OLERACEA L.**

Not very abundant about the lake and usually not growing to a very large size. One of the most common weeds in the state in rich moist ground, usually coming up after cultivation is finished, and making rapid growth. It is often affected by a fungus which makes white pustules on the leaves, and it is eaten by larvæ of one of the sphinx moths, but both of these enemies together do very little toward keeping it in check.

## Family 51. Alsinaceæ. Chickweed Family

### 318. COMMON CHICKWEED

**ALSINE MEDIA L.**

Not particularly abundant; scattered in waste places. Noted in flower east of the lake April 11, 1901, and at the depot grounds April 16. In flower east of Chadwick's November 21, 1904.

One of the hardiest members of our flora, often growing if not thriving, in the cracks of sidewalks. Blossoming the entire year through, even throughout the winter in sunny situations.

### 319. LONG-LEAVED STITCHWORT

ALSINE LONGIFOLIA (Muhl.) Britton

Scattered in flat moist places. Found in flower along the road back of the grist-mill June 15, 1901.

### 320. LARGER MOUSE-EAR CHICKWEED

CERASTIUM VULGATUM L.

Scattered in open rather grassy places. Blossoming almost the entire year through in protected sunny situations. Blossoms were noted in May and June, 1901, and late into the winter of 1904.

### 321. THYME-LEAVED SANDWORT

ARENARIA SERPYLLIFOLIA L.

An insignificant plant with the aspect of a small chickweed, blooming throughout the entire summer. Chiefly a member of the railroad flora, growing on sand on railroad embankments and between ties. Seedlings were observed coming up late in the autumn, October 12, 1907. Noted in flower May 5, 1901, along the railroad by the icehouses on October 29, 1904, on Long Point and on November 4, 1904, by Arlington.

## Family 52. Caryophyllaceæ. Pink Family

### 322. COCKLE; CORN COCKLE

AGROSTEMMA GITHAGO L.

Fairly common in wheat fields and occasional along the railroad.

### 323. STARRY CAMPION

SILENE STELLATA (L.) Ait.

Not common; scattered at the edges of woods and copses; more abundant on Long Point hill back of Duenweg's than anywhere else. In blossom July 26, 1906, and as late as October 27, 1904. The rather handsome flower looks more like an immense chickweed than anything else.

### 324. BLADDER CAMPION

SILENE LATIFOLIA (Mill.) Britten & Rendle

Quite common in patches near where the old Van Schoiack homestead used to be, the plants having evidently arisen from stray seed. First noticed in the autumn of 1912.

### 325. SLEEPY CATCHFLY

**SILENE ANTIRRHINA L.**

Common, especially in sandy places. Very abundant in the sandy open flats west of the Assembly grounds.

A most business-like plant. Like many others it has "regular office hours" during which the flowers are open to insect visitors. In addition visitors are admitted "only at the office door." "No admittance" signs in the shape of sticky patches are posted just beneath each node, and such thieves and robbers among the insects as try to get in any other way than the proper places are likely to get caught. These sticky places, inconspicuous at first, darken with age, and an old, much-branched plant with its little dark band of insect "bird lime" at each joint of the stem is an interesting and instructive object. The first man who wrapped cotton or what-not about his plum tree to keep curculios from getting up had no patent on the process and might have even improved it by using something sticky.

Where this catchfly grows among tall bluegrass, the swaying plants often come into contact with each other and the sticky places of the catchfly gather crops of ripened grass seed.

### 326. SOAPWORT; BOUNCING BET

**SAPONARIA OFFICINALIS L.**

Common on banks along the railroad, especially at the ice-houses; also by the Assembly grounds, along the depot grounds, and east of Lakeview Hotel. The plants also form a dense patch along the railroad north of the lake. This plant is usually found in open sunny places but along Yellow River below Plymouth is a dense patch in woods. The plants grow in thick patches and form regular flower-beds, conspicuous for a considerable distance. All the flowers seen at the lake were single, as is usually the case with the railroad patches. The plants bloom to some extent until clipped by frost. This is a favorite flower with humming-birds, which can often be found in considerable numbers where the patches of bouncing bet are.

### 327. COW-HERB; COCKLE

**VACCARIA VACCARIA (L.) Britton**

Collected by Dr. Scovell quite early in the series. Probably found in waste places.

## Family 53. Ceratophyllaceæ. Hornwort Family

### 328. HORNWORT

CERATOPHYLLUM DEMERSUM L.

This is one of the most common plants in the lake, and is, indeed, one of the most common lake weeds in the state. It also grows in slow stretches of rivers, or rather bayous, or in old canal or ditch beds. It often comes up in long tangles attached to fish-hooks and is popularly called "water-moss." It was found abundant in nearly all lakes visited. At Lake Maxinkuckee it is found scattered through most parts of the lake in rather shallow water, and was found near the Weedpatch in water eighteen feet deep. It grows abundantly by the Inlet. It is also abundant in Lost Lake and in the Outlet far below the lakes.

The hornwort does not possess roots or any sort of hold-fast during any part of its existence. From this it might be supposed that it had no permanent or local habitation in the lake but drifted here and there according to winds and currents. Such, however, is not the case. It usually stands more or less upright in the water but does not come near enough the surface to be caught by winds, and seems to be so "loggy" that it is very little affected by currents. The heavy lower part of the plant usually lies on the bottom and forms a sort of drag-anchor. One rarely or never sees great masses washed ashore, as is common with Vallisneria, Philotria and other weeds.

Ceratophyllum varies considerably in appearance, especially in robustness, in different localities and situations. That far down the outlet is exceedingly robust and handsome, and it is difficult to understand how it keeps its place in the good current there. Some plants found during the summer of 1909 in the mouth of the Desplaines River, Illinois, were so exceedingly attenuated that it took some effort to recognize them as a form of the old *Ceratophyllum demersum*.

The winter behavior is slightly different in different situations. Generally speaking it keeps more or less green all winter and differs very little in appearance during the different seasons, though perhaps a little duller in color in winter. The large robust plants down the outlet retained a bright vivid green during the winter and had delicate pink tips. In many places what might be called winter buds were formed by a cessation of growth in late autumn or early winter of the tip of the stem, and by the rotting away of the part underneath. These winter buds are wafted about more

or less by waves, and supplement the work of the seeds in distributing the plants. Both seeds and flowers are inconspicuous objects. In spring the buds, when they begin growth, show marked heliotropism.

Apparently in some places at least, these plants retained more or less activity, as well as form and color, throughout the winter. Generally above the apices of the plants under the clear ice there were large bubbles frozen into the ice, and toward the latter part of the winter, especially above a patch down by Norris Inlet, there were crossing and recrossing curves of rows of fine bubbles, like strings of minute beads, suggesting that the plants had been exhaling small bubbles of gas, perhaps oxygen, the winter long and the moving plant tips, swayed perhaps by moving currents, or in all probability following the circle of the sun, had left behind a record or graph of their gyrations. The hornwort appears to be one of the most active oxygenators of water we have. In window aquariums on bright days during winter, when the sun shines in on these plants, one often sees a rapid succession of minute bubbles form a line from leaf tips of these plants to the water surface, the bubbles breaking at the surface in rapid succession with an audible lisping sound and a minute dash of spray. It is not certain that all these bubbles are oxygen formed during the ordinary processes of photo-synthesis in the plant, as in some cases bubbles are given off rapidly from broken bits of stems.

## Family 54. Cabombaceæ. Water-shield Family

### 329. WATER-SHIELD

**BRASENIA SCHREBERI** Gmel.

Rare in Lake Maxinkuckee, the only patch in that lake being near the green boathouse in the vicinity of Norris Inlet. It is fairly abundant in Lost Lake and there are a few plants in the old bayou (a remains of the old channel or thoroughfare) west of the railroad. It blossoms very rarely here. The leaves take on beautiful hues in autumn. The young leaves down close to the rootstock remain green all winter. It starts up early in spring; small leaves were seen near the bottom of Lost Lake May 3, 1901. Green leaves were washed ashore November 3, 1904.

The plant is peculiar in having its stems and flower-stalks coated in a clear gelatinous substance so that it appears as if encased in glass.

## Family 55. Nymphæaceæ. Water Lily Family

### 330. LARGE YELLOW POND LILY

**NYMPHAEA ADVENA Soland.**

This plant is rather scattered in Lake Maxinkuckee, as it thrives best in shallow water and rich mud and such places are only occasional in the lake. It is found along shore in front of Overmyer's flat woods, in the Norris Inlet region and in front of the Academy grounds. It occurs in the thoroughfare below the wagon bridge and is very abundant in Lost Lake. Here great masses of roots occasionally rise to the surface, making a sort of floating island; they have the appearance of having been lifted by some upheaving force. This has by some been attributed to marsh gas, caused by the disintegration of much organic material in the bottom of the lake. It is also likely the soft bottom is unable to hold down the buoyant mass of roots when it has grown beyond certain dimensions. These great masses, floating on the surface, impede boating and give a tropical aspect to the sluggish dark waters of Lost Lake and the upper part of its outlet. *N. advena* also grows in Green's marsh, and in Hawk's marsh. It is one of those plants of a tolerably wide range of environment and exhibits a marked response to surroundings, as do most plants of this sort. Where it grows in shallow marshes it has stout stems with the stiff and firm leaves standing at an angle to the horizon and sometimes with traces of fluting somewhat like that of a palm-leaf fan, radiating from the base of the petiole. The petioles of the water forms are comparatively flaccid, and the leaves usually horizontal floating on the surface of the water. The young leaves have a rich violet coloration due to an abundance of cell-sap, and this probably serves as a protection from the rays of the sun.

While not so handsome as the white water-lily, the half-open buds of this plant have a certain charm. Both small leaves and tiny buds remain in the bottom in cold storage during the winter ready to expand and grow when the water warms up in spring. There is no formation of winter buds nor anything like the dead appearance which we are accustomed to in our common deciduous plants.

The ripened seed pods form a food for the muskrat. It is said that the Indians roasted and ate the large farinaceous rootstocks, and they form a favorite food of the moose where that animal is found. The plant is often badly affected, and its beauty marred, by a sort of plant louse or leaf hopper which attacks it in great numbers.

*N. advena* is the only species found about Lake Maxinkuckee; at Lake Cicott and Bass Lake some plants with much longer narrower leaves were seen, but not collected; they were probably *N. sagittaefolia*. At Lake-of-the-Woods, the spatterdocks had a large globular reddish fruit and were probably *N. microphylla*.

The following are some of the most important notes taken: April 26, 1901, leaves up and floating quite in summer fashion. May 19, 1901, in flower in Green's marsh. October 27, 1900, leaves of this and Castalia badly covered with plant lice or leaf-hoppers. November 4, 1904, a flower bud washed ashore east side Lake Maxinkuckee. November 12, plants frozen in a dry pond. Walley's woods.

### 331. SWEET-SCENTED WHITE WATER LILY

CASTALIA ODORATA (Dryand.) Woodv. & Wood

Not common in Lake Maxinkuckee as there is not sufficient mucky bottom; there is one small patch near the Outlet, and another near Norris Inlet. There are large patches in Lost Lake, both near the Outlet and near the center of the lake. Flowers are kept pretty well plucked by the cottagers and excursionists. They are not borne in great profusion and are rather small. Our plants have the underside of the leaves purplish, in this respect resembling *odorata*, but the relatively small flowers are not especially fragrant and the rootstalks have tuber-like outgrowths. In this respect they approach *C. tuberosa*. It is probable the two species are considerably more alike than one would be led to believe from current descriptions.

The water-lilies of Twin Lakes a few miles north are abundant, much larger and deliciously fragrant, and some have an exquisitely delicate pink tinge.

## Family 56. Magnoliaceæ. Magnolia Family

### 332. TULIP-TREE; YELLOW POPLAR

LIRIODENDRON TULIPIFERA L.

Not especially common in the immediate vicinity of the lake. There are no trees directly west of the lake but they are more plentiful toward the south. A good many young trees were noted in Farrar's woods, and there are several large magnificent trees north of the lake; there are scattered trees in the woods of the east side. April 30, 1901, leaves beginning to show green. May 25, flower-buds well developed and of good size. May 28, in flower on the east side.

In the vicinity of Washington, D. C., it was noted that the purple finches were fond of the tulip tree seed. They attacked the spread cones during the winter and made seeds fly in every direction. The seeds germinate in late spring or early summer. Many seedlings just up were observed near Twin Lakes in June, 1909, and seedlings, more fully grown, were common about the lake in the autumn.

The tulip tree is easily queen among our native trees, excelling all others in beauty of blossom, shapeliness of form, and attractiveness of clear bright foliage. It is also one of the most valuable of our timber trees, and for this reason has disappeared from many localities where once abundant. A tree full of the bright tulip-shaped blossoms, greenish with a lurid inverted U at the base of each petal, is a sight to be remembered.

Although the natural tree is hard to improve on, there are several interesting variations, some of them found in parks. There is a fastigiate form having much the outline of a Lombardy poplar. In the Agricultural Department grounds at Washington, D. C., is a tree of which most of the leaves have a white blotch, a peculiarity which hardly adds to the attractiveness of the tree, as it gives it a diseased appearance. On the White House grounds is a small, beautiful specimen with the leaves mottled and clouded with white.

## Family 57. Annonaceæ. Custard-apple Family

### 333. PAWPAW

**ASIMINA TRILOBA (L.) Dunal**

Not generally common in the vicinity of the lake. The only ones on the south side of the lakes were in a small patch in Overmyer's woods. These rarely bore any fruit, as they were probably too young in 1901; a few of the trees were coming into bearing during the latter part of our stay at the lake. On the east side it was more plentiful. There was a fine dense grove along the ditch beside the Maxinkuckee road. There were also a few trees, probably planted, in one of the lots east of the lake, not far from the Maxinkuckee road. There were also a few fine groves in Culver's woods. A few miles south of the lake along the Tippecanoe River near Delong, and a few miles north in woods along the Yellow River, there are magnificent groves. Near Arlington Hotel, about where we had thrown some seeds in 1901, there were fine large bushes in 1909, but they had not yet come into bearing.

The pawpaw is, in many respects, among the most remarkable and interesting of our native shrubs. It usually grows in rather

thick groves in rich ground in deep woodlands. It seems to be a shade-loving tree, and when the forests around them are greatly thinned or cleared away, the groves usually soon die. In cities, where surrounding buildings protect them, they grow and thrive where it is more or less open. There are two fine trees in the Botanical Garden at Washington, D. C., a tree was observed close to the house in a dooryard in the same city, and another in Bloomington, Ind. The flowers, which come out just preceding the leaves, are peculiar in that they expand when still small, and are at first ordinary leaf-green in color. Finally they grow to full size and ripen to a rich chocolate brown or brownish purple. Each blossom has a cluster of erect ovaries in the center, and these as they grow heavy and hang down, turn back against the flower-stalk, so that each bunch or cluster of pawpaws comes from a single flower. In early autumn, sometimes as early as August, the immense leaves begin to turn a rich yellow, and there are few more striking sights in the vegetable world than a large grove of these trees lighting up the dun forest gloom with their great tawny leaves. One might say to them even more appropriately than to the dandelion:

> "Gold such as thine ne'er drew the Spanish prow
> Through the primeval hush of Indian seas,"

for they give a sense of tropical luxuriance rarely equalled in our native forests.

As a matter of food, the pawpaw appeals to different people quite differently. The greater number of people appear to dislike it at first, and among those who like it it seems in most instances to be an acquired taste. The wood and bark have a peculiar, disagreeable flavor, and this seems to be concentrated in the queer corrugated kernel of the seed. Much depends upon the condition of the fruit. A slightly underripe pawpaw is decidedly sickening, and one can hardly get them too ripe. Most people probably at first get one a little too green. The dead ripe pawpaw is soft and usually has an aroma reminding one of guava jelly. Much depends upon the manner in which the pawpaw is eaten. The habit of paring them with a knife and trying to eat the solid center as one would eat an apple, is quite likely to prejudice one against them. The proper way to do is to gently work up the pulp into a custard consistency without breaking the skin, an art that requires some practice, and then suck out the semi-liquid pulp through a little hole bitten in the end. The seeds are something of a bother at first but one soon learns to manage them without much difficulty.

The pawpaw has many points which commend it for experiments in domestication. The bush is one of the most handsome and striking of our native shrubs. It is by far the largest of our wild fruits, larger perhaps than the original apple from which all our modern varieties have sprung. It is at the start far superior in flavor to the early apple which is said to have been exasperatingly sour. If it could be as greatly improved over the wild stock as was the apple, we would have one of the most remarkable fruits, as large perhaps as pumpkins, and of multitudinous flavors to the rich custard of its fruit.

There is a general opinion among woodsmen that there are two kinds of pawpaws, a yellow, which is delicious, and a white, which is inferior in flavor. This is probably due to the fact that considerable critical attention is paid to the first and minor differences are easily noticed. Everybody knows that the persimmon is even more variable, and we have summer and autumn persimmons, winter persimmons, flat or long, yellowish or reddish, and sweet or puckery. Any one who pays especial attention to any of our fruits will find similar wide range of variations.

The following are some of the more important field notes:

September 30, 1900, plentiful by Tippecanoe River; October 11, a barren grove in Overmyer's woods; October 3, seen along Yellow River; May 14, 1901, in flower south of the lake; October 25, 1904, leaves mostly green. August 16, 1906, leaves beginning to turn golden. September 18, leaves beautifully golden, and fruits ripe. October 6 and 14, 1906, still a few found, some fine ones gotten; October 30, all gone.

## Family 58. Ranunculaceæ. Crowfoot Family

### 334. YELLOW-ROOT; GOLDEN SEAL

#### HYDRASTIS CANADENSIS L.

This plant, once fairly common throughout the state, is now becoming rare in most places. It is one of the important drug plants of the country and the root is demanding an increasing price on the market. It is gradually coming into cultivation in gardens of medicinal plants. The ginseng-grower at Plymouth, Indiana, had a fine patch in cultivation. At Lake Maxinkuckee it is not very common. A few plants were found out of flower along Overmyer's creek May 31, 1901.

### 335. MARSH-MARIGOLD

CALTHA PALUSTRIS L.

This attractive flower, generally known through the state as cowslip, grows quite abundantly some distance up Culver Inlet, also in marshes west of the lake and along Overmyer's creek. The leaves are sometimes used for "greens." The fruit, after the carpels have opened and discharged the seeds, is a pretty object, almost as handsome as the blossom.

In flower along Culver Inlet April 19, 1901; April 23, not yet in flower, west side; April 30, in flower both sides of the lake; May 14, still in flower along creek by Overmyer's. It will be observed that it has a long blossoming period.

Occasionally it blossoms a second time in the season, late in autumn. On October 28, 1906, plants were found in flower along Norris Inlet marsh.

### 336. FALSE RUE ANEMONE

ISOPYRUM BITERNATUM (Raf.) T. & G.

Not especially common. In flower northeast of the lake by Culver's April 19, 1901.

### 337. WHITE BANEBERRY

ACTAEA ALBA (L.) Mill.

Occasional in moist woodlands. In flower along Overmyer's creek May 25, 1901. Fully ripe about the same location October 23, 1904.

### 338. WILD COLUMBINE

AQUILEGIA CANADENSIS L.

One of the most attractive and interesting of our native flowers; rather common on partly shaded bluffs about the lake; found on the bluff by Culver railroad bridge, by Lakeview Hotel, and on Overmyer's hill. It first came up about April 12, 1901, and by April 19 was growing rapidly—up about four inches high and a bright purplish green. By May 16 it was in flower north of the lake. In some places it continues blooming until after July 1. The peculiar form of the flower has doubtless been evolved to favor certain insect visitors, and a select sort of visitors they must be that could alight on the underside of the pendant swaying bells and insert the proboscis to the very depth of the "horns of plenty" projecting above. The wise, burglarious bumblebee, however, frustrates all this invention and solves the problem easily by nipping little holes at the apices of the spurs, and sucking the nectar out.

Oddly enough he appears never to have struck the same plan on the wild touch-me-not, a blossom similarly built in this respect, though almost every country child knows the trick with the touch-me-not but never tries it on the columbine.

### 339. LONG-FRUITED ANEMONE

ANEMONE CYLINDRICA A. Gray

Not very common; found growing on sandy hillsides. Both this and the following have the seeds coated with a peculiar wool. Rather common about Eagle, or Winona Lake, at Warsaw, Indiana.

### 340. TALL ANEMONE

ANEMONE VIRGINIANA L.

Quite common at edges of woodlands and on open hillsides; found on the hill between the Culver railroad bridge and the depot, by Overmyer's, along the railroad by the icehouses where it was in flower June 21, and on the shore by Walter Knapp's where it was seen in fruit October 28, 1904. The flowers are rather large, but inconspicuous and homely. The seeds remain attached to the columella until worn off by age. It is difficult to see how the dense pinky wool assists in the distribution of the seed as it offers little surface to the air. It would be very odd, but not in the least surprising, to find that they depended for distribution on their chance of being used as a downy lining for the nests of mammals and birds.

### 341. WIND-FLOWER; SNOW-DROPS; WILD ANEMONE

ANEMONE QUINQUEFOLIA L.

One of the most dainty members of our flora, growing shyly in shaded places in woodlands, the face of the sepals white, the backs a rich purplish pink. April 26, 1901, just coming up, Farrar's woods; April 30, in flower, east side; May 3, a good deal seen in flower, west side. May 5, a good deal in flower near Scovell's; May 16, still in blossom, Farrar's woods.

### 342. ROUND-LOBED LIVERWORT; ROUND-LOBED LIVER-LEAF

HEPATICA HEPATICA (L.) Karst.

Generally speaking, a rather rare form in the state, though tolerably abundant in a few counties. It closely resembles the other, a well known form through the state, differing principally in the rounded lobes of the leaf. Rather common about the lake; found on the east side north of Aubeenaubee Creek, by Overmyer's woods, and at Long Point. Noted in blossom from April 5 to May 17.

### 343. SHARP-LOBED LIVERWORT

HEPATICA ACUTILOBA DC.

This does not appear to be so common about the lake as the other species. Throughout the state in general it is common, though becoming scarcer from year to year, and is one of the best known and beloved of early spring flowers. Excepting the snow trillium, which is rare and local in the state, it is the first of our conspicuous spring flowers, preceded only by a few such forms as skunk cabbage, silver maple and pepper-and-salt. The leaves themselves are highly ornamental, being beautifully blotched with tracings of brown. The flowers, delicate in appearance but firm in stem and texture, and lasting well as cut flowers, have a faint sweet odor, hardly perceptible with single flowers but in clusters well marked, but delightfully faint and elusive. The flowers range greatly in color, from pure white to a deep pink and a deep blue, the deeper colors found in the more shaded situations. Occasional noteworthy forms occur. Near Fort Wayne, Indiana, was found one plant which had the petalloid sepals white with a decidedly greenish cast so that it could be called a green flower without, however, being a structural reversion as many green flowers are; another was found bearing delicate pink blossoms fully double to the center, and of course bearing no seed. This plant was removed to a dooryard where though neglected utterly, it continued to bear its double blossoms year after year. In flower east of the lake April 19.

### 344. RUE-ANEMONE

SYNDESMON THALICTROIDES (L.) Hoffmg.

A well-known spring flower, somewhat resembling the wind flower, *Anemone quinquefolia*, with which it is sometimes confused. It is not, however, so pretty a flower. Abundant in shady pastures throughout the state. It was found in flower east of the lake, April 11, 1901, on Overmyer's hill April 15, and was abundantly in blossom April 18 in Vajen's gulch. It was still in blossom April 30. Although generally regarded as one of our early spring flowers it sometimes persists in flowering until June or July. Flowering specimens were found as late as this in the vicinity of Winona Lake in the summer of 1900.

### 345. YELLOW WATER-CROWFOOT

RANUNCULUS DELPHINIFOLIUS Torr.

Common in temporary woodland ponds in Farrar's woods, and common in such situations throughout the state. Like the water-

parsnip, Riccia, and other forms found growing in places where it is dry ground part of the year and a good depth of water other times, this plant is remarkable for its protean changes of form, and exhibits the remarkable adaptability of organisms to changed conditions. In winter and spring the leaves, covered with water, are finely dissected, and with the exception of a few choice forms like the water parsnip and some of the Potamogetons, which have exceptional beauty of form, few plants show up so beautifully through the clear ice of early winter. There are few richer experiences than walking over the clear ice of some shallow pond, when all the world outside is sere and barren, and looking down at the green velvety water-meadows of water-crowfoot beneath.

In summer, when the pond is a dry cracked mud-flat, the crowfoots still persist bright green as ever, but so changed in form as to be hardly recognizable; instead of the leaves being flaccid and finely dissected, they are firm of texture and merely lobed.

In spring, after the ice has disappeared, and the plant puts forth its new growth, bearing floating leaves and flecking the surface of the pond with golden blossoms, we have a vertical variation, the lowermost leaves being finely fimbriate and flaccid, the successively higher ones less fimbriate, and the floating leaves like those of the land plant, merely lobed, and rather firm.

### 346. PURSH'S BUTTERCUP

RANUNCULUS PURSHII Richards

Noted in flower at the tamarack west of the lake May 23, 1901.

### 347. KIDNEY-LEAVED CROWFOOT

RANUNCULUS ABORTIVUS L.

One of our common, homely weeds found scattered in moist open places, and preferring a heavy clay soil. Quite variable in size and form, with inconspicuous flowers. Found in flower east of the lake May 3, 1901.

### 348. HOOKED CROWFOOT

RANUNCULUS RECURVATUS Poir.

Common in the woods between Farrar's and Overmyer's near the edge of the pond which joins the lake. Collected in blossom May 20, 1901. The globose heads with their hooked beaks remind one somewhat of the fruits of species of Geum of the Rosaceæ.

### 349. BULBOUS BUTTERCUP

RANUNCULUS BULBOSUS L.

Not common; only 1 clump of plants seen. This was found in flower by the Arlington depot May 24 and June 4, 1901. The seed was probably brought in by the railroad.

### 350. HISPID BUTTERCUP

RANUNCULUS HISPIDUS Michx.

Not abundant; collected on Long Point back from the shore of the lake; found also near Green's marsh where it was in flower May 13, 1901.

### 351. WHITE WATER-CROWFOOT

BATRACHIUM TRICHOPHYLLUM (Chaix) F. Schultz

During the early part of the survey this did not appear to be a common plant. A few were found by the green boathouse near Norris Inlet in 1900, and in 1901 a patch was found in flower June 8 in Lost Lake near the east shore. In later years it appears to have increased a good deal. In 1904 some was found on shore north of the icehouse, and on November 16 of that year it was still as green as ever, in Outlet Bay. In 1907 and 1908 there were large patches along the north shore of Long Point.

The plants remain all winter, and are broken into fragments along shore by the winds and waves of March and April, each fragment taking root and growing. The white flowers are rather small and inconspicuous, giving the water surface a powdery, dusty appearance.

Frequently, in late autumn, the plants are covered by a dense growth of diatoms.

### 352. PURPLISH MEADOW-RUE

THALICTRUM DASYCARPUM Fisch. & Lall.

Probably not common; only one plant collected and its identification somewhat doubtful. We have found in meadows near Fort Wayne plants that appeared intermediate between this species and *polygamum*.

### 353. EARLY MEADOW-RUE

THALICTRUM DIOICUM L.

Common on the east side on wooded hillsides, also found west of the Palmer House. Abundant on the hill fronting Overmyer's field. One of the earliest and most graceful of our spring flowers, but by no means showy. Noted in blossom April 23, 1901.

### 354. FALL MEADOW-RUE

**THALICTRUM POLYGAMUM Muhl.**

Not very common; occasionally found in moist, open places. The masses of rather long whitish filaments make the tall plants, when in bloom, rather conspicuous objects. Found in blossom southwest of the lake June 26, 1901.

### 355. VIRGINIA VIRGIN'S BOWER

**CLEMATIS VIRGINIANA L.**

Rather uncommon about the lake, and most of the plants seen were staminate and stunted in growth. There were plants near McSheehy's and by Lakeview Hotel, and some along the Maxinkuckee road some distance back from the lake. The only pistillate plants seen were those near the Chandler cottage southeast of the lake.

We have few plants more worthy of cultivation. Pistillate plants should always be chosen, with perhaps a few staminate ones to fertilize them. These, in July, cover trellises with a perfect mass of creamy white blossoms in clusters, to be followed later, especially after frost, with masses of feathery fruit, giving the appearance of masses of smoke. The effect on trellises, striking as it is, is not so remarkable as where the wild plants which grow very robust in rich black bottom lands trail over brushes and shrubs and hang down in great festoons; first of blossoms during a comparatively flowerless season of the year, and later in smoke, adding their soft hazes to those of mellow Indian summer days.

### 356. LEATHER-FLOWER

**VIORNA VIORNA (L.) Small**

Not found in the immediate vicinity of the lake, but common along Tippecanoe River near Delong and Yellow River near Plymouth. It is also common in Allen County near Fort Wayne, Indiana. Attractive for trellises, but considerably inferior to *C. coccinea* already in cultivation which is much like it in every respect except that it has much more brilliant flowers.

## Family 59. Berberidaceæ. Barberry Family

### 357. BLUE COHOSH

**CAULOPHYLLUM THALICTROIDES (L.) Michx.**

Occasional on the east side of the lake, where it was found in flower April 23, 1901. Grows best in the moist rich soil of deep

woodlands. A coarse rank plant. The large fruit, somewhat resembling a grape is mostly composed of a bullet-like seed which appears to be composed of vegetable ivory.

### 358. MAY APPLE; WILD MANDRAKE

**PODOPHYLLUM PELTATUM L.**

Fairly common in rather dry woodlands. Noted in flower in Farrar's woods May 14, 1901; the umbrellas were up in fine shape by April 19 and the buds had been showing for some time. Near Bloomington, Indiana, a number of years ago, a clump of remarkable plants of this species was found; nearly every flower was monstrous, the carpel not closing, so that the seeds were borne on the outside. Plants observed near Washington, D. C., had the umbrella-shaped leaves richly colored with a regular pattern of purple, and would be worthy of a place in a flower-garden. On August 12, 1906, one of the inhabitants of Culver was seen with a large basket full of the ripe fruits—fine large ones, some russetty on one side, all an exquisitely rich yellow—altogether an unusual sight. It looked like the garden of the Hesperides had been burglarized. The fruits are sometimes used to make a jelly.

## Family 60. Menispermaceæ. Moonseed Family

### 359. MOONSEED

**MENISPERMUM CANADENSE L.**

Not very common about the lake; some plants seen on Overmyer's hill. The blackish berries, which have a peculiar disagreeable, astringent taste, are eaten by birds. In some places this plant is known as "Wild Sarsaparilla" (a name also applied to *Aralia nudicaulis*), and a decoction of the long yellow rootstock is used in the preparation of home-made medicines. Old dead vines separate along the medulary rays and the segments twist about each other like the coils of a rope.

## Family 61. Lauraceæ. Laurel Family

### 360. SASSAFRAS

**SASSAFRAS SASSAFRAS (L.) Karst.**

Very common about the lake, especially southwest, by Farrar's and Overymyer's, and back of Walley's. Found on the east side by the Chandler cottage; also on the depot grounds near shore. In flower May 6, 1901, and everywhere in bloom May 7. September

21, 1900, leaves in bright autumnal coloration; October 28, leaves nearly all shed, the trees bare.

Interesting on account of the various leaf forms, three forms being common on the same tree—oval without lobes, mitten-shaped with a small lobe on one side, and with a small lobe on each side. In Zechiel's woods opposite Busart's were some young sprouts with immense, very broad leaves, these frequently bearing five lobes.

In dry sandy soils the sassafras takes an autumn coloration very early—sometimes in August—the coloration consisting of a red spotting which finally spreads over the whole leaf. Between the field fence and heavy forest in Walley's woods was a long patch of sassafras, which, turning a beautiful red while the forest behind it was still green, made an attractive sight for the distance of a half-mile or more. In northern Indiana the sassafras is a rather small tree, rarely exceeding a diameter of 9 to 12 inches; farther south it attains a considerably greater diameter. The stump sprouts badly from the root, and it is difficult to keep down these sprouts in new fields. This is most easily done by pasturing over the places where the stumps are.

The wood is very durable in contact with the soil, and is sometimes used for fence-posts. It splits and ignites easily, and therefore makes excellent kindling wood; some people believe a superstition regarding it which prevents their using it for fuel.

There is a popular belief in some parts of the country that there are two kinds of sassafras, the red and white, but we know of no fact or variation upon which this distinction could be based.

The sassafras exhibits considerable individuality in regard to time of flowering, some trees blooming a week to ten days later than others in the same neighborhood.

### 361. SPICE-BUSH

BENZOIN AESTIVALE (L.) Nees

A well known shrub, once common in low rich woods throughout the state, but disappearing as these are cleared up, drained or pastured. At Lake Maxinkuckee it was found in Overmyer's woods and on the east side of the lake. It was well out in flower by April 30, 1901.

The small yellow flowers, preceding the leaves make this shrub somewhat attractive, and the spicy fragrance of the crushed branches and leaves is agreeable. The red elliptical berries are too few to make much show. The leaves turn to a beautiful golden in autumn.

## Family 62. Papaveraceæ. Poppy Family

### 362. BLOODROOT; PUCCOON-ROOT

**SANGUINARIA CANADENSIS L.**

Common in woodlands, especially on the east side of the lake. Noted in flower from April 11 to April 30. Some of the flowers were pretty badly frozen April 19, 1901. The petals are usually pure white. Some seen near Bloomington, Indiana, had a pinkish tinge.

## Family 63. Fumariaceæ. Fumewort Family

### 363. DUTCHMAN'S BREECHES

**BICUCULLA CUCULLARIA (L.) Millsp.**

Abundant northeast of the lake in Culver's woods. Collected in flower April 30, 1901.

## Family 64. Cruciferæ. Mustard Family

### 364. GOLD-OF-PLEASURE; FALSE FLAX

**CAMELINA SATIVA (L.) Crantz**

Not common; a member of the railroad flora, and apparently of recent introduction. In flower along the railroad in front of the Assembly grounds May 18, 1901.

### 365. SHEPHERD'S-PURSE

**BURSA BURSA-PASTORIS (L.) Britton**

Like the dandelion and English sparrow, one of the hardy emigrants found thriving everywhere and at all times and seasons. It is not so much of a nuisance as the dandelion, however; it is easily killed out by cultivation and while sometimes annoying in lawns, it cannot compete with a vigorous growth of grass, and is not so conspicuous or persistent as the dandelion, being an annual. It is essentially a plant of waste places. It is usually one of the very earliest plants to be found in spring, and the latest in autumn. At Lake Maxinkuckee, it was found everywhere in waste places and at all seasons.

### 366. MARSH WATER-CRESS; YELLOW WATER-CRESS

**RADICULA PALUSTRIS (L.) Moench**

Common in wet places, forming scattered patches. Although abundant in places it never becomes a bad weed, as it is confined to grounds too moist to cultivate.

### 367. TRUE WATER-CRESS

**SISYMBRIUM NASTURTIUM-AQUATICUM L.**

Not abundant, and in quite localized patches. It either does not find conditions favorable for spreading, or has been only recently introduced. One small patch was found at the edge of the lake at Barnes's pier and another small patch at Farrar's. It was pretty well established in a creek entering Culver Bay. In 1904 another small patch was found on the north shore west of the depot. In flower on the northeast side of the lake June 5, 1901.

In springy places by the Vandalia railroad between Plymouth and Twin Lakes this plant grows with great luxuriance.

### 368. HORSE-RADISH

**ARMORACIA ARMORACIA (L.) Britton**

Not abundant; in flower in waste places May 20. Several plants found on the ice ridge at the south end of the lake.

The horse-radish has never been planted to any extent in this district. In many parts of the state where planted and not kept within bounds it becomes a great nuisance, especially in rather moist clay. It does not spread far, as it fortunately produces no seed, but every fragment of root grows with great tenacity, and an effort to get rid of the plant by hoeing out the roots is likely only to increase their number by dividing them.

### 369. WILD PEPPER-GRASS

**LEPIDIUM VIRGINICUM L.**

One of the most common and variable of our plants, especially variable in size and leafiness. In spite of its great abundance and adaptability, it never appears to become a bad weed. Some plants attain only the height of a few inches, others become a foot or more high; some have only a rosette of leaves at the base, while others are leafy throughout, with a rosette of leaves at the top. The leaves vary considerably in shape. Plants begin blooming very early in spring—our earliest record is May 13, though they doubtless bloom much earlier. They continue blooming until killed by freezing—indeed, in protected situations in mild winters, they probably bloom all year. Although the growth is usually indeterminate, in rich black ground, especially in a dry autumn, the entire plant ripens, the leaves fall off, leaving a round clump of a plant with innumerable small pods; these sometimes of a pleasing purplish color. They were noted brightly in blossom as late as November 24. The later flowers are reduced, having only 2 stam-

ens, and the late fruits are often attacked by a fungus which causes them to blast and turn black. The plants furnish a good deal of bird food during early winter, and one can frequently notice in early snows numerous bird-tracks among these plants, and note where the birds have been pecking. The late autumn seedlings survive the winter in the form of small rosette plants, ready to push up a flowerstalk with the advent of spring.

### 370. HEDGE WEED OR MUSTARD

**ERYSIMUM OFFICINALE (L.) Scop.**

Common in open waste places. Noted in flower on the east side May 28, 1901, and in blossom in Chadwick's yard September 13, 1907. It blooms until killed by frost; many of the later blooming plants are seedlings which have sprung up during the late summer. There was a good patch near the Bardsley cottage.

### 371. TALL HEDGE MUSTARD

**NORTA ALTISSIMA (L.) Britton**

Apparently of recent introduction. A number of plants found in a single patch along the railroad by the icehouses. The plants had been in flower for some time by June 11, and by this time the pods were well developed.

### 372. HAIRY ROCK-CRESS

**ARABIS HIRSUTA (L.) Scop.**

Rather common in dry ground north and northwest of the lake. Collected in flower and with the pods somewhat grown May 27, 1901.

### 373. SMOOTH ROCK-CRESS

**ARABIS LAEVIGATA (Muhl.) Poir.**

Rather common on the steep rocky bluffs, along the eastern shore of the lake. In flower May 24 and later. Specimens were collected May 27, 1901.

### 374. SICKLE-POD

**ARABIS CANADENSIS L.**

Rather common in dry gravelly shaded places on both sides of the lake; noted at Long Point, by Lakeview Hotel, and along the east side on the high banks. The curved pods resembling the blade of a scythe in shape or the semi-transparent partitions left after the valves have fallen, form rather conspicuous objects during the winter months. Noted in flower early in June.

### 375. MEADOW BITTER-CRESS; CUCKOO-FLOWER

**CARDAMINE PRATENSIS L.**

One of the most attractive of the cardamines, with its tall stem and comparatively large white flowers. Common, scattered through moist open meadows such as the flat west of the grist-mill and Green's marsh. In flower from May 5 on.

### 376. PENNSYLVANIA BITTER-CRESS

**CARDAMINE PENNSYLVANICA Muhl.**

Common in swamps and wet places. Collected in flower near the shore of the lake, in the low woods by Overmyer's May 25, 1901.

### 377. PURPLE CRESS

**CARDAMINE DOUGLASSII (Torr.) Britton**

Rather common, especially on the northeast side of the lake about the low margins of marshes and in wet woods generally. It is common throughout the state in wet woods. In early spring the plant shoots up quickly from a sort of tuber. The flower buds, first as minute little bells, gradually enlarging and showing glimpses of pink are among the earliest promises of spring flowers, though several other plants not so prominent in bud, bloom earlier. In flower April 19, 1901, abundantly in flower April 30.

### 378. SPRING CRESS; BULBOUS CRESS

**CARDAMINE BULBOSA (Schreb.) B. S. P.**

Once common throughout the state in rich woods, especially in wet places, but disappearing as these are drained, cleared or pastured. A very hardy plant, the naked flowerbuds showing exceedingly early in spring. One of our best known spring flowers. April 19, 1901, in flower on the east side of the lake. April 30, abundantly in flower. May 5, collected in Green's marsh.

### 379. CUT-LEAVED TOOTHWORT

**DENTARIA LACINIATA Muhl.**

Not so abundant as the cardamines, but growing in similar situations; partial to rich leaf-mold. April 11, 1901, in large bud east of the lake; April 18 in flower in Vajen's gulley; April 19, 27 and 30, still continuing in bloom. It bears yellow fusiform tubers resembling miniature sweet potatoes. These have a pleasant mustard-like flavor.

380. CHARLOCK; WILD MUSTARD

SINAPIS ARVENSIS L.

Not common; a member of the introduced railroad flora.

381. RAPE

BRASSICA NAPUS L.

Occasionally cultivated and sometimes escapes. Some plants grew along the railroad north of the icehouses and had well developed pods by June 11, 1901.

## Family 65. Sarraceniaceæ. Pitcher-Plant Family

382. PITCHER-PLANT

SARRACENIA PURPUREA L.

This interesting plant was once quite common in the neighborhood of the lake. They were once quite abundant in the large tamarack a few miles west of the lake, but with the draining of this marsh they rapidly disappeared. A few fine plants were seen at the edge of Lake Maxinkuckee, but they were not seen on the later visits to the lake, and have probably died out. They still are rather common in Hawk's marsh, and appear to be thriving there. The leaves vary somewhat in color, some being nearly uniformly green, others with deep purple veins. They usually contain the remains of large insects, such as beetles, grasshoppers and the like. A small, long-legged mosquito-like insect seems to live, and probably to breed, in them. It has no trouble rising straight out of the cups. In many cases insects gnaw their way through, though whether from the inside or outside has not been determined; many of the pitchers are empty, with large holes gnawed through the base.

The liquid within the pitchers freezes perfectly solid during the winter but this never breaks or splits the pitcher, perhaps on account of their elasticity. The purple blossoms, which appear in late May and early June, are large and handsome; the large umbrella-shaped expansion of the style gives them an odd, bald appearance.

## Family 66. Droseraceæ. Sundew Family

383. ROUND-LEAVED SUNDEW

DROSERA ROTUNDIFOLIA L.

Not common; found in a few small patches along the northeast and east shore of Lost Lake; a small patch found also a consider-

able distance down the outlet of Lost Lake, at the edge of a high bank on the west side (1904). The sundew patches were found growing in patches of various species of mosses, principally sphagnum, or in wet sand, and the occurrence of little patches of sphagnum here and there at the edge of Lost Lake is especially interesting, as it shows the first stage of the conversion of a lake into a peat bog. The sundew plants grew close to the water's edge, just at such places as the clouds of midges perform their aerial dances. The central leaves of the sundews stayed green all winter, rolled up like fern fronds, forming a tiny rosette. By May 27, 1901, the leaves had unfolded and were covered with the remains of tiny midges they had captured; the place where they grew seemed especially favorable for the capture of prey.

The plants, especially when in bloom, with the drops of secretion sparkling and glistening in the sunlight, are remarkably attractive.

### 384. SPATULATE-LEAVED SUNDEW

**DROSERA INTERMEDIA Hayne**

Much more abundant than the other species and more confined to sphagnous bogs. There were small patches in Walley's peat-marsh and others of considerable extent in Hawk's marsh. Not so attractive as the other sundew, as the leaves are too narrow to give much foliage effect. The leaves turn bright red in autumn and are killed quickly by frost, though the central bud of the plant persists.

## Family 67. Crassulaceæ. Orpine Family

### 385. LIVE-FOREVER

**SEDUM TRIPHYLLUM (Haw.) S. F. Gray**

A clump found on the lake shore by Murray's and one on the road to Delong. This species is usually found in the vicinity of old homesteads, as if at one time planted for ornament. The rose-colored cymes of flowers are rather pretty, but the plant seldom blooms, usually propagating by joints. The plants near Lake Maxinkuckee, growing in the wilds, bloomed profusely. This plant, like others of the stonecrops, is noteworthy for its abundance of soft mesophyll. If the leaf-stem is broken off, the leaf may be gently macerated and the mesophyll squeezed out, leaving the leaf as an empty bag.

## Family 68. Penthoraceæ. Virginia Stonecrop Family

### 386. DITCH OR VIRGINIA STONECROP

PENTHORUM SEDOIDES L.

Common in ditches and swampy places, such as back of Winfield's, by the railroad bridge, and in Green's marsh. Although the flowers are small and inconspicuous, the clusters of fruits which are often reddish in color, are quite attractive.

## Family 69. Parnassiaceæ. Grass-of-Parnassus Family

### 387. CAROLINA GRASS-OF-PARNASSUS

PARNASSIA CAROLINIANA Michx.

Scattered in patches in boggy marshes among sedges and grasses. Found in the Inlet marsh and in low grounds along Outlet Bay. The creamy flowers are quite attractive, but in spite of their apparent firmness, wither quickly on being plucked. The plants frequently continue in blossom until killed by frost. Some were noted in flower September 27, 1900.

## Family 70. Saxifragaceæ. Saxifrage Family

### 388. SWAMP SAXIFRAGE; PENNSYLVANIA SAXIFRAGE

MICRANTHES PENNSYLVANICA (L.) Haw.

Scattered rather sparingly in swampy places. Found in the marsh back of the Culver grist-mill and in the tamarack west of the lake. Noted in flower May 17 and 22, 1901.

### 389. ROUGH HEUCHERA

HEUCHERA HISPIDA Pursh

Scattered in woodlands in various places about the lake, such as at Long Point, near Farrar's, and near the depot grounds. The flowers are inconspicuous but noteworthy for their red stamens and very red pollen. The leaves remain green all winter. They frequently assume purple tints in well marked patterns and are quite attractive when most other leaves are dead and brown. Collected in blossom in early June.

### 390. TWO-LEAVED BISHOP'S CAP OR MITRE-WORT

MITELLA DIPHYLLA L.

Found in shady ravines on the east side of the lake. One of the daintiest of our wild flowers, the small white flowers with their

incised petals resembling snowflakes. Leaves, scapes and flower-buds showed well by April 19. Some of the first blossoms were out April 30, 1901.

## Family 71. Hamamelidaceæ. Witch Hazel Family

### 391. WITCH-HAZEL

**HAMAMELIS VIRGINIANA L.**

Quite abundant, forming a long narrow patch or copse along the low bluff which borders the east shore of the outlet of Lost Lake back of Green's. A number of bushes also on the high bank by McOuat's east of the Lake. It seems to thrive best in a somewhat sandy soil.

Even scattered bushes of the witch-hazel are attractive and interesting, and the habit of putting out blossoms late in autumn when the leaves are falling or are wholly fallen, when no other shrubs or even herbs with conspicuous flowers are in bloom, makes it an especially desirable plant for parks. It is among flowers what Indian summer days are to the year. It is not so often found in parks as one might expect; we have never seen it in any of the Chicago parks; there are one or two in the Department of Agriculture grounds, but in none of the other Washington parks, not even in the Botanic Garden, though the Japanese witch-hazel, which blooms in early spring, is there. The individual blossoms are small and inconspicuous, but on a particularly floriferous bush they grow in such abundance that they cover the tree with a golden haze, considerably more effective than the Carnelian Cherry, *Cornus mas*, which blossoms in early spring, and which we have taken the trouble to import from Europe for park purposes.

The witch-hazel exhibits a good deal of variation and individuality, and the more showy individuals should be selected for planting.

The clump along Lost Lake was really one of the features of the region, and indicated how it should be planted for the best general effects, i. e., in large clumps.

An element that always makes the witch-hazel especially interesting is that of uncertainty as to just what it will do. Blooming as it does, late in autumn or early winter, when inclement weather is likely to occur at almost any time, it has to adapt itself to circumstances. A warm, favorable autumn brings it out more or less all at once, and the blooming season, though fairly long, is considerably shorter than under more unfavorable conditions. In 1906 the bushes of Lost Lake copse were beginning to be full of bloom

by September 14. They were beautifully in flower October 15, 18 and so on, continuing until November 22. On October 12, the blossoming bushes were covered with snow. On such years the plants are more showy as they have all their blossoms crowded into the shorter season. When the autumn is full of inclement days, however, the buds stay closed on bad days, peeping out only on bright pleasant days, and the flowering period is prolonged, thus in 1900-1901, the blossoms which were noted fully in flower October 23, continued flowering until after New Year, when one could skate across the ice of Lost Lake for a bouquet.

The witch-hazel appears to bear its great abundance of flowers every other year, ripening its fruit in alternate years so that though every year there will be a few flowers or a little fruit, there will usually be especially floriferous years when there is little fruit alternating with especially fruitful autumns when there are few flowers.

Places not far apart geographically may have the years different. In 1909 the bushes at Fish Lakes, Indiana, bore immense quantities of fruit, while those of Lake Maxinkuckee had many flowers but little fruit.

The fruit is as interesting as the flowers, each fruit consisting of a pair of woody elastic valves. As these ripen and dry, they exert a pinch or pressure upon the black shining seed, which is shot out with some force. The witch-hazel seed is about the shape of an apple seed and placed in the pod sharp end down so that it is shot out just as a boy shoots apple seeds by pressing them between the thumb and finger. The seeds are shot some 20 to 40 feet. By getting a fruitful branch and hanging it up in a room or placing it in a vase and waiting, the interesting bombardment will soon begin.

The seeds are edible, but are tedious eating.

The leaves turn to a beautiful gold in autumn. Young leaves are often purplish, suggesting the possibility of developing a form with attractive foliage.

## Family 72. Altingiaceæ. Altingia Family

### 392. SWEET GUM

LIQUIDAMBAR STYRACIFLUA L.

Rare; two trees found in a lot on the east side of the lake, the larger about twenty-five feet high. They may have been planted trees, as this is unusually far north for this species in Indiana. Dr. Stanley Coulter, however, reports the species from the

neighboring county of Kosciusko. The trees were out of flower by May 28, 1901. The glossy leaves take on a strikingly rich coloration in autumn and the branches are remarkable for their broad plates of corky outgrowth.

## Family 73. Grossulariaceæ. Gooseberry Family

### 393. WILD BLACK CURRANT

**RIBES AMERICANUM Mill.**

Infrequent in the vicinity of the lake, though common throughout the state in low, damp woods. The only plants found were in the neighborhood of Inlet marsh. Although this plant is considerably inferior in appearance to the Missouri currant, and the blossoms lack the spicy odor of that species, the pale yellow tresses of blossoms are decidedly handsome, and are borne in considerable profusion. The fruits are rather pleasant eaten out of hand, but are of too gamy a flavor to be used in cooking.

### 394. WILD GOOSEBERRY

**GROSSULARIA CYNOSBATI (L.) Mill.**

Fairly common in woodlands. The earliest of our shrubs to leaf out in spring, a wild gooseberry bush shows at a distance its halo of green when the surrounding trees and bushes are still brown and bare. The blossoms contain an abundance of sweet nectar which can be obtained by biting off the basal portion. The berries are sometimes cooked after the spines are rubbed off, but the fruit is inferior to that of garden sorts. The leaves are quite resistant to mildew which so frequently plays havoc with cultivated varieties, and the "currant worm" seems never to trouble them. Wild gooseberry bushes are occasionally seen growing high on the top of old stubs of trees.

April 19, 1901, tips of buds show green; April 22, leaved out so as to show green for some distance, many leaves entirely unfolded; April 30, nearly in flower, east side; May 3, in flower, Walley's woods.

### 395. NORTHERN GOOSEBERRY

**GROSSULARIA OXYACANTHOIDES (L.) Mill.**

Not common; found in the tamarack west of the lake, also in the one northeast of the lake. Found in flower May 22, 1901. The fruit is smaller than that of the prickly gooseberry and borne rather sparingly. The flowers are markedly different from those of the preceding species, having a very shallow cup.

## Family 74. Platanaceæ. Plane-tree Family

### 396. SYCAMORE

PLATANUS OCCIDENTALIS L.

A fairly common tree in the immediate vicinity of the lake, the greater number growing rather close to the shore line. No very large trees were seen.

The sycamore is much more common on the west side of the lake than on the east, as there is more low level ground there. Along the west, south and southeast sides of the lake the trees are scattered along the shore from Long Point to Norris's. Six trees were found in the Long Point region. Along the top of the ice-beach near the road in front of Green's occurs a row of sycamores from 15 to 20 feet high, bearing fruit. Another row is found on shore between Murray's and Farrar's, and a third row is found between the Inlet and Norris's. A large stub of the largest tree noted remains in the region by the wagon road at Culver Bay. Small trees are occasional in front of the Assembly grounds.

In some parts of the state this species reaches an immense size, perhaps exceeding in diameter any other species.

The seeds are shed during the winter, the process continuing sometimes well on into spring. The ice was sometimes covered with them in places. The young seedlings germinate in May and June. As in the case with the elm, seedlings of this species come up in great numbers along the high-water line of the lake. There was a long row about two inches high on the sandy beach in front of Green's, one in the low woods near Overmyer's, and one on the shore between the Inlet and Norris's. The bearing row of saplings in front of Green's seems to have been the survivors of such a row left in a year of unusually high water.

The leaves are not remarkable for autumnal coloration; they turn a dull yellow, then brown. The leaves were decidedly brown by September 27, 1904, and were falling by September 29. Some trees had leaved out well by May 9, 1901. The sycamore has the somewhat peculiar habit of having the axillary buds protected by the leaf-petiole.

The sycamore was once confined chiefly to the edges of watercourses and ponds throughout the state, but it now often springs up in cleared places in the upland, where it appears to grow quite rapidly. This change of habit is perhaps due to the fact that when the country was well covered with forests and the winds had not so wide a sweep, the seeds were chiefly carried by water.

but with the opening up of the country, giving the winds greater play, the seeds, which are well adapted to wind dispersal, were scattered farther and more widely by it than heretofore.

From the lumberman's and woodman's point of view, the sycamore has a low value. The lumber is brittle, very liable to windshake, but very difficult to split. The tree has, however, a high ornamental value. It has a peculiar habit of shedding its bark every year; this process is sometimes gradual, so that it is not noticeable in the act; at other places the shedding of the bark is an active process, which usually takes place in July or August and occupies only a few weeks, the bark falling in considerable patches about the trees. The bark from which the old patches have recently fallen is more or less greenish, soon blanching to snowy whiteness.

The sycamore is said to make a good street tree; many of the streets of Washington, D. C., are bordered by the oriental species, which is not so handsome. When grown in the open this tree is quite regularly pyramidal; in natural conditions they are quite irregular in growth, like the white-oak. It is in its native setting, that some gigantic stately old tree of this species, with bark of snowy whiteness, leaning over some water course and glimpsed through the distance and through vistas of native trees, shows at its best—standing like Nausicia the white-armed, at the water's edge—and the tale of the Persian conqueror's having fallen in love with a plane-tree and adorning it with necklaces and jewels does not seem so improbable.

In recent years, both in the neighborhood of Lake Maxinkuckee and other regions where sycamores abound, it was noticed that the upper surface of the leaves turned a dead sickly whitish during the summer. This is due to the presence of a species of lace-bug which is almost as constant an associate of the sycamore as the potato beetle of the potato, and both adult and young bugs are usually abundant on the underside of the leaves during late summer. The adult bugs winter under the scales of bark. These bugs are among the most beautiful objects that can be obtained for examination under a lens.

Near the road by Murray's, a sycamore sprout developed which was peculiar in having variegated leaves, the leaves having large splotches of white, with clouded splotches. The leaves came out this way every year. On the Yellow River is a tree fifteen or twenty feet high, all the leaves of which are similarly marked and forming a beautiful and unusual sight. Such a form would be well worthy of propagation by grafts or cuttings.

Within the area where the mistletoe thrives the sycamore is a fairly common host of this parasite; along the Cumberland River we saw numerous trees thus affected, though it is not so susceptible as the blue-gum and elm.

The fuzz of the sycamore leaves, when breathed into the nose or trachea, causes a violent and distressing cough.

## Family 75. Rosaceæ. Rose Family

### 397. NINEBARK

**OPULASTER OPULIFOLIUS (L.) Kuntze**

Not common; one plant, which has long since disappeared, grew on the north shore of Long Point; a small patch was found in a gully east of Overmyer's; cultivated for ornament on the Culver Military Academy grounds. Leafed out by May 4, 1901. Just coming into blossom June 10 at Long Point.

The ninebark is a rather variable plant, sometimes not particularly attractive, but at its best one of the most attractive shrubs we have. Indeed, there are few shrubs that can compete with it, for there are forms ornamental in flower, some in fruit, and some in foliage. If all of these three forms could be combined into one the plant would be almost incomparable.

The plants in flower resemble a large-flowered spiræa of the *van houttei* type and are borne in numerous many-flowered corymbs. These are followed by clusters of inflated pods—five pods to each flower. These pods are frequently green in color, when they have no especial ornamental value; some growing in a rich mucky swamp in Allen County, Indiana, had the pods a rich red color; these were remarkably handsome, more striking indeed than the flowers. In the park about the ellipse at Washington, D. C., is a golden-leaved form, the leaves of which with the glinting of a peculiar golden shade mingled in with greener portions, give a splendid richness of color hardly to be equalled in any other style of leaf-coloration.

### 398. MEADOW-SWEET

**SPIRAEA ALBA Du Roi**

Scattered through low grounds in the vicinity of the lake, as about Long Point, near Lost Lake, and in Walley's marsh. A rather handsome erect shrub with steeple-shaped panicles of white, slightly fragrant flowers. Leafing out near Long Point, April 29, 1901; in flower by Lost Lake July 26. Much in flower in Walley's marsh, August 19, 1906.

### 399. HARDHACK; STEEPLE-BUSH

SPIRAEA TOMENTOSA L.

Not common in the immediate vicinity of the lake; a few plants in low places. It thrives best in tamarack and sphagnum bogs, and in mucky places. More attractive than the other species; its purple flowers in dense steeple-shaped erect panicles. On August 14, on the way from Bass Lake, great patches of this species gave color to the whole landscape at one place.

### 400. FIVE-FINGER; COMMON CINQUEFOIL

POTENTILLA CANADENSIS L.

Rather common in dry places about the lake but not so common as to form large patches to the exclusion of everything else as it is in dry hills about Eagle Lake. In flower along the railroad north of the icehouses, May 16, 1911. A common and well known plant throughout the state. Associated with the roots are small onion-shaped tubers, astringent to the taste and of great repute among herb doctors as a remedy for cholera morbus.

### 401. ROUGH CINQUEFOIL

POTENTILLA MONSPELIENSIS L.

Quite abundant in various waste places. Found in flower along the south edge of the lake June 12, 1901. It continues blossoming late; barely out of flower by October 24, 1904. A coarse homely weed unaffected by the early frosts and freezes.

### 402. PURPLE OR MARSH CINQUEFOIL

COMARUM PALUSTRE L.

Scattered; common in marshy places, especially cold sphagnous bogs. Found in the Inlet marsh, by the Outlet, and along the northeast shore of Lost Lake. In flower June 3, 1901. The large purple flowers are quite handsome and so unlike anything else that they attract attention.

### 403. WILD STRAWBERRY; VIRGINIA STRAWBERRY

FRAGARIA VIRGINIANA Duchesne

Not very common; found near Farrar's and along the railroad. In flower May 2, 1901; ripe June 3. Variable in size and shape. Some along the railroad were much larger than the others and were probably escapes from the cultivated berry. Leaves turn bright red in autumn and persist during the winter.

### 404. SOFT AGRIMONY

**AGRIMONIA MOLLIS** (T. & G.) Britton

Common on the dry gravelly flat at the north end of Long Point; plentiful near shore south of Green's and farther south, beyond Murray's. North of the Outlet and present in small quantities near Winfield's. A nuisance on account of its small burrs.

### 405. MANY-FLOWERED AGRIMONY

**AGRIMONIA PARVIFLORA** Soland.

Common in rich ground in somewhat open places. Like the other, its burry seed capsules make it a disagreeable weed. Fortunately, however, it never grows in cultivated ground.

### 406. WHITE AVENS

**GEUM CANADENSE** Jacq.

Scattered in shaded woodlands. Found in Farrar's woods, also in Culver's woods northeast of the lake some distance back.

### 407. WILD RED RASPBERRY

**RUBUS STRIGOSUS** Michx.

Not common; although the books give its habitat as "dry rocky situations", the most common situation in which we have found it is in old drained tamaracks and mucky or peaty soils. As it is never found in wet or living sphagnum swamps it is probable that the plants found in the dried up marshes have arisen from seeds dropped by birds, and having found congenial soil have multiplied. In such situations the plants bear fruit rather sparingly. A few plants were found in the drained tamarack northeast of the lake January 3, 1905.

### 408. BLACK RASPBERRY

**RUBUS OCCIDENTALIS** L.

Once common throughout the state in open woods, about stumps at the edges of copses and about fields. Not found in deep woodlands but appearing quickly where lands have been partly cleared so as to make the forests more open. Its rapid and extensive dissemination in such places is due to birds. It soon disappears from woodlands that have been heavily pastured. In many parts of the state where it was originally common it has become rare, due to pasturing.

Not especially common about Lake Maxinkuckee; there was a

small patch along the railroad near Green's marsh. Leaved out well by May 2, 1901. In flower May 19.

### 409. DWARF RED RASPBERRY

RUBUS TRIFLORUS Richards

Not common; generally found in sphagnous marshes or in mossy places in woodland ponds, sometimes growing in mucky places. Found at the border of a pond in Walley's woods and in the tamarack marsh west of the lake. In flower May 22, 1901.

A delicate, thin-leaved trailing plant. The white blossoms have an exquisite, delicate odor. The fruit, which is borne sparingly, is exceedingly handsome, purplish-red in color and exceedingly good eating, somewhat sour but with a delicious aromatic flavor.

### 410. TALL BLACKBERRY

RUBUS ARGUTUS Link

Rather common in scattered patches; on the hill north of the icehouses and in front of the Assembly grounds. A fine large patch on the side of the slope east of Lost Lake outlet back of Green's field. Very abundant in Walley's woods where, in 1906, it bore a great abundance of fruit. Scattered plants through Farrar's woods.

June 4 to 14, 1901, in flower in Farrar's woods. July 29 to August 29, 1906, in fruit in Walley's woods. Leaves very tardily shed in protected situations in woodlands; they remained green nearly all winter in Farrar's woods.

A plant with large long crystal-white fruit, very sweet and delicious, was found near Fort Wayne and transplanted from the woods where found, but it finally died. Another patch with small yellow berries, which always remained rather sour, was found in the same woods. "White" blackberries can be told from others even in the winter, by the paleness of the canes.

### 411. DEWBERRY; LOW RUNNING BLACKBERRY

RUBUS PROCUMBENS Muhl.

Common in sandy places, along the railroad, in old fields, etc. The flower buds showed well along the railroad May 10, 1901, and by May 19 it was fully in flower. In this vicinity it usually yields rather sparingly but in 1909 there was an immense crop in one of Green's fallow fields. With a good market, this should prove a profitable crop in some of the sandy fields. The leaves assume

beautiful coloration in autumn, and were very attractive from September 27 to October 11 and on.

### 412. RUNNING SWAMP BLACKBERRY

RUBUS HISPIDUS L.

Rather common in low marshy places, especially among sphagnum. Found on the edge of Lost Lake marsh and on the west side of Lost Lake outlet. The shining glossy leaves make this the most attractive in foliage of the dewberries, but the fruit which is borne quite sparingly is small and sour and altogether worthless.

### 413. SWAMP ROSE; WILD ROSE

ROSA CAROLINA L.

Common at the edges of swamps; found in the tangle at Long Point, along the edge of the pond below Farrar's and in swamps in Walley's woods. In flower at Long Point June 28, 1901. The flowers of this rose are not particularly handsome; the stems are very erect and stiff. It comes nearer being a rose-tree than any other species and might form an excellent stock upon which to graft attractive varieties to produce standard forms.

### 414. LOW OR PASTURE ROSE

ROSA VIRGINIANA Mill.

Rather common on railroad embankments; abundant on the bank near the icehouse, by McSheehy's pier and on the railroad embankment between the icehouses and Culver. Leafing out, April 29, 1901. In flower, June 10. Like the common blue violet it has a second blossoming period in autumn. Some were observed in flower September 28, 1900. The bushes along the railroad bore an abundance of very large, flattish hips like miniature apples, and these, ripening with one bright pink cheek, were almost as handsome as the blossoms.

### 415. SWEETBRIER

ROSA RUBIGINOSA L.

Not common; one clump found by the Long Point road a little north of Green's field and another clump in a pasture, close to Lost Lake outlet, some distance down across the road from Walley's.

Not especially common in northern Indiana; rather common in the south. The seed is distributed by birds. In spite of its exceeding thorniness, the most delightful of roses, the whole plant, especially on moist days, exhaling a delicate fragrance, which announces its presence for several rods.

## Family 76. Malaceæ. Apple Family

### 416. AMERICAN CRAB APPLE

**MALUS GLAUCESCENS Rehder**

Rather common on high ground south of the lake and a tree or two north of the lake. Nearly past flowering May 22, 1901. Fruit ripe, rich yellow, October 25.

Well known for the beauty and fragrance of its flowers. In some locations the fruit remains a dull green when ripe, in others a dull yellow. Trees in the Botanic Garden at Washington bore fruit almost twice as large as those at Lake Maxinkuckee which may be due to cultivation; however, different trees vary considerably in size of fruit, though they seem to possess the same flavor. In spite of their sourness cattle seem to be fond of them, and a cow was once seen under a wild crab tree eagerly nosing out and picking up the apples.

### 417. APPLE

**MALUS MALUS (L.) Britton**

Several wild apple trees are scattered about the lake; one by the icehouses, two between Murray's and Farrar's, and some on the east side. Some trees at the head of a gully in woods on the east side bore a pleasant but rather acid fruit.

### 418. RED CHOKEBERRY

**ARONIA ARBUTIFOLIA (L.) Ell.**

Collected in a swamp near the lake May 16, 1901. Apparently rare; this is the only record, and the fruit has not been noticed.

### 419. BLACK CHOKEBERRY

**ARONIA MELANOCARPA (Michx.) Britton**

Rather common in sphagnous bogs, near the birch swamp, and in Hawk's marsh. In flower May 13, 1901. It usually bears fair crops of fruit which resemble small black juneberries but are too astringent to eat. At Bass Lake, August 14, 1906, bushes hanging over the edges of the lake were almost broken down with an abundance of large fruit.

Inasmuch as this bush is quite closely related to the apple, it might be worth while to graft the apple on to it to see if it would unite and form dwarf fruit trees.

### 420. JUNE-BERRY; SERVICE-BERRY

AMELANCHIER CANADENSIS (L.) Medic.

A few trees on the bluff by Overmyer's field south of the lake, a few on the depot grounds, and several on the bank northeast of the lake near where the road comes down to the lake. In full blossom April 30, 1901.

Where it grows in woodlands this tree grows tall and slender, but in the open it branches out broadly. A tree with its racemes of long-petalled flowers is exceedingly handsome in blossom, looking like a great mass of snow in the distance. The flowering season is short, and is followed in due time by a crop of bluish red berries, of a tartish, delicious flavor when ripe, and eagerly sought after by birds. The species is well worthy of cultivation both for flowers and to attract the birds. The fruit is excellent eating but hard to get at on account of the limberness of the twigs.

### 421. SHINING THORN

CRATAEGUS NITIDA (Engelm.) Sargent

A tree thought to be this species grew on the shore of the lake near the depot grounds. The fruit was glaucous and persisted until winter. The flesh, as well as the skin, of the fruit of this tree was deep scarlet, and the flavor inferior.

### 422. RED HAW; SCARLET THORN

CRATAEGUS COCCINEA L.

Not abundant; a few trees north of the lake, also south of the lake between Murray's and Farrar's; one or two on the depot grounds. The fruit is sometimes pretty fair eating, but is likely to be wormy. It is said to make quite good jelly when procured free from "worms" or insect larvæ. In blossom about the middle of May.

### 423. RED-FRUITED OR DOWNY THORN

CRATAEGUS MOLLIS (T. & G.) Scheele

Scattered about the lake; one tree on the east side not far from shore, and several by a swamp north of Busart's field south of the lake.

It is perhaps chiefly this haw that one finds in pastures in various parts of the country, the young trees being trimmed into symmetrical shapes by grazing cattle. Little haw trees thus trimmed are familiar to every traveler throughout the regions where these haws abound and pastures are frequent. In but few

places is the pruning carried out to such perfection as near Plymouth, Indiana.

There the citizens had their own delightful wild park, between the millrace and the river, below the most charming and picturesque dam, and above the picturesque old water mill and by the big fountain.

Across the millrace, on the townward side, the cows kept their formal garden—a smooth green velvety lawn billowy with the undulations of the ground, a patriarchal old hawtree in the midst and around about, scattered over the whole pasture, the numerous progeny of younger trees.

The hand of no gardener ever clipped box or privet with more primness or precision than the cattle had trimmed some of the trees; here was a perfect pyramid, clipped to a sharp point, the repeatedly trimmed branches so dense they could hardly be separated by the hand, all covered with new rosy leaves; there was a perfectly rounded dome, and yonder a clump of three or four forming an irregular but well trimmed group. One tree, trimmed into a perfect pyramid or rather cone, had escaped from the cattle at the very tip and formed a tall slender sapling with the skirt about its base. A row of young haw trees with a few cattle on each side would soon form a pretty perfect hedge without any trimming by hands. It was very likely from the work of browsing cattle that men first got their ideas of trimmed trees, and the haw was our first hedge tree.

So dense do these cow-trimmed trees grow that we have been informed that one was observed in New York which bees had been using for a hive, having built the thick tangle full of comb and honey.

## Family 77. Amygdalaceæ. Peach Family

### 424. WILD RED PLUM

PRUNUS AMERICANA Marsh.

Not especially common; one tree south of the lake, a tree east of Lakeview hotel, and a number northeast of the lake on hillsides and gullies. In flower May 3, 1901. The fruit here is of little value, being small in size and infested by the curculio.

### 425. CHOKE CHERRY

PADUS NANA (Du Roi) Roemer

Not common; a few low bushes on the bluff at the lake shore by Murray's. It attained a height only of three or four feet. Leafing

out March 31, 1901. In flower May 16. The fruit, which is often large and red, and quite handsome, is too astringent to be eaten.

### 426. WILD BLACK CHERRY

PADUS VIRGINIANA (L.) Mill.

Large trees are rare; small trees fairly common. One tree on Long Point hill, a large tree by the Maxinkuckee road, a rather large tree beyond Murray's, some along the shore west of the depot, a small tree by McSheehy's pier, and scattered trees in various other places. Buds began to show green April 23, 1901, and by April 30 the trees showed green some distance away. April 27 in flower. On account of its value as a lumber tree, large trees have nearly all disappeared. The wild cherry is usually disfigured by nests of the web worm, and in some parts of the state by black knot.

### 427. PEACH

AMYGDALUS PERSICA L.

Seedling peach trees were occasional through copses; a tree grew in the edge of the woods between Murray's and Farrar's which had a fine crop. Some trees along shore back of Van Schoiack's had small fruit but of excellent flavor.

## FAMILY 78. CÆSALPINIACEÆ. SENNA FAMILY

### 428. RED-BUD; AMERICAN JUDAS-TREE

CERCIS CANADENSIS L.

Not common; a few trees east of the lake back of the Edwards cottage.

A handsome tree when in flower, and worthy of cultivation for ornament. Some wild trees seen which bore reddish pods so that they were ornamental in fruit as well as in flower. There has recently appeared in cultivation a white-flowered form.

### 429. WILD OR AMERICAN SENNA

CASSIA MARILANDICA L.

Occasional, scattered; a few plants found at Long Point in 1900. There is a good patch along the street in Culver near Ferrier's lumber yard. Flowers rather homely; the numerous scythe-shaped pods are often rather striking after the leaves have fallen.

### 430. SENSITIVE PEA

CHAMAECRISTA NICTITANS (L.) Moench

Rare; a few plants collected along shore near the Farrar cottage in 1900.

### 431. PARTRIDGE PEA; LARGE-FLOWERED SENSITIVE PEA

CHAMAECRISTA FASCICULATA (Michx.) Greene

A few plants were noted near Murray's in 1900, a few of the later flowers still persisting on September 24. Of recent years it has increased greatly in abundance, but all at one place, the Gravel-pit, and north of it, where it makes large dense patches in the barren gravel. When in bloom, these patches are quite showy. In some places in the country, especially in dry sandy soils, the plant is so abundant as to make whole stretches of landscape an unbroken yellow. The Lake Maxinkuckee plants have stout pubescent stems and appear to belong to the subspecies *robusta* Pollard, which is listed as a southern form.

The leaves, though said to be sensitive, are rather feebly so. There is a peculiar black gland on the base of each leaf-stock. What the function of this gland is it would be difficult to say. Ants have been observed to go regularly from one to another, obtaining food. Whether they are kept from molesting the flowers by procuring food lower down at the leaf-stalks has not been determined.

### 432. KENTUCKY COFFEE-TREE; COFFEE-NUT

GYMNOCLADUS DIOICA (L.) Koch

Scattered in woodlands east of the lake; one tree near the lake a little north of the Maxinkuckee road. A little distance up the Maxinkuckee road is the stump of a very large tree, perhaps two feet in diameter. It is usually a very tall slender tree of too small a diameter to be of value for lumber. The heart wood is a pleasing color of brown. Found in flower on the east side of the lake June 5, 1901. The flowers are inconspicuous on account of their greenish color, but are remarkably fragrant, and the long corolla tubes are usually split open by bumblebees or other insects which visit them. Northeast of the lake some trees were found January 3, 1905, with a remarkably heavy crop of fruit. The coffee-nut tree is usually found within the flood-basin of creeks or rivers. Both the green pulp surrounding the seeds and the yellow kernel of the seeds are reputed to be poisonous.

## FAMILY 79. FABACEÆ. PEA FAMILY

### 433. LARGE WHITE WILD INDIGO

BAPTISIA LEUCANTHA T. & G.

Scattered, in dry sandy places. Found by Lakeview Hotel, and rather common in Green's woods by Lost Lake. In flower in

Green's woods June 19, 1901. The plant turns black after frost and the foliage falls, leaving the naked branch surmounted by the raceme of large conspicuous pods.

### 434. WILD LUPINE

LUPINUS PERENNIS L.

Common in the Culver cemetery where it was noted in blossom May 18, 1901; also scattered in woods near a tamarack marsh near the dune region. In many parts of the state it is found principally along railroads.

### 435. BLACK OR HOP MEDIC

MEDICAGO LUPULINA L.

Rather rare, and apparently of recent introduction; a few scattered plants found along the north shore of the lake and in grass on the depot grounds. Frequent in the state along roadsides.

### 436. WHITE SWEET-CLOVER

MELILOTUS ALBA Desv.

Not so abundantly introduced as in many parts of the state; at present found in rather small patches along the railroad on a hill near the depot, on Long Point, and on a roadside east of the lake. It is one of the earliest plants to put forth green leaves in spring. In blossom by June 26, 1901. It frequently continues to blossom after pretty severe frosts, and was still in blossom October 25, 1904.

In most parts of the state this plant is found only in waste places and along roadsides. It first appears in or about cities, from which it travels outward along highways and as one goes out farther and farther into the country the roadside patches break up and disappear. Although it gives the places where it grows an unkempt appearance, it does not appear to invade cultivated fields and gives no indication that it will ever become a bad weed. It grows with surprising luxuriance on dry sandy or gravelly soils where few other plants will grow at all. Stock of any kind will not touch it except in exceptional instances, although it is said they will eat the hay. It makes good bee pasture, and it is said to inoculate the ground so that alfalfa will thrive where it has grown. Seed is sold by some seedsmen under the name of Bokhara or bee clover. It is of considerable value in adding humus to poor soils and it appears to be one of the few European weeds whose introduction is not to be regretted.

### 437. YELLOW SWEET-CLOVER

MELILOTUS OFFICINALIS (L.) Lam.

A few plants in waste places about Culver. Not nearly so robust a plant as the other species. It preceded the white sweet clover a number of years in its introduction into this country, and was well known in waste places about cities long before the other species was ever heard of. It never succeeded in spreading far into the country and is now rather scarce even in cities, it having apparently been largely supplanted or crowded out by its more robust relative and rival.

### 438. RABBIT-FOOT CLOVER

TRIFOLIUM ARVENSE L.

Not particularly common; only a few plants seen. Found in dry sandy places and old wornout sandy fields. It seems actually to prefer barren wornout rocky places and the more eminently desolate the place may be as to other plants, the better the rabbit's foot clover thrives. The elongate woolly pink blossoms are among the prettiest to be found among the clovers.

May 25, 1901, in flower by Arlington; October 25, 1906, finely in blossom in the Assembly grounds; November 6, 1904, nearly ripe, at the edge of Green's marsh.

### 439. RED CLOVER

TRIFOLIUM PRATENSE L.

Common everywhere in open places along highways, a few plants scattered along the lake shore. In flower from May 23 until into November.

### 440. ALSIKE; ALSATIAN CLOVER

TRIFOLIUM HYBRIDUM L.

Somewhat common along roadsides and a few plants on the lake shore near Farrar's. This clover will thrive in black loamy soils where the red clover freezes out. It, mixed with timothy, is becoming a favorite hay crop in some parts of the state. Noted in bloom first blossoms about June 11, abundant in flower June 17. It should make a good honey plant, flowers exceedingly fragrant, the odor being soft and bland when compared with that of the white clover, which is somewhat spicy.

### 441. WHITE CLOVER

TRIFOLIUM REPENS L.

Rather common, but not covering large areas as in many places in the state. Unlike many of the other legumes, it does not reach its best development in sandy soil. Where pastured off, it continues blossoming all summer, especially in wet years, and forms a long period of bee-pasture. At the lake it was noted in flower from May 23 until November 9.

### 442. LEAD-PLANT; SHOESTRINGS

AMORPHA CANESCENS Pursh

Not abundant; a few plants south of the Bardsley cottage, on the east bank of Lost Lake.

### 443. CAT-GUT; GOAT'S RUE

CRACCA VIRGINIANA L.

Abundant in a sterile sandy field west of the ice-houses; a few plants scattered on the east bank of Lost Lake below the Bardsley cottage. In flower about the middle of June. The unusual combination of yellow and purple in the blossom makes this a striking and handsome flower.

### 444. LOCUST-TREE; BLACK LOCUST

ROBINIA PSEUDO-ACACIA L.

Common along a crossroad or by-lane near Culver, also by the Chandler cottage on the southeast side of the lake. It is not native about the lake; the trees found were either planted trees or seedlings of such.

Said to be durable in contact with soil, and frequently planted in some parts of the country for fence-posts or railroad ties. A favorite dooryard tree in many places, noteworthy for the fragrance of its attractive white blossoms. The roots bear large tubercles. It sprouts badly from horizontal roots. In the south some shoots were seen which were either diseased or bud variations, all the leaves being dwarfed to a minute size.

### 445. CAROLINA MILK VETCH

ASTRAGALUS CAROLINIANUS L.

Scattered in dry ground along the border of the lake; not particularly abundant; noted along the road by Long Point north of

Green's marsh, on the beach east of the Inlet, near Norris's, and considerable on the hill on the east shore of the lake, especially the northern half of the shore. It was out well in leaf May 12, 1901, and in flower by June 18. The leaves bear cold remarkably well. They were bright and green as late as November 22 and probably remain green in protected places all winter. The pods are conspicuous during the winter months.

### 446. NAKED-FLOWERED TICK-TREFOIL

**MEIBOMIA NUDIFLORA (L.) Kuntze**

Common; scattered through dry woodlands; some seen in the drier portions of Farrar's woods. The plant, when barren, closely resembles that of the hog-peanut. On account of the sparseness of fruit, this is not so much of a nuisance as most of the tick-trefoils.

### 447. POINTED-LEAVED TICK-TREFOIL

**MEIBOMIA GRANDIFLORA (Walt.) Kuntze**

Common in woods and thickets and by the spring in Overmyer's woods.

### 448. ROUND-LEAVED TICK-TREFOIL; PROSTRATE TICK-TREFOIL

**MEIBOMIA MICHAUXII Vail**

Scattered in shaded woodlands; noted at the edge of Green's woods near Lost Lake, and along the road through Farrar's woods. Easily recognized by its prostrate habit and large circular leaves. On account of its habit its burrs do not frequently have opportunity to catch in clothing as do those of the higher growing sorts.

### 449. SESSILE-LEAVED TICK-TREFOIL

**MEIBOMIA SESSILIFOLIA (Torr.) Kuntze**

Occasional at the edges of woodlands.

### 450. LARGE-BRACTED TICK-TREFOIL

**MEIBOMIA BRACTEOSA (Michx.) Kuntze**

Occasional in thickets; one of the tallest species of the genus, the fruit forming a troublesome sticktight. Not abundant enough, however, to be much of a nuisance.

### 451. PANICLED TICK-TREFOIL

**MEIBOMIA PANICULATA (L.) Kuntze**

Occasional at the edge of thickets.

452. ILLINOIS TICK-TREFOIL

**MEIBOMIA ILLINOENSIS** (A. Gray) Kuntze

Occasional in open places.

453. SHOWY TICK-TREFOIL; CANADIAN TICK-TREFOIL

**MEIBOMIA CANADENSIS** (L.) Kuntze

Common along the railroad between the lakes, especially on the west bank, and along railroad cuts. When in full bloom the abundant large red-purple blossoms make this the most handsome species of the genus; the flowering season is short, however. The blossoms turn indigo blue and drop off in a few days, to be followed by the rapidly growing loments or saw-like pods, which attach themselves so readily when ripe to woollen clothing.

454. SMOOTH SMALL-LEAVED TICK-TREFOIL

**MEIBOMIA MARYLANDICA** (L.) Kuntze

Occasional, scattered at the edges of open woodlands and in copses.

455. BUSH-CLOVER

**LESPEDEZA VIOLACEA** (L.) Pers.

Common in open places, along the shore west of the lake in dry ground; also by Lakeview Hotel. The bush-clovers bear a general resemblance to the tick-trefoils, but lack the disagreeable burrs of that genus. In the south, some of the tall species, probably including this, completely cover the ground in places, and are cut for hay. Indeed, one of the most important pasture plants of the south is a small plant, *L. striata* (Thunb.), the Japanese clover, belonging to this genus.

456. SLENDER BUSH-CLOVER

**LESPEDEZA VIRGINICA** (L.) Britton

Occasional in dry places. Similar to the preceding.

457. HAIRY BUSH-CLOVER

**LESPEDEZA HIRTA** (L.) Hornem.

Occasional in dry places.

458. ROUND-HEADED BUSH-CLOVER

**LESPEDEZA CAPITATA** Michx.

Very common in dry soil in open grassy places; noted along the lake south of Green's and in Green's woods near Lost Lake; a large

patch on the hill south of the ice-houses and near the road leading up to Culver. A peculiarity about this patch was that while some of the plants looked green from a distance, a large number were whitish, and from a distance appeared as if mildewed. This mildewed appearance, however, was due to the plants being clothed with dense white silky hairs.

### 459. VEINY PEA

LATHYRUS VENOSUS Muhl.

One small patch near Walley's birch swamp, on the east side of the railroad in a flat, marshy stretch of sand. In flower May 23 to June 12. Flowers quite attractive. The plants are quite leafy and make a good growth after being cut. It is possible they would make a good hay crop.

### 460. MARSH VETCHLING

LATHYRUS PALUSTRIS L.

A few plants scattered among grasses and sedges in the north end of Green's marsh. Noted in blossom June 5, 1901. The purple flowers are attractive. In low places where it is common this plant is the most valuable ingredient in prairie or marsh hay.

### 461. GROUND-NUT; "WILD POTATO"

GLYCINE APIOS L.

Rather common in low rich black ground along the bank of the lake; noted at Long Point by McSheehy's pier and in low woods by Overmyer's. Abundant near the railroad at the Outlet; here it bore great racemes of its fragrant brownish purple flowers.

This plant is known as "wild potato" in some parts of the state, because of its tubers which somewhat resemble small potatoes, but are borne differently, being simple swellings of the rootstock, the "potatoes" being borne in rows like the beads of a rosary or necklace. In most parts of the state where they have been examined the tubers reached fair size but the blossoms usually dropped off without perfecting any fruit. In a marsh near Washington, D. C., the tubers were very small but the pods, full of beans, were abundant. The plant is said to furnish good food for pigs. Some of the tubers were boiled and experimented with as an article of diet. The majority of persons who tried them did not relish them, though one might go farther and fare worse. On account of the food stored up within the tubers the plants come up early in

spring and grow pretty rapidly. Coming up well along the railroad May 12. Blossoms from July till frost. Where it will thrive this plant is well worthy of cultivation for ornament, and is sold by some seedmen as the "tuberous rooted wistaria."

### 462. HOG PEA-NUT; WILD PEA-NUT

FALCATA COMOSA (L.) Kuntze

Rather common in places; a large patch among the willows down in the Inlet region near the green boathouse; common along the south side of the road near Outlet Bay, and on the bank of the lake near the Palmer House.

This is a tall, slender twining vine with thin leaves and purple blossoms, thriving best in rich black loam. It is an interesting plant, bearing several kinds of blossoms. The upper blossoms, which are rather pretty, give rise to thin pods resembling miniature pea-pods and bearing small bean-like seeds which are prettily lined and mottled with bluish purple. Underground are borne flowers that never open, but which produce a brown hairy one-seeded pod hardly as large as a cultivated pea. In hard ground these underground pods form irregularly, rather resembling a miniature potato in shape; but in looser ground they are regular in shape, being round in outline and slightly flattened laterally, that is, thick lens-shaped. The seed, on being removed from this thin pod, resembles a pea in shape. A cup-full of them thus shelled has an attractive appearance, all of them being marked on the thin skin by longitudinal stripings and mottlings which may be either pink or purple. These peanuts have somewhat the same taste as the raw cultivated peanuts. They were tried cooked, both roasted and boiled, and although edible, and perhaps acceptable in times of unusual hunger or need, formed a rather indifferent dish. They lack the oiliness of the real peanut. A hog-peanut patch in the rich black soil along the railroad by Plymouth, Indiana, and one near Fort Wayne, bore considerable of underground fruit, and a fair quantity could be obtained in a short time. It takes the whole summer to produce the crop; the peanuts germinating in the spring and the fruit setting on rather late in the summer. The underground fruit quickly dries, and will probably not germinate if taken out of the ground and kept in a dry place. Unlike the aerial pea it needs no resting period, but if planted in a warm place will germinate and grow at once. Some were dug in the fall of 1909, placed in a can of moist earth and taken to Washington. It was found that they had germinated in transit, they were therefore planted in pots and placed in

a window. They grew rapidly and about Christmas began bearing blossoms; all the blossoms, though borne above ground, were cleistogamous; they resembled the mature fruit from the first and simply increased in size until they ripened in early spring. It is probable that plants from the underground fruits have a tendency to produce cleistogamous flowers, and that by cultivation and selection from seeds of the same plant, one could soon develop two strains, one bearing nearly all its fruit under ground and the other bearing it all overground.

The little beans, produced by the aerial flowers, did not germinate until spring and formed very delicate spindling plants.

In the autumn of 1909 both the aerial and underground seeds were planted in open ground in a backyard lot at Fort Wayne. Both germinated about May 10; those from the underground nuts being large robust plants, those from the aerial peas being so small and inconspicuous as to be easily overlooked.

The tops of the hog-peanut are eagerly eaten by cattle and would probably make good hay where obtainable in quantity. The roots of the hog-peanut abound in tubercles and it would undoubtedly be a good plant to add nitrogen to the soil.

It would be interesting to experiment with the hog-peanut in cultivation. It would be well to try some of the sorts or strains bearing an abundance of underground fruit, in connection with the Jerusalem artichoke. The hog-peanut vines, with the artichoke tops, would produce an abundance of hay, the peanut plants would add nitrogen to the growing artichoke crop and artichokes and hog-peanuts together would furnish an abundant and varied ration to hogs.

### 463. TRAILING WILD BEAN

**STROPHOSTYLES HELVOLA (L.) Britton**

When the investigation of the lake first began, this plant was not common in the region; there was one clump on a hill along the railroad and one in front of the Assembly grounds. It was probably a recent arrival at the lake. Since then it has spread rapidly but with the exception of a few plants near Chadwick's pier, which did not persist, it has confined its spread to the region along the railroad. It is now common by Arlington and farther south. A very fine patch of plants was established in 1909 on the railroad embankment at Plymouth.

The wild bean has very attractive pea-like blossoms, the color pale pink with the narrow standard deep purple and giving a pe-

culiar effect. The flowers are borne on long stiff stems, usually two on a stem blossoming at a time, finally followed by more, and making exceedingly pretty cut flowers. They last only a day and before the petals drop they assume a creamy white appearance; they are followed by a long bean pod which develops rapidly and in general appearance resembles a garden bean. The pods are rather tough and have a slightly bitterish taste; they would probably not be edible cooked as snaps. It is said, however, that the Indians ate the beans, which are cylindrical, truncate at each end, and woolly.

The wild bean appears to reach its best development in a well drained sandy clay.

A single vine at Plymouth made such a remarkably dense and extensive covering for the ground, which was by no means good soil, being a railroad embankment, mostly gravel, that the question occurred whether it might not be valuable as a hay plant. Some was offered to a cow who ate it greedily. The plant would yield an immense amount of feed per acre if it grew as it did there, and was as well relished. The particular plants seen were growing in sunlight and it appears to grow best in the open. Along the rich black bottom lands of the central Mississippi it grows in great abundance. It is there called "Gopher-vine", but the same name is applied to the wild sweet potato (*Ipomoea pandurata*). In the barren sand dunes south of Kiethsburg, Illinois, where nothing else will grow, the wild bean vine thrives, not producing a great amount of plant but bearing a good crop of seeds. In Tennessee, along the Cumberland, its distribution was peculiar. It was found only at the sites of old Indian camps or burying places, and near the places where they had their clam bakes; this suggests that its presence there may be due to seeds left by them.

Apparently in some cases the seeds germinate the same year thy ripen. In late September, 1913, seedlings just germinated were observed in the gravel bed of the railroad near Arlington.

The seed of the wild bean requires a resting period before germinating. Some planted in a pot and kept under growing conditions did not germinate until spring, and then they made a very rapid growth. The germination is like that of the garden bean, the cotyledons coming out of the ground, the plumule-leaves simple and opposite, the later leaves alternate and trifoliate. The roots of the wild bean bear large nodules about the size of peas, and it would undoubtedly prove valuable as a nitrogen gatherer.

464. PINK WILD BEAN

STROPHOSTYLES UMBELLATA (Muhl.) Britton

Occasional, scattered along the railroad, considerably resembling the preceding, but with shorter pods and smaller seeds; flowers much the same.

465. SMALL WILD BEAN

STROPHOSTYLES PAUCIFLORA (Benth.) S. Wats.

Rather common along the railroad a mile or so south of the lake. Rather more bushy than trailing, the flowers and pods smaller than those of the preceding species; seeds smooth and shining.

## Family 80. Geraniaceæ. Geranium Family

466. WILD GERANIUM; WILD CRANE'S-BILL

GERANIUM MACULATUM L.

Fairly common, but not so abundant as formerly; once common throughout the state, but becoming scarce in many localities on account of woodlands being pastured. It grows in shaded situations. In flower at Long Point May 6. One of the most attractive of our native wild flowers. In some places known as "pucker-root" on account of the astringency of its rootstocks. It has considerable repute among herb doctors as a medicine.

467. CAROLINA GERANIUM OR CRANE'S-BILL

GERANIUM CAROLINIANUM L.

Abundant in open sandy places, especially in old fields. Especially abundant in Green's field adjoining Lost Lake outlet; common along the railroad. The seeds germinate in the fall; they were noted coming up October 26, and grew quite rapidly for awhile. In flower May 19, 1901. The flowers are rather small and inconspicuous, and are much outdone in attractiveness by the bright orange-red of the autumn leaves, which remain through the winter and into spring. The plants ripen and are dead by the end of June.

## Family 81. Oxalidaceæ. Wood-sorrel Family

468. YELLOW WOOD-SORREL; SHEEP-SORREL

XANTHOXALIS STRICTA (L.) Small

Common in open dry places. Begins blossoming in April and continues until after frosts.

469. YELLOW PROCUMBENT WOOD-SORREL

XANTHOXALIS CORNICULATA (L.) Small

An introduced plant, not common. A few plants were found near Arlington Hotel in 1900; these were quite dwarfed, and had the appearance of being natives. In the grass about the edge of the flowerbeds of the depot grounds is a form with deep purple leaves. These were first noted in 1906 and were probably imported accidentally with other plants from the railroad company's gardens at Sewickley, Pa.

The violet wood-sorrel was found along the Tippecanoe River by Delong, but was not found in the immediate vicinity of the lake.

## Family 82. Linaceæ. Flax Family

470. FLAX; LINSEED

LINUM USITATISSIMUM L.

Occasional along the railroad. It is not cultivated in this region, and now only rather rarely within the state.

## Family 83. Balsaminaceæ. Jewel-weed Family

471. SPOTTED OR WILD TOUCH-ME-NOT

IMPATIENS BIFLORA Walt.

One of the most common members of the flora back of the beach from Long Point nearly to Norris Inlet. In rich grounds the immense orbicular cotyledons, pale green in color, are one of the first things to attract attention after the beginning of spring germination.

472. PALE TOUCH-ME-NOT

IMPATIENS PALLIDA Nutt.

In more shady situations, and not so common as the other. Flowers more gibbous and larger.

## Family 84. Limnanthaceæ. False Mermaid Family

473. FALSE MERMAID

FLOERKEA PROSERPINACOIDES Willd.

Somewhat common in woods northeast of the lake, in black ground along streamlets. In blossom April 30. A slender inconspicuous plant found growing in patches.

## Family 85. Rutaceæ. Rue Family

### 474. PRICKLY ASH

ZANTHOXYLUM AMERICANUM Mill.

Not common; a small thicket south of the lake in Farrar's woods.

### 475. HOP-TREE; THREE-LEAVED HOP-TREE

PTELEA TRIFOLIATA L.

Not common; a few plants noted down the outlet of Lost Lake, not a great way above the Tippecanoe River, and some by a woodland swamp near Busart's field. Common at Plymouth where it is infested by a very peculiar-looking leaf-hopper which lays its eggs on the petiole of the leaves. Seed with a peculiar fragrance. The flat disk-like fruit, papery in texture, remains on the bush nearly all winter, giving the bush a peculiar attractiveness when nearly everything else is barren.

## Family 86. Simaroubaceæ. Ailanthus Family

### 476. TREE-OF-HEAVEN

AILANTHUS GLANDULOSA Desf.

Several young trees along the road on the east side of the lake. Quite persistent where planted, sending up shoots from the roots and spreading widely by seed. Some of the trees which have scarlet samaras are quite ornamental in fruit. The winged twisted seed acts like a boomerang and on being flipped away partly or wholly returns.

## Family 87. Polygalaceæ. Milkwort Family

### 477. CROSS-LEAVED OR MARSH MILKWORT

POLYGALA CRUCIATA L.

Not common; found in the marsh east of Lost Lake, back of Green's field.

### 478. WHORLED MILKWORT

POLYGALA VERTICILLATA L.

Rare; found in dry ground, in open places.

### 479. FIELD OR PURPLE MILKWORT

POLYGALA VIRIDESCENS L.

Rather common in moist sandy soil southwest of the lake, along the railroad in the vicinity of the birch swamp. Noted in flower from July 21 till September 29, the handsome head of flowers re-

minding one of a globe amaranth in shape, except that it is somewhat longer and narrower.

### 480. RACEMED MILKWORT

**POLYGALA POLYGAMA Walt.**

Rather common, but local in distribution. In flower on the hill near the south end of Lost Lake June 22, 1901. Noteworthy for the abundance of its odd cleistogamous flowers which are borne on horizontal underground branches, resembling roots. Aerial blossoms attractive.

## Family 88. Euphorbiaceæ. Spurge Family

### 481. VIRGINIA THREE-SEEDED MERCURY

**ACALYPHA VIRGINICA L.**

Common everywhere about the lake, scattered through woods and thickets and occasionally open places, frequent on the beach. A homely, weedish-looking plant, but never a nuisance as it is easily killed by cultivation. The bracts subtending the blossoms often turn bright pink in autumn and remain so into the winter, when they are quite attractive.

### 482. HAIRY SPREADING SPURGE

**CHAMAESYCE HUMISTRATA (Engelm.) Small**

Not rare; found at the end of Long Point and near the depot along shore.

### 483. MILK PURSLANE; SPOTTED OR BLOTCHED SPURGE

**CHAMAESYCE MACULATA (L.) Small**

Along the outlet and on the railroad embankment. This, and other of the spurges, which resemble it, are reputed to cure warts; the manner of applying the remedy is simply to allow the broken stem to touch the wart, and cover it with the milky secretion.

### 484. LARGE OR UPRIGHT SPOTTED SPURGE

**CHAMAESYCE PRESLII (Guss.) Arthur**

Excepting perhaps *T. corollata*, the most common species about the lake; common on dry embankments; found in front of the Scovell cottage, on a hill in the Assembly grounds, on the flat beach east of Lakeview Hotel, on the beach in front of the Palmer House, and on a hillside north of the lake. Occasional on the railroad embankment.

### 485. BLOOMING OR FLOWERING SPURGE

TITHYMALOPSIS COROLLATA (L.) Kl. & Garcke

Quite common in open grassy places. It appears to be making considerable gains since the investigations of the lake first began. At first there were only a few plants along the railroad near Murray's. It is now scattered more or less everywhere in dry ground about the lake, though there are no dense patches, as there are in some parts of the state. Its straggly growth gives waysides, where it thrives, a somewhat unkempt appearance and occasionally, in sandy neglected fields, it takes the whole area. We saw a field near Bass Lake white with it. It is not to be dreaded as a weed, however, as it does not appear to be able to withstand competition with crops or to endure cultivation. The impression it gives improves considerably upon acquaintance. When first met, it looks like a weed; as acquaintance progresses it becomes more and more like a flower. It has a long flowering season—from April till October—and in autumn the leaves, especially the lower ones, turn a bright orange red, contrasting vividly with the green about them. One of the cottagers at the lake called attention to the marvelous variability of this form—in the denseness and arrangement of the flower clusters, the shape and size of the corolla-like appendages, etc. A green-flowered plant was found by the elevator in 1909. Increasingly interesting and attractive at all times as one's acquaintance with it progresses, it always shows best in the summer twilight when it looms up with peculiar ghostliness.

### 486. CYPRESS SPURGE

TITHYMALUS CYPARISSIAS (L.) Hill

A patch near the Culver cemetery, from which it had escaped. In blossom in May. Almost every cemetery of the country has a few patches of this plant, which soon becomes a nuisance, spreading through lawns and growing extensively from rootstocks. Although it becomes a nuisance in the immediate vicinity where it was planted it does not spread far. The flowers are odd, and the whole plant pretty. In autumn coloration it is simply unsurpassed, the colors of the leaves running from red to violet, changeable in various lights.

### 487. TOOTHED SPURGE

POINSETTIA DENTATA (Michx.) Small

This appears to have been a recent arrival at the lake; a few were noted along the railroad by the Gravelpit in 1909.

## Family 89. Anacardiaceæ. Sumac Family

### 488. DWARF BLACK OR MOUNTAIN SUMAC

RHUS COPALLINA L.

Occasional, in clumps in open places. One clump on Long Point, about a quarter of a mile from the tip of the point, and another along the road near Farrar's. One of the earliest shrubs to take on autumn coloration, the dark shining leaves becoming a rich cherry red, brighter than the other sumacs. The highest panicles are mostly staminate; the more perfect flowers are on the lower panicles.

### 489. STAGHORN SUMAC

RHUS HIRTA (L.) Sudw.

Common, in clumps in dry places. One clump by Overmyer's; more common on the east side of the lake; one clump at the corner of Culver's, along the road, another back in the edge of the woods, a third clump along the road on the east side. These latter are of unusual size, almost trees. The fruit bearing panicles retain the fruit several seasons, apparently until it actually weathers off from the parent plant. Some plants noted were defoliated by insects.

### 490. SMOOTH UPLAND OR SCARLET SUMAC

RHUS GLABRA L.

Occasional in clumps in hilly places, scattered all about the lake. A large clump by Overmyer's field, and along the road through the woods from that place, another patch on the lake shore between Green's and Murray's, and another north of the ice-houses. A handsome bush, one of the first shrubs of the season to assume autumn tints, the lower leaves often flaming red by August. The seeds are scattered by birds, and colonies often become established along fence-rows and ditches, where it spreads by root, and being difficult to eradicate, becomes a great nuisance.

### 491. GREENE'S SUMAC

RHUS ARBUSCULA Greene

A low dwarf form, somewhat resembling *Rhus glabra*, makes a small clump in Green's woods near Lost Lake, just below the Bardsley cottage, this being the type locality, the type and a cotype having been collected there in 1906. It is distinguished from *R. glabra* by its smaller size, fewer and smaller and thinner leaflets and smaller fruit. In the autumn of 1913 additional localities were

found for this species. A patch of staminate plants was found at the south end of Green's woods along Lost Lake north of the fence going down to the lake a little below its middle, another patch in woods at the north end of Lost Lake, another along the public road near the railroad crossing, and a fifth patch down by Overmyer's.

### 492. POISON SUMAC; SWAMP SUMAC

**TOXICODENDRON VERNIX (L.) Kuntze**

Common in sphagnous bogs; abundant in Hawk's marsh, some trees near the lake by Farrar's. Remarkable for its brilliant autumnal coloration in which the color of flames—orange and yellow —predominates. Very poisonous, more so than the poison ivy. The famous Japanese lacquer is obtained from a tree very like this, and is procured by making incisions in the bark. The varnished, pearl-gray berries, which hang down in loose bunches, are rather pretty.

### 493. POISON IVY; THREE-LEAVED IVY

**TOXICODENDRON RADICANS (L.) Kuntze**

Rather common in open places and at the edge of woodlands. Some in Farrar's woods, climbing trees, others growing in the edge of an old field near by, are stiff and erect, like bushes. The plants climbing trees put out long horizontal branches. The leaves are quite poisonous to the touch to some people, but after having been poisoned a number of times one apparently becomes immune. According to Hough, fluid extract of Grindelia is a certain remedy for ivy poisoning. The leaves turn flaming yellow in the fall. Various birds in their fall migrations often flock to the poison ivy vines for the berries; downy woodpeckers also eat them. On one occasion seeds of poison ivy were noted coming up thickly on May 26. The cotyledons are small, ovate-linear, the second leaf being characteristic and giving the clue to the species.

## Family 90. Ilicaceæ. Holly Family

### 494. WINTERBERRY; VIRGINIA WINTERBERRY; BLACK ALDER

**ILEX VERTICILLATA (L.) A. Gray**

Common, in patches in low wet grounds, as along the northwest shore of Lost Lake, in the swamp near the lake between Murray's and Farrar's; in Hawk's marsh, etc.; some remarkably fine plants grew in shallow water in a permanent pond along a road northeast of the lake. One of the best patches west of the lake is around a swamp in a field along the railroad a little above the birch swamp.

There is another fine patch near the lake-shore between Murray's and Farrar's. The berries begin to ripen in September and remain on the bushes all winter. They make a very handsome appearance after the leaves have fallen. The patch at the head of Lost Lake glowed in the distance as a patch of scarlet all winter and was very conspicuous a quarter of a mile away. Birds do not appear to relish the berries, at least until spring, when the cedar waxwings seem fond of them. Twigs with berries on them are often found at flower stores of larger cities. There was considerable variation noted in the size and distribution of the berries on these plants. The species is well worthy of cultivation if in its cultivated state it could approach the beauty it displays when wild. It blossoms about the middle of June, but the flowers are small and inconspicuous.

### 495. MOUNTAIN HOLLY; WILD HOLLY

NEMOPANTHUS MUCRONATA (L.) Trelease

Common in Hawk's marsh; going out of flower May 20, 1901. Fruit showy in August and September. When full of fruit this is a very attractive shrub.

## Family 91. Celastraceæ. Staff-tree Family

### 496. RUNNING STRAWBERRY BUSH

EUONYMUS OBOVATUS Nutt.

Not common; only a few plants seen, on the low ice-beach by Overmyer's. In flower May 31, 1901. The small blossoms are dingy and inconspicuous, but rather attractive. The rough coated fruit is very pretty but borne too sparsely to make much of a show.

### 497. BURNING BUSH; WAHOO

EUONYMUS ATROPURPUREUS Jacq.

Rare about the lake; rather common in the state in low rich bottoms. Usually a shrub with us; farther south it attains the dimensions of a small tree. Attractive when in fruit, but usually rather sparsely fruited. Often grubbed up by gatherers of medicinal plants.

### 498. SHRUBBY OR CLIMBING BITTERSWEET; WAXWORK

CELASTRUS SCANDENS L.

Common about the lake in high ground; at Long Point, at Wilson's on the east side, along shore by the depot grounds, by Over-

myer's field and by Busart's, etc. Our only native vine that frequently strangles trees to death. One occasionally finds various forest trees that have grown over the strangler forming a screw-shaped crease, and apparently strangling the vine. These vines rather rarely twist about each other forming vegetable ropes (a habit rather common with the Dutchman's pipe farther south). On the depot grounds is an umbrella-shaped trellis grown over by this vine, and this shows how admirably it can be used as an ornamental plant if used rightly. The leaves remain a bright green until most other leaves are gone, then they turn to a pale lemon yellow and drop.

## Family 92. Staphyleaceæ. Bladder-nut Family

### 499. AMERICAN BLADDER-NUT

STAPHYLEA TRIFOLIA L.

Not common; a few shrubs in woods near Busart's field, near a woodland pond. The bushes were tall and handsome. Well worthy of cultivation, especially in parks, more attractive than the European species one often finds in parks; the flowers are not so showy, but are more graceful, and are succeeded by the bladdery pods which remain well through the winter and give the plant an ornamental value when nearly everything else is barren. The hard, globose seeds which loosen from the pod easily after ripening make a very effective rattle. There is a good deal of variation in the shape and hue of the pods. They are sometimes elongate with three long apices, and sometimes short and globose. They are usually green, turning brown at maturity, but a bush near Plymouth had pink roundish bladders, and some in Tennessee had a black mixed in with pale green in such a manner as to give the appearance of high-lights and shadows, with a highly decorative effect.

## Family 93. Aceraceæ. Maple Family

### 500. SILVER MAPLE; WHITE OR SOFT MAPLE

ACER SACCHARINUM L.

Scattered in low places; on the depot grounds, in the swamp between Farrar's and Overmyer's. Most of the trees in the vicinity of the lake are of only small or moderate size; along the Tippecanoe River about four miles away, some of the trees are immense. One of the first of our plants to flower, running a close second to skunk cabbage and harbinger-of-spring; trees in the streets of large cities blossom earlier than those in forests, perhaps on account of

plenty of sun, and the protection of surrounding houses. They seem able to endure considerable cold after blossoming. Noted in blossom April 5, 1901, the seeds developing rapidly after fertilization, and ripe and falling by May 21. The period between flowering and fruiting is remarkably brief, almost as brief as in the case of the elm, so that only a small part of the plant's time is occupied by the reproductive period, the blossoming period is over and the fruit often well grown before the tree leafs out fully. The haste in maturing seed, as in the case of the elm, seems to be to get them on the ground before the high spring floods have subsided, for the seeds are disseminated as much by water as by wind, or rather much more so, for although they have a large well expanded wing, the embryo is heavy, and they are usually observed falling on calm days. The tree is very prolific and the seeds can be observed falling in great numbers. They drop almost directly to the ground, the whole fruit whirling rapidly at an angle about the heavier end, so that the appearance is much like a lot of butterflies falling. The embryo is prepared for rapid germination and growth, being large, heavy, and provided with chlorophyl and starch. These seedlings have a starchy, slightly bitterish taste, and though full of food material, nothing appears to eat them, perhaps because of the peculiar flavor. The seed-coat is very thin and fragile, almost like paper, and the seeds germinate very soon after reaching the ground. Along the high-water mark of ponds and rivers one often finds young silver maples by the millions, thick as they can be sown. They grow rapidly, forming straight, handsome little trees nine inches to a foot high by midsummer. Practically all these little trees die, and the characteristic growth along river banks is not chiefly maples or elms, as the springtime promises, but willows. In parks the fruits are often found gathered into bundles, the seeds buried in the ground, the wings projecting from the ground. The appearance presented suggests that fishworms have burrowed up under the seeds which have sunken into the burrow.

The silver maple is a favorite street and park tree on account of its rapid growth and handsome appearance. It is exceedingly variable in many respects, including especially leaf-form and general habit, and a glance down an avenue of these trees in winter will reveal different peculiarities in almost every tree. Some are fairly stiff and erect, and from this form we have different degrees of drooping habit until there are pretty well developed weeping forms. There are, again, all degrees of laciniation of leaf, and, as in the case of the Japanese maples, the cut-leaf usually accompanies

the weeping habit. There is an actual "cut-leaved" form (Wier's cut-leaved Maple) and it has a decidedly weeping habit. In some of these cut-leaved maples all the leaves are well laciniated, others approach the typical form.

Another peculiarity of habit of some trees is the tendency to have the leaves compactly crowded close to the main branches. This oddity had reached its perfection in a tree seen on an island of the Cumberland River a few miles above Nashville, the leaves all clustering so closely and compactly to the branches that the appearance of the tree was that of a lot of ropy festoons—much the effect that the tree might have presented if wholly dead, and covered densely over, the minutest branches and all, with a closely growing vine of ivy. Although this particular tree was surrounded and backed by other trees of the same species, so great was its contrast in form, that it could be distinguished from the growth about it as far as the eye could see it at all. Such an unique tree would be well worthy of an attempt to perpetuate if possible for use in parks; either standing by itself or in mass backed with the common form, it would produce a striking spectacle unlike that of any other tree.

The silver maple has not as beautiful autumnal coloration as the red and hard maples; sometimes the leaves turn red, sometimes pale yellow. In open places, the top leaves are shed first, leaving the lower boughs still leafy. The trees were shedding their leaves rapidly in the latter part of October.

It is not rare to find silver maples with leaves red or purplish red all summer. This color is characteristic of the young leaves when they first appear, and seems to be due to an abundance of cell-sap; its continuance through the summer appears to be due to a sort of prolonged youthfulness of the leaves, and is especially likely to happen in saturated or acid soils. In some cases it appears to be an individual peculiarity of certain trees, and one planted in the sandy soil near Long Point retained its brilliant foliage all summer. By paying especial attention to this peculiarity we could probably develop strains of silver maples with colored foliage and in due time accomplish with our arboreal maples as astonishing results as the Japanese have done with their shrubby species.

The sap of the silver maple has a much lower sugar content than the sugar maple, but the tree yields a much larger supply. It makes an excellent maple syrup or sugar.

In its use as a street or shade tree the silver maple is more admirable for its possibilities than for what has as yet been accom-

plished. The charm that first took men's eyes, of great masses upturning their leaves to the wind and forming rounded mass after mass like looming thunder heads, is one that cannot be reproduced on the narrow limits of a small estate. It is one of those fugitive charms of wild things which cannot be transplanted, and in the case of the silver maple most will be accomplished by paying attention to the individual tree, and by propagating especially choice forms. Along the streets of Defiance, Ohio, one tree was noted with the more or less festoony habit described above; another with exquisite pink color of the younger leaves, making all the branches pink-tipped.

Along various rivers—the Mississippi for example—the great crops of seeds falling on the water float to shore, where they are left by the receding waters. There they come up in thickly sown rows extending for miles. One can in a short time examine innumerable examples of seedlings and note the variations; the most common variation is for the young plant to have three seed leaves and its subsequent leaves arranged in whorls of three instead of opposite. There are indications that this habit has a tendency to right itself. It certainly does in some cases, and very likely the majority if not all secondary branches will be normal. Another, but rare, tendency is the production of splashed leaves; whether this is permanent remains to be seen; some such trees are now being reared.

A clump of the young seedlings at a favorable location near the water's edge was under daily observation during the spring of 1913. When the water rose, saturating the ground where they grew, the leaves changed to a purplish red, giving the mass of plants all the gayety and attractiveness of a posy bed. When the waters receded and the soil dried out the leaves returned more nearly to their normal green.

### 501. RED MAPLE; WATER MAPLE

ACER RUBRUM L.

Not so common as the preceding; most of the trees indeed are planted trees along the road back of the cottages at Long Point; a few trees found also on the east side. It usually blooms somewhat later than the preceding, and the flowers are a trifle more showy. In blossom April 11; seeds ripe May 23. The flowers offer a great attraction to bees, and the trees in blossom were humming like hives. The leaves turn brilliant red in autumn. They were in the height of their splendor about October 21.

At Lake-of-the-Woods, Marshall County, Indiana, an unique and beautiful tree of this species was noted. It was a small tree about five inches in diameter. The stem, after reaching a height of about fifteen feet, abruptly terminated in a number of slender weeping branches, quite or almost as markedly weeping as the weeping willow. The leaves were not laciniate, as is usual with weeping maples, but were of the usual form.

Near Cumberland Falls, Ky., some remarkably beautiful trees of this species were seen, the green leaves being brilliantly veined with red.

### 502. SUGAR MAPLE; SUGAR-TREE; HARD MAPLE

**ACER SACCHARUM Marsh.**

Rather common on hills and along gullies on the east side of the lake, but not abundant enough to make the manufacture of syrup a local industry; a few trees on the southwest side of the lake, near Overmyer's. The buds showed green by April 27. In flower April 30. The yellowish green blossoms on long drooping hairy pedicels, while not so striking in appearance as those of the red maple, have a peculiar grace and attractiveness. The seeds which ripen and drop in autumn (they were falling September 26 to October 7), lie over all winter and germinate in the spring. Seedlings were noted coming up April 3. The forest floor of a large woods near Maxinkuckee on the east side was almost carpeted with young sugar trees about two inches high in the autumn of 1904. The preceding year's crop of seed must have been unusual.

The autumn colors are gold, splashed and touched with red, making it one of the most attractive of our autumn trees, especially as the colors flame from distant hillsides.

### 503. BOX ELDER; ASH-LEAVED MAPLE

**ACER NEGUNDO L.**

It is not certain whether the box elder is native to the region immediately surrounding the lake, as most of the trees scattered about are rather young, and may have sprung from the seed of trees planted in the Military Academy grounds. There are a few trees, all of small size, along shore in front of Green's and some on the east side of the lake. This species is fairly common in some parts of the state in low ground along streams. It is frequently planted as a shade-tree in dooryards and parks and, where pistillate trees are planted, spreads rapidly by seed and soon becomes

established. In addition to the ordinary form, there is a variegated-leaved variety in cultivation.

The box elder has the peculiar habit of shedding the first-formed leaves early in the year, the leaves turning golden and often covering the ground about the base of the tree, making an autumn in springtime. The staminate trees can be distinguished from the pistillate even before they bloom, as the buds are single, long and pointed, while those of the pistillate trees are rounded and in bunches of three. Bees come in great numbers about the staminate trees, filling the air with a continuous hum, but appear wholly to neglect the pistillate trees. The tree yields a fair abundance of sweet sap which boils down to an excellent maple syrup or to a sugar, which unlike the sugar of the hard maple, is white instead of brown. As the box elder grows quite rapidly in good ground the establishment of a sugar camp by planting this species would be a matter of comparatively few years.

The seeds are borne in great profusion, and remain on the tree late in the winter or until spring, making the tree picturesque throughout the winter. The seedlings come up in May—very robust little trees—the first set of leaves single, so that the tree looks very much like the other maples at this stage.

## Family 94. Aesculaceæ. Buckeye Family

### 504. BUCKEYE

#### AESCULUS GLABRA Willd.

Not common about the lake; a few trees found on the east side by Vajen's. The earliest of our trees to leaf out in spring, the trees showing green when everything else is bare. By April 19, 1901, the leaf-buds had swelled and the leaves were nearly out, the trees showing a rich purplish green some distance away. April 27 the leaves out, and the flower-buds showing. May 3, in flower. September 26, 1906, fruit ripening.

As it is the earliest tree to leaf out in spring, so it is the earliest to assume autumn tints and shed its leaves, carrying the autumn forward into the summer. In a trip on the Maumee River and another on the Cumberland, early in August, the buckeye trees, which were sprinkled among the other forest trees on the hills and bluffs, could be picked out a half-mile away as patches of red among the surrounding green, and on the trip last mentioned, about the middle of August, some trees were seen wholly naked except for the heavy crop of buckeyes. The fruit of the buckeye occasionally poisons cattle.

## Family 95. Rhamnaceæ. Buckthorn Family

### 505. NEW JERSEY TEA; RED-ROOT

**CEANOTHUS AMERICANUS L.**

Not very common; a few plants scattered in dry ground about Long Point, along the railroad by Arlington and in Green's woods near the northeast part of Lost Lake. In flower June 24, 1901. The leaves sometimes stay green far into the winter. They were still green, but dried up considerably, December 18, 1904.

## Family 96. Vitaceæ. Grape Family

### 506. NORTHERN FOX-GRAPE; PLUM-GRAPE

**VITIS LABRUSCA L.**

Occasional in sandy places west of the lake. There is a good vine clambering over an old fence and low bushes beside the road between Murray's and Farrar's; this is generally fruitful; another vine, not so fruitful, climbs the tall poplars farther down along the road. There are two low vines, generally pretty fruitful, in the woods where the birch swamp is located. The species reaches its best development in Walley's woods along the edge of a long narrow swamp. Here it forms a remarkable wild arbor, the vines climbing tall trees or forming a thick canopy over low bushes or the tops of fallen trees. Saplings and small trees, bent over by the weight of the vines, formed graceful arches. The year 1906 was an unusually fruitful year, and this arbor, hanging thick with clusters of the ripened grapes, many of them larger than the cultivated Concord, formed a scene of great attractiveness. The grapes, though tough, were sweet and pleasant when ripe, and were soon cleaned up by birds in their autumn migration. There are several fine arbors far down the outlet.

### 507. SUMMER GRAPE

**VITIS AESTIVALIS Michx.**

Common in woods west and south of the lake and occasional on the east side. The most common grape of the region.

### 508. DOWNY GRAPE

**VITIS CINEREA Engelm.**

Rather rare, a few vines west of the lake.

### 509. BLUE OR WINTER GRAPE

**VITIS BICOLOR LeConte**

Occasional in thickets west and south of the lake.

### 510. SWEET SCENTED GRAPE; RIVERSIDE GRAPE

VITIS VULPINA L.

Rather common near shore on banks along the west shore, as on Long Point, and along the road on the east side of the lake. The term "sweet-scented" was probably intended to refer especially to the blossoms, which have a pleasant, spicy, far-reaching fragrance. The large glaucous fruit is sometimes flattish. The taste is usually insipid, especially when the fruit is dead ripe, so that it is generally the poorest in quality of all our wild grapes.

Some vines which appeared to be of this species grew at the edge of Busart's pond, and bore an abundance of large, excellent fruit.

### 511. FROST GRAPE; CHICKEN GRAPE

VITIS CORDIFOLIA Michx.

Scattered about the lake, at Long Point, along the railroad, in Green's and Walley's woods, etc. In flower along the railroad May 26. The smallest of our grapes, quite sour but with a rather agreeable flavor. The seedlings come up in May and have rather ovate pale cotyledons. The first pair of leaves are rhomboidal in form, reminding one of leaves of the dogwood.

### 512. VIRGINIA CREEPER

PARTHENOCISSUS QUINQUEFOLIA (L.) Planch.

Rather common in woodlands; common along the east shore of Long Point.

One of the most brilliant of our plants in autumn coloration, and most effective when forming a close carpet-like growth about old dead stubs. It is used on the railroad grounds to cover dome-shaped trellises, and here it is very effective, especially in autumn when in brilliant coloration. It is occasionally used to screen porches, a use to which it is very well adapted. It attains its brightest coloration about the middle of September. The leaves have, under different conditions, various peculiarities in coloring; sometimes part of the leaflets of a leaf will turn red, while the remainder are still green. One by the Fish Commission cottage was peculiarly and beautifully colored, the leaves red, flecked with small quadrate patches of green. The young leaves come out in spring with a beautiful purplish color much like the purple beech in tone.

Delightful as the Virginia creeper is in northern Indiana, no one fully realizes its possibilities or full attractiveness until he sees it where it attains its most perfect development, which is probably along the Cumberland River.

Here it clothes the trees along the river, dead and living alike, with a dense carpet-like growth, often extending over small limbs, and all apparently to no detriment of the tree. At other places it thus carpets the faces of the vertical limestone cliffs, and even creeps down over the mud banks of the river, growing downward instead of upward. Along the Caney Fork, however, where it grew on the sycamores and other trees along the river's edge, it outdid itself. Here, after it had occupied all available space on the tree, it hung down from horizontal boughs in great swinging festoons, some of them 10 or 15 feet long and 6 inches in diameter.

Where the vines grew in such profusion, leaves were ripening and reddening all summer long, so there were patches of red here and there throughout the growing season. On the upper Cumberland one vine was noted with purple foliage; like that of some of the Japanese maples.

## Family 97. Tiliaceæ. Linden Family

### 513. BASS-WOOD; AMERICAN LINDEN

TILIA AMERICANA L.

Rather common along the lake shore. One of the landmarks on the shore of Long Point near the Scovell cottage was a tree leaning far out over the water. Large trees occur in the low ground near Overmyer's field. Part of a large forest on the east side, near Peebles, is composed mainly of this species, some of the trees being unusually large and fine. A large tree in full bloom is a regular dome of fragrance and a forest of linden will scent the air about it for a mile. In close proximity, the odor of the waxy blossom is rank, but tempered by distance it is one of the most delightful odors, and the linden is famous as a producer of delicate-flavored honey. The young seedlings come up in early spring (May) and are noteworthy for their lobed, hand-shaped cotyledons.

## Family 98. Malvaceæ. Mallow Family

### 514. COMMON MALLOW; CHEESES

MALVA ROTUNDIFOLIA L.

This well known plant is common in waste places about Culver. Although common in waste grounds it never appeared to venture into cultivated grounds or lawns and become a weed until within recent years. It is very hardy and withstands a great deal of tramping and rough treatment. It begins blossoming rather early in the

spring—some noted in blossom near the Assembly grounds May 25, and it has often been noted in blossom earlier than this—and it continues blossoming until severe frosts. Some was noted in flower October 27 west of the depot. In common with several other plants of the family, the seeds and green fruit are notably mucilaginous.

### 515. EUROPEAN MALLOW

**MALVA ALCEA L.**

A favorite in old-fashioned gardens, resembling a hollyhock with small single blossoms like a larger edition of the *M. rotundifolia,* but red or pink. A few plants which had escaped from seed of some old garden near Culver.

### 516. PRICKLY SIDA; INDIAN OR FALSE MALLOW

**SIDA SPINOSA L.**

A rather slender, inconspicuous weed with pale yellow flowers, rather common in grassy places along walks on Long Point near Scovell's and neighboring cottages.

### 517. VELVET LEAF; BUTTER-PRINT

**ABUTILON ABUTILON (L.) Rusby**

Not abundant west of the lake; evidently brought in by the railroad as most of the plants were found along the railroad by the ice-houses. Exceedingly abundant, 1904, in a field northeast of the lake. This native of India has found congenial soil in many parts of our country and in some places has become one of the worst of our weeds. It seems queer to think of this rank weed with rather inconspicuous yellow flowers as once thought of as ornamental; it is from gardens that it, like its pestiferous but much prettier relative, the ten o'clock, has spread. It prefers rich black loam. It is an annual but bears an immense crop of seeds and these will germinate any time during the summer when the ground is stirred, and in places whole fields become a mass of these plants. It is markedly heliotropic, and a densely grown field from a few inches to knee high or higher, all pointing eastward with one accord in the morning, and nodding heavily westward toward the setting sun in the evening, makes a striking sight. Young plants can spring up late in summer and hurry through the life cycle soon enough to leave plenty of seeds by autumn. The velvet-leaf has a rather strong shreddy bark when dead, but not strong enough to make it of any value as a fiber plant.

518. HALBERD-LEAVED ROSE-MALLOW

HIBISCUS MILITARIS Cav.

A few clumps down toward the mouth of the Outlet, not far from the Tippecanoe River; not found in the immediate vicinity of the lake; abundant along the Kankakee River.

Although large insects, such as bumblebees, frequently visit the flowers of this plant, probably for pollen, the nectaries are hidden in the little tent formed about the base of the column which bears the stamens, the only entrance to this tent being the five narrow clefts between the lobes of the corolla. This tent is usually inhabited by a large number of minute beetles which are able to enter the clefts.

519. BLADDER KETMIA

HIBISCUS TRIONUM L.

A few plants found along the north shore of the lake, near Morris's boathouse. This low herb with its conspicuous creamy black-eyed blossoms was a favorite in old fashioned gardens. It has escaped, and in many parts of the state is becoming one of the most pestiferous weeds. A well developed plant bears an enormous number of seeds. These have great germinating power and will spring up in cultivated ground almost at any time during the summer even after the cultivation for the year is over and rapidly produce seed. The seeds are easily distributed through hauling hay, manure, etc.

## FAMILY 99. HYPERICACEÆ. ST. JOHN'S-WORT FAMILY

520. ROUND-PODDED ST. JOHN'S-WORT

HYPERICUM CISTIFOLIUM Lam.

Occasional on wet banks about the lake.

521. VIRGATE OR COPPER-COLORED ST. JOHN'S-WORT

HYPERICUM VIRGATUM Lam.

Specimens were obtained in moist grounds about the lake.

522. SPOTTED ST. JOHN'S-WORT

HYPERICUM PUNCTATUM Lam.

A few plants found along the lake shore south of Green's. Rather common throughout the state in moist soil.

523. DWARF ST. JOHN'S-WORT

HYPERICUM MUTILUM L.

Common along the edges of ponds; very abundant along the northeast shore of Lost Lake. Nothwithstanding the small size of plant and flower, this plant with its coppery blossoms is very pretty and more attractive than some of the more showy species. It was seen in blossom as late as October 25, and the leaves had before this time assumed beautiful reddish tints.

524. ORANGE-GRASS; PINEWEED

SAROTHRA GENTIANOIDES L.

A member of the xerophyte flora on the dry bank along the east shore of Lost Lake; an inconspicuous plant, the leaves reduced to mere scales so that the plant looks strikingly naked. It has a close general resemblance to *Bartonia virginica*, a member of the Gentian family.

525. MARSH ST. JOHN'S-WORT

TRIADENUM VIRGINICUM (L.) Raf.

Scattered, in the marsh near Norris Inlet. This plant, with its rather broad clasping glaucous leaves and rather large dark-purple blossoms, does not much resemble its close relatives, the upland St. John's-worts, and though not nearly so showy, is in a way more attractive than any of them. Attractive, in the secondary sense of the word. The impression the plant gives is rather that of being unusual. There is nothing else it reminds one of, and it is seen only by those who venture into the marshes. Tamarack bogs are one of its favorite habitats.

## FAMILY 100. CISTACEÆ. ROCK-ROSE FAMILY

526. LONG-BRANCHED FROSTWEED

CROCANTHEMUM CANADENSE (L.) Britton

Rather common in sandy soil, especially north and east of Lost Lake. Found also by Murray's and by the ice-houses. The thin-petalled, bright yellow flowers, about an inch in diameter and furnished with a brush of numerous yellow stamens, have a peculiar charm. It is after the first hard freezes of autumn, however, that the plant is most striking. The bark at the base of the plant cracks open and sparkling crystals of ice emerge, the result of the freezing of the sap. Plants noted in bloom early in June.

### 527. THYME-LEAVED PIN-WEED

LECHEA MINOR L.

Rather common in the dry sandy ground north of Lost Lake, associated with *Crocanthemum canadense;* some plants in front of the Military Academy and some on the beach beyond Norris Inlet. Flowers inconspicuous. The prostrate runners or stolons with their leaves arranged symmetrically, are the most attractive features of the plant, especially in winter when the leaves turn bronze red. The leaves persist throughout the winter. Noted in flower about the middle of August.

## FAMILY 101. VIOLACEÆ. VIOLET FAMILY

### 528. BIRD'S-FOOT VIOLET

VIOLA PEDATA L.

Found only along the ridge on the east side of Lost Lake and its outlet, back of Walley's woods, and along the railroad. Its distribution is peculiar and interesting. Its range covers a large area, occupying most of the eastern United States, but within that range it is only where some favored sandy or sandy clay hill suitable to its growth occurs, that this plant is to be found. There may be whole counties without a plant of this species, and in Indiana it is usually found in only small patches, though abundant within the limited areas in which it occurs. It (especially the bicolor form) is the largest and in some respects the most handsome of the violets. It has two flowering seasons, one in late spring when it blossoms abundantly, and one in late autumn when it produces only a few flowers. In flower May 2 and later along the railroad southwest of the lake. In blossom October 24 and 25 along Lost Lake outlet; in 1900, some buds, overtaken by cold, remained all winter, but did not blossom in spring. In 1907, flowers were seen September 11 and 29 by the birch swamp along the railroad, and on October 14 they were still abundantly in flower.

We did not find any of the bicolor form with the upper petals black and velvety. It is likely to occur, however, wherever the other form is found.

### 529. EARLY BLUE VIOLET

VIOLA PALMATA L.

Common in dry shady places, also on dry banks along the railroad. One of the early spring flowers which continues blossoming for a month or more.

### 530. MEADOW OR HOODED BLUE VIOLET

**VIOLA PAPILIONACEA Pursh**

The well-known "Johnny-jump-up" of the country. Abundant in various places, especially where moist. Commonly blue but variable in color, sometimes entirely white, sometimes white with a purple or blue eye, and sometimes curiously mottled and blotched. Found most abundantly on the east side of the lake. Noted abundantly in flower April 30, 1901. It has a second flowering season late in autumn. In flower plentifully along the railroad October 27 and 28, 1906.

### 531. SOUTHERN WOOD VIOLET

**VIOLA HIRSUTULA Brainerd**

Collected in blossom at Long Point May 11, 1901. Probably rare.

### 532. OVATE-LEAVED VIOLET

**VIOLA FIMBRIATULA J. E. Smith**

Rather common in flat ground about the lake, especially southward along the railroad. Collected in flower May 23, 1901.

### 533. SWEET WHITE VIOLET

**VIOLA BLANDA Willd.**

Rather common, but not abundant, in low flat places, such as Green's marsh and the low flat fields west of the grist-mill, and in woodland ponds east of the lake among moss. One of its favorite habitats is on the moss growing on submerged logs in ponds. It prefers constantly saturated ground. The daintiest and smallest of our violets, with a delightful fragrance. Blossoms in April and May, most abundantly in May. It also blossoms again somewhat sparsely, in autumn. Some were found in blossom along the Outlet, opposite Zechiel's, September 29, 1907.

### 534. LANCE-LEAVED VIOLET

**VIOLA LANCEOLATA L.**

Quite abundant on both sides of the railroad southwest of the lake, and near Walley's where the ground was saturated. Common also at the edge of the marshes surrounding Lost Lake. Frequently growing at the bases of low willows at the edges of swamps. In flower from the beginning to the end of May, probably longer.

535. HAIRY OR DOWNY YELLOW VIOLET

VIOLA PUBESCENS Ait.

One of the best known forms in the state, commonly abundant in dry woodlands. Common in Farrar's woods, also in woodlands east of the lake.

536. LONG-SPURRED VIOLET

VIOLA ROSTRATA Pursh

One of the least common of our violets, and noteworthy for the long slender spur. Not abundant anywhere in the state. In flower about the end of April on the east side of the lake in shaded places. Flowers of an attractive gray color.

## FAMILY 102. CACTACEÆ. CACTUS FAMILY

537. WESTERN PRICKLY PEAR

OPUNTIA HUMIFUSA Raf.

Abundant in sand dunes west of the lake. They are said to have escaped from an old cemetery, and are now fairly abundant in old deserted fields in the dune region. Young erect "pears" were abundant August 16, 1906, mostly green, but all full-sized; few were ripening and one flower bud was seen. The plant behaves much like a native.

Observation on prickly pears, probably of this species, in another section of the country, showed some interesting developments. Sometimes the "pears" bore "joints" and these in turn bore blossoms and fruit.

The plant is very tenacious of life. Joints laid on a table will put forth buds, which will grow for some time.

## FAMILY 103. THYMELEACEÆ. MEZEREUM FAMILY

538. LEATHER-WOOD; MOOSE-WOOD

DIRCA PALUSTRIS L.

Local; rather abundant in a deep rich gully northeast of the lake, which is known in the country round about as "the canyon". In flower April 30, 1901. It does not appear to be a common plant in northern Indiana, and usually grows along the slopes of gullies.

## FAMILY 104. LYTHRACEÆ. LOOSESTRIFE FAMILY

539. SWAMP LOOSESTRIFE

DECODON VERTICILLATUS (L.) Ell.

Common in swampy portions of the shore, as at the edges of Norris Inlet and Norris Inlet marsh; formerly common on

the south shore of Outlet Bay; also along the outlet of Lost Lake. The densest patch is a long stretch along the margin of Norris Inlet, where the plants form a broad border on each side for some distance, the plants curving down with their tips in the water, and forming an almost impenetrable thicket. The plants are rather showy when in blossom, the flowers reminding one somewhat of the crepe myrtle of which this plant is a relative; the leaves and fruiting calyces, which turn red in autumn, are also showy. The plant forms a mass of peculiarity spongy tissue around the submerged parts. The bark of the plant is one of the favorite foods of muskrats in winter.

### 540. WING-ANGLED LOOSESTRIFE

LYTHRUM ALATUM Pursh

Common in low grounds about the lake, such as Green's marsh. In places it grows so thickly that the purple blossoms give their color to extensive areas. It is a common plant in low grounds about various lakes of the state.

## Family 105. Melastomaceæ. Meadow-beauty Family

### 541. MEADOW-BEAUTY; DEER-GRASS

RHEXIA VIRGINICA L.

Not common; one small patch on the bank of the thoroughfare between the lakes and north of Lost Lake and another south along the railroad near the birch swamp. In flower from early August to the latter part of September. The flowers are quite handsome and striking; it is indeed one of the most attractive plants in the region. The charm of the plant does not vanish when the blossom dies. The pods, surrounded by the globularly-swollen, cylindrical-necked calyces, are attractive, vase-like objects.

## Family 106. Onagraceæ. Evening-primrose Family

### 542. MARSH PURSLANE

ISNARDIA PALUSTRIS L.

An inconspicuous little creeping plant, quite common in the bottoms of ditches, and dried up or nearly dried up ponds. What are usually the conspicuous parts of a flower—septals, petals, stamens and pistils—are in this plant greatly reduced and inconspicuous, while the pod or fruit is the most evident part. Found at Winfield's and near Chadwick's, also at the bottom of dried up puddles along the railroad near the birch swamp.

543. FALSE LOOSESTRIFE; MANY-FRUITED LUDWIGIA

LUDWIGIA POLYCARPA Short & Peter

Not common; in moist ground opposite Overmyer's field; also in wet soil by the birch swamp. An inconspicuous plant.

544. SEED-BOX; RATTLE-BOX

LUDWIGIA ALTERNIFOLIA L.

Scattered, in marshy places; near the birch swamp and north of Lost Lake. The plants when in flower are quite conspicuous, the bright yellow blossoms, which drop their petals when shaken or shocked, catching the eye for a considerable distance. The plant is an attractive object in autumn when the leaves and sepals turn red, and in the dead of winter when the shapely seedboxes with the square lid, arranged orderly on the stalk, project above the snow.

545. LINEAR-LEAVED WILLOW-HERB

EPILOBIUM LINEARE Muhl.

The presence of this species is attested by an herbarium specimen collected by Dr. Scovell August 26, 1900. No definite record can be given of its occurrence, as the species of willow-herb are not especially conspicuous and are difficult to recognize in the field.

546. PURPLE-LEAVED WILLOW-HERB

EPILOBIUM COLORATUM Muhl.

A few plants along the lake shore near Green's, mixed in with cockleburrs and grasses. Abundant in a low swale near Murray's, almost wholly occupying the central portion. Common in low open places. More conspicuous in fruit than in blossom, the silky seeds escaping from the pods producing a cottony effect. On a trip to Bass Lake August 14, 1906, whole stretches of landscape in low grounds were whitened by the seed-silk of these plants.

547. COMMON EVENING-PRIMROSE

OENOTHERA BIENNIS L.

An occasional beach plant, as at Long Point near the Barnes cottage and beyond Norris Inlet. A few plants on the depot grounds near the lake. The greater number of plants, however, grow back from the lake in dry ground. There are good patches in open lots on Long Point, and the old sandy fields about the lake bear numerous scattered plants. Common on the east side by McOuat's.

Although the evening primrose is common through fields, it is not a bad weed, as it is easily killed out by cultivation and prefers to grow in waste situations, especially in sandy soil. It is our most common representative of the family to which the cultivated Fuchsia belongs, and a comparison of the evening primrose with a fuchsia blossom will at once reveal the similarity.

The seeds of the evening primrose germinate during the summer and live throughout the winter, forming an attractive green or purplish rosette, the exposed portion of the leaf being purplish, the hidden parts green. The plants begin blooming about midsummer and continue until killed by frost; small secondary blossoms are formed late. In early summer, in sandy dry places, even before the plants have bloomed, the leaves, which vary considerably in shape, assume a bright red "autumnal coloration"; this is the first in the procession of plants to assume the vivid livery of the fall.

A noteworthy feature of the evening primrose is the rapidity with which its buds open. Shortly after dusk, in the midst of the growing season they open within a remarkably short space of time; and it is doubtful if any other flowers open with such rapidity as in some of the cultivated forms similar to this. The eye is hardly quick enough to watch the unfolding bud, and as a number of blossoms open on one plant it is almost like watching corn popping. The moon-flower, well known for the rapidity of its blooming, is behind in the race with this. The newly opened blossoms emit a delightful fragrance, and the pollen grains, which under magnification are seen to be curiously 3-angled, are hung together by a mass of cobwebby threads. A peculiarity of the evening primrose is the tendency of the stem to grow out into a broad flat blade. The dead stalks with their multitude of close-set pods are a feature of the winter landscape. During the winter the goldfinches stay about these plants quite constantly pecking about for seed, and in autumn and spring the downy and perhaps hairy woodpecker spends a great deal of time on this plant and the mullein, seeking either seeds or the larvæ of insects.

### 548. SMALL SUNDROPS

KNEIFFIA PUMILA (L.) Spach

A very pretty evening primrose-like plant, rather uncommon in the vicinity of the lake. Found near the birch swamp, along the railroad; in blossom June 17, 1901.

549. ENCHANTER'S NIGHTSHADE

CIRCAEA LUTETIANA L.

Common in shady places. Quite frequent in Farrar's woods near the pond; also east of the lake. An inconspicuous little plant, the small flowers with the two heart-shaped petals and two stamens presenting an odd appearance. The clubshaped bristly fruit adheres closely to clothing, but is too small and scattered to make it much of a nuisance as a burr.

## FAMILY 107. HALORAGIDACEÆ. WATER-MILFOIL FAMILY

550. MERMAID-WEED

PROSERPINACA PALUSTRIS L.

Rather common in ditches in Green's marsh and along the railroad near the old thoroughfare. The flowers and fruit are inconspicuous but the gracefulness and adaptations of the plant make it attractive. The submerged leaves, like those of the water-parsnip, are finely dissected, while those of the aerial stems show more and more solid expanse and substance to the blade, until they are merely serrate. The leaves persist all winter under the ice in the bottoms of pools, and assume a purplish pink hue, which, with their lake-like form and symmetry of arrangement, makes them very pleasing, especially when nearly everything else is barren.

551. SPIKED WATER-MILFOIL

MYRIOPHYLLUM SPICATUM L.

Of the two species of milfoil found in the Lake Maxinkuckee region this is much less common. It is not found in the large lake at all, but occurs in the ponds along the railroad between the lakes, and is abundant in the extreme south end of Lost Lake and far down the Outlet.

*M. spicatum* is the more delicate and graceful of the two found here. Not much was found in flower. A few plants were seen in blossom September 1, 1900, and on September 18 it was found in fruit.

In autumn, in the still water of the lake and lagoons, the terminal portion forms elongated very compact conelike winter buds, the apical portion being rounded or hemispherical, the lower part gradually tapering to a long point. These buds are copper-colored or reddish. The plant below them becomes fragile, breaks up or decays. In early spring the bud elongates rapidly and forms

a new plant. In the Outlet, where there is a good current, no winter buds are formed, but the plant remains entire the year through. The tips, however, become reddish.

### 552. WHORLED WATER-MILFOIL

#### MYRIOPHYLLUM VERTICILLATUM L.

A very common plant in both lakes and distributed everywhere where the water is not too deep. It grows in rather compact patches, usually mixed with other plants. It flourishes in depths ranging from 6 to 23 feet, and usually in bottom where there is some mud. Unlike the horn-wort (*Ceratophyllum*) this plant possesses roots, and attaches itself to the bottom. It seems to grow best on sloping bottom. Among the most noteworthy patches in the lake are those about the west edges of Outlet Bay, off from the ice-houses, off from Overmyer's field, and out from the Gravelpit. It is common throughout most of Lost Lake. It grows far out from shore at a point in line with Norris pier and opposite Overmyer's field and in the vicinity of Norris Inlet.

This plant retains its form pretty well during the winter, but the old leaves assume a brownish tinge. The growing tips of plants form rather compact, elongate, winter buds—one could hardly call them that either; they seem rather the first step toward the formation of winter buds and are the result of a cessation of elongate growth of the plant's axis, and are not nearly as well differentiated as those of *M. spicatum*.

In early spring the waves break some of these tips loose, wash them ashore, or scatter them generally. Such buds were noted as pretty abundant during the latter part of March and all of April. By April 23 the buds had loosened up pretty well from their winter compactness and started to grow. Plants were noted in flower the first of September. Both flowers and fruits are inconspicuous.

The Whorled Milfoil is rather more conspicuous than *M. spicatum*, but not so conspicuous as several other species. It is not so attractive or interesting as *M. heterophyllum* which is, oddly enough, absent at Lake Maxinkuckee, although common in Bass Lake and other lakes near by. As an aquarium plant for ornamental purposes it is far inferior to the imported and cultivated *M. proserpinacoides* or Parrot's feather.

This plant is very little used as food by any of the fishes of the lake. One of its principal functions is in affording a place of attachment for other organisms. Rivularia frequently grows thickly all over the plants, and it is the favorite habitat of some of the species

of Vorticella. As furnishing a haunt for amphipods and other crustaceans, however, it is far inferior to Ceratophyllum.

Myriophyllum can be studied excellently through the ice, especially as regards distribution. Whenever, in going over clear ice, one comes to a place where the water deepens rather suddenly and the bottom, a moment before visible, slopes rather abruptly to a black abyss, a thick fringe of this plant is pretty sure to show, and the last glimpse of vegetation to be seen is the tops of the milfoils projecting up out of the dark depths. One patch of this sort was found notheastward from the ice-houses and northward from Chadwick's, and another off the Gravelpit about 1,000 feet out from shore.

## Family 108. Araliaceæ. Ginseng Family

### 553. AMERICAN SPIKENARD

ARALIA RACEMOSA L.

Not common about the lake, but found scattered through woodlands. Once common throughout the state, but disappearing in many places on account of woodlands being thinned out and used for pasturage. It thrives best in rich leaf- or wood-mold, and reaches its greatest development at the base of old rotten stumps. A well-grown plant is one of the most tropical looking, stately objects to be found in our woodlands, and the species might prove of value as an ornamental plant in parks if it could be induced to thrive. The black spicy berries somewhat resembling elderberries in appearance grow in a handsome cluster. The thick spicy root is used in some places as an ingredient in home-made salves.

### 554. WILD, OR VIRGINIAN SARSAPARILLA

ARALIA NUDICAULIS L.

Not common; a few plants were seen on Long Point back of the Jenks cottage. Leaves well up by May 10. This plant thrives best in leaf-mold, and is usually seen about the head of gullies and on steep slopes, especially where there is a thick layer of old dead leaves. It is not an especially striking plant. The long rootstocks have some medicinal repute.

### 555. GINSENG

PANAX QUINQUEFOLIUM L.

Rare; only one plant found northeast of the lake in a gully in the corner of Culver's woods. Once common throughout many

parts of the state, but now mostly cleaned out by "Sang" diggers and by pasturing. It is not rare about Plymouth and some wild plants were seen quite full of fruit. There is a "ginseng" farm at Plymouth where the plants thrive and attain a good size and yield profitable returns. Some fine plants, one about a foot high, were found north of Hibbard.

### 556. DWARF GINSENG OR GROUND-NUT

PANAX TRIFOLIUM L.

A good patch of scattered plants found near a pond on the east side, among partridge-berries and other out-of-the-way plants. The compact globe of little white blossoms is quite striking and the tuber-like globular root is quite different from that of the other species. In flower April 30, 1901.

## Family 109. Ammiaceæ. Carrot Family

### 557. RATTLESNAKE-MASTER; BUTTON SNAKEROOT

ERYNGIUM AQUATICUM L.

A few plants bordering the marsh on the east side of Lost Lake outlet, in the large meadow-like flat. A rather thick patch was also found in the border of Farrar's woods near a field. Its favorite situation is in flat wet grassy or sedgy places. The resemblance of this plant in leaf and general habit to some of the yuccas, as indicated by its old specific name is quite remarkable, all the more so as the yuccas usually grow in high and dry situations and the button snakeroot usually is found where it is wet. The reduction of the cyme to a close head is another interesting feature.

### 558. SANICLE; BLACK SNAKE-ROOT

SANICULA MARYLANDICA L.

Fairly common in moist shady places. In flower on Long Point June 8, 1901. A weedy-looking plant of rich soil.

### 559. WOOLLY SWEET-CICELY; HAIRY SWEET-CICELY

WASHINGTONIA CLAYTONI (Michx.) Britton

Rather common in woodlands. Frequent on the east side of the lake in shaded ravines. In flower by Vajen's May 28, 1901. The delicate fern-like woolly leaves of this plant give it a graceful appearance. When ripe the long slender seeds function as burrs which readily stick through cloth and are thus carried about.

### 560. SMOOTHER SWEET-CICELY

**WASHINGTONIA LONGISTYLIS (Torr.) Britton**

Not nearly so common as the preceding, and much like it, but smooth. The roots are very spicy having the odor of sweet anise. We have never noted the roots of this plant being disturbed by small mammals, though the oil of sweet anise (which these roots resemble in odor) is one of the principal scents used by trappers to attract fur-bearing animals.

### 561. HONEWORT

**DERINGA CANADENSIS (L.) Kuntze**

A rather low, homely plant with inconspicuous flowers and thin leaves, growing in patches in shady places. Frequent in Farrar's woods where it was noted in blossom June 11.

### 562. WILD PARSNIP

**PASTINACA SATIVA L.**

Abundant along the shore of the lake in front of Green's. It appears to have escaped from trains or from seeds dropped from some passing wagon. It was found also near Farrar's. The seeds, which mature in late summer, or early fall, germinate almost at once and pass through the winter as little rosettes; some were noted just leaving the seed September 20, 1900. They stay more or less bright and green all winter. As the broadly winged seeds are borne in considerable numbers and are easily carried by wind, this plant tends to become a weed in waste places. It is a remarkable fact that the roots of this plant which has been cultivated for food for years, become poisonous after a generation or two of wildness, and the eating of them is liable to be followed with serious if not fatal results.

### 563. COW-PARSNIP

**HERACLEUM LANATUM Michx.**

A few plants along the west side of the lake near Winfield's; rather abundant on the east side in the marshes fringing Aubeenaubee Creek; occasional about the edges of Norris Inlet marsh. This tall plant with its large hollow stem and immense leaves is one of the most striking and stately of our native plants. The flowers are rather peculiar in that the outer petals forming the border of the corymb are considerably enlarged and elongate, like the blossoms of candytuft and a few other peculiar plants.

564. GREAT HIGH OR PURPLE-STEMMED ANGELICA

ANGELICA ATROPURPUREA L.

Rather frequent in swampy places.

565. COWBANE

OXYPOLIS RIGIDUS (L.) Raf.

This species did not come under frequent observation, and we have no note concerning it. Its presence in the vicinity of the lake is attested by an herbarium specimen.

566. HAIRY-JOINTED MEADOW PARSNIP

THASPIUM BARBINODE (Michx.) Nutt.

Rather common on Long Point in McSheehy's and neighboring yards near the road. A rather tall, stately plant, without any particular attractiveness of flower.

567. CUT-LEAVED MEADOW-PARSNIP

THASPIUM PINNATIFIDUM (Buckl.) A. Gray

Occasional in dry shady places. The small light yellow flowers have no special attractiveness, but the shapely dissected leaves are pretty.

568. YELLOW PIMPERNEL

TAENIDIA INTEGERRIMA (L.) Drude

A clump found growing on a clay bank by the lake between Kreutzberger's and the depot pier. A tall parsnip-like plant with not particularly showy yellow flowers. Fruit had begun to develop pretty well and plants were collected, by May 18, 1901.

569. EARLY MEADOW-PARSNIP

ZIZIA AUREA (L.) Koch

Occasional in level moist places. A small patch grew along the railroad back of Green's field on Long Point, on a slope near the railroad fence. In blossom during May and June. Some of the fruit was pretty well matured by June 7. Like most of the parsnips, not a particularly showy plant, the golden yellow flowers being small and inconspicuous.

570. HARBINGER OF SPRING; PEPPER-AND-SALT; TURKEY-PEA

ERIGENIA BULBOSA (Michx.) Nutt.

Common in the woods northeast of the lake. This was formerly rather common throughout most of the state, nowhere abund-

ant, but forming little patches about the roots of trees in the rich earth-mold. In many places it has disappeared, owing to the pasturage of woodlands, to which the vanishing of many members of our native flora is due.

This plant is popularly known and loved as the "first flower of the spring." The skunk cabbage in the swamps and the silver maple blossoms in the trees may precede it by a few days, but they escape common observation; and, anyway, no one thinks of making bouquets of them; but this little flower, or rather flower cluster, with its modest prettiness—the dainty little petals besprinkled with the red stamens—and with its fresh delightful odor, appeals to everyone. The flower clusters precede the leaves and are rapidly followed by fruit, the plant having a very short growing season.

In blossom from April 6 to April 19; by April 30 the fruit was pretty well grown. The round tuber-like roots of this plant are eaten by children; it is from these that the name "turkey pea" is due.

### 571. HEMLOCK WATER-PARSNIP

**SIUM CICUTAEFOLIUM** Schrank

Not abundant about the lake; occasionally found in shallow swamps; some was found in the Norris Inlet marsh, back of the ice-beach, some in the swamps adjacent to the lake between Farrar's and Overmyer's, and some in a permanent pond east of the lake.

Among the most interesting of our plants are those that grow in temporary ponds or at the edge of lakes where they are at times submerged and at other times left high and dry. It is such vicissitudes of alternating drouth and flood that have produced in *Riccia lutescens* a floating and a creeping form, and the whole legion of plants with two or more sorts of leaves, one floating, firm in texture, another kind submerged, thin or dissected, etc. Such forms impress upon us most forcefully the influence of environment in developing new forms, and the mutability, not of species merely, but of individuals.

Among these amphibious plants with variously-shaped leaves to suit different conditions, none is more striking than the water-parsnip.

The lower, radicle leaves, which are usually covered by water, form a large circular rosette of the most lacy, fairy-like texture imaginable. These leaves usually turn purplish during the winter, and there are few prettier sights than one of these fluffy, dainty masses at the bottom of a clear pool. It shows to especially fine advantage when one, standing on clear ice, can look down on these

plants underneath him. The plants remain in this condition until some time after the ice has melted and the water warmed up, gradually greening up with the progress of the spring. The delicate plant taken out of the water collapses into a wilted-looking shapeless mass.

With the progress of spring the plant puts forth a stout club-like stem which finally becomes hollow; the lower stem leaves are rather finely serrate, but much coarser than the radicle ones. As the stem mounts higher and higher out of the water and into the air, the leaves take on increased firmness and simplicity of outline until the uppermost are simply shallow-toothed or almost entire.

The flowers are not remarkable, being simply small white blossoms of the usual parsley style in an umbel.

### 572. WATER HEMLOCK; MUSQUASH ROOT

CICUTA MACULATA L.

Rather common in places; a few plants along shore south of the ice-houses, in front of the Assembly grounds, and south of Winfield's. A few along the road in low wet places. Well up and in leaf by May 9. Still in blossom as late as October 24. In many low meadows this is one of the most persistent and annoying weeds, and many swampy places are, in the height of the flowering season, almost white with them. The delicate white umbel of blossoms has won for the plant in some places the name of "lace plant" or "Queen Anne's Lace" a name which belongs rather to the wild carrot, *Daucus carota*. The roots, somewhat resembling dahlia roots, contain a deadly poison. It is by the scattering of these tuber-like roots by the plow that the plants are disseminated through low fields.

### 573. BULB-BEARING WATER HEMLOCK

CICUTA BULBIFERA L.

Common about Lost Lake, on the low swampy shores of Lake Maxinkuckee, in the Norris Inlet, and the outlet region. Flowers and fruit are very rare, only one plant being found in fruit. Tiny bulblets are borne in great numbers in the axils of leaves; these drop off into the water and are carried by waves to various places along shore, and form a very efficient means of propagation. A few plants grew on Long Point near Scovell's, many in low ground by Overmyer's, and formerly it was common at the tip of Long Point, from which it has disappeared on account of changed conditions.

## Family 110. Cornaceæ. Dogwood Family

### 574. SILKY CORNEL

**CORNUS AMOMUM Mill.**

Rather common along low parts of the lake shore, forming low thickets. Found in the flat south of Outlet Bay, in the swamp by Farrar's, and by the green boathouse near the south end of the lake. The fruit, which is not borne in great abundance, is remarkable for being of a beautiful pale blue shade, one of the rarest of colors among fruits. It is not at all a showy color, and it is only by focussing attention somewhat narrowly on a bunch of ripened fruit that one can properly appreciate it. It is one of those objects that do not readily take the casual glance, but whose charms grow and increase under close scrutiny. We have not seen birds feeding on the berries of this particular species, although they probably do so to some extent. At the south end of the lake we found an old empty bird's nest well filled with the seeds of a species of Cornus, probably this. The shell had been gnawed through and the kernels eaten out, probably by mice.

### 575. RED-OSIER DOGWOOD

**CORNUS STOLONIFERA Michx.**

Common, forming dense clumps in low flat places in black ground. Found along the low border of the lake by Green's, between Farrar's and Overmyer's, and by Norris Inlet; also found at the tamarack swamp. Not a very conspicuous plant during the growing season, though the flat corymbs of small white flowers and the white berries when ripe are mildly attractive. The plant shows at its best during the winter, especially when there is snow, when the bright red of the bark of the young shoots shows conspicuously. In landscape gardening and laying out of parks where each season has to be considered and provided for, this plant, or a species that is closely related, usually *C. tartarica*, is used for the mass of color the red bark gives to winter landscapes. In flower about the lake during the middle and latter part of May.

### 576. PANICLED CORNEL

**CORNUS FEMINA Mill.**

Not very common about the lake; a patch noted on the east side of Long Point near McSheehy's, and another southward not far from Farrar's. Not so much a lover of wet swamps as the last two species, it grows best and most extensively on flat loamy

soil where there is considerable moisture; it will also grow on high clay hills, and thrive well in neglected fence corners. In some of the northern parts of the state this species is known among old settlers as "Pigeon-oak." In flower, stem and leaf, this shrub is rather inconspicuous; but the clusters of white fruit, or reddish stems, in the shape of dense corymbs, are very conspicuous. They form a favorite food for birds. Cedar waxwings were noted feeding their young in September on the berries of this or a similar species, and the flocks of southward migrating birds clean up the entire crop in a few days in some seasons and localities. Whenever any are left late enough they form a favorite food of the tree-sparrow upon its return from the north. In blossom at the lake by the middle of June.

### 577. ALTERNATE-LEAVED DOGWOOD

CORNUS ALTERNIFOLIA L. f.

Uncommon; only a few trees seen; two or three in the low ground in Overmyer's woods and one or two on the east side some distance back in the forest. Intermediate in size between the various species of bushy cornels and the flowering dogwood. It is the least attractive species of the genus, usually growing in the form of a large crooked straggling shrub or small tree.

### 578. FLOWERING DOGWOOD

CYNOXYLON FLORIDUM (L.) Raf.

Not common; a few trees along the northeast shore of the lake, more abundant farther back, in Culver's woods. There used to be a popular saying in some parts of the state that when the dogwood blossoms were large and abundant it would be a good year for corn. This notion probably arose from some reminiscence of the name, Cornus or Cornel, applied to the tree, although it is always spoken of as dogwood. In flower along the lake shore May 27. Attractive not only when in blossom, but in the splendor of autumn foliage and fruit.

### 579. BLACK OR SOUR GUM

NYSSA SYLVATICA Marsh.

Confined pretty closely to Lost Lake and its outlet. A row of trees borders the edge of Lost Lake marsh just west of the railroad near Arlington. These trees form a narrow row at the very edge of the marsh. The shining leaves, glistening as if varnished, are always attractive but become particularly so in early autumn.

They are among the first of the trees to color up in the fall, closely succeeding the buckeye, and surpass it by their vivid glistening red. At first a stray leaf reddens here and there; finally the whole tree becomes scarlet. From September 23 to October 27, 1900, these highly colored trees formed a conspicuous landmark, the long patch of low-bush huckleberries making a duller flame about their roots.

Trees are more or less scattered along the east side of Lost Lake outlet back of Green's and Walley's woods. The young trees down along the outlet put out their branches in a horizontal direction, and in late autumn, winter and spring, when the boughs are barren, the bark, on bright days shimmers with a satiny effect and gives a peculiar effect like that of a multitude of immense low horizontal spider-webs. In the southern states this tree is a favorite host of the mistletoe.

## Family 111. Pyrolaceæ. Wintergreen Family

### 580. SHIN-LEAF

PYROLA ELLIPTICA Nutt.

Scattered through dry woodlands. It was observed more commonly in Zechiel's woods than elsewhere. It is never found in much abundance but usually in small patches on shady slopes. The waxy blossoms are rather pretty, but the odor, though not unpleasant in quality, is so intense as to be disagreeable.

### 581. PIPSISSEWA; PRINCE'S PINE

CHIMAPHILA UMBELLATA (L.) Nutt.

Rare; only one patch, but this was a fair-sized compact patch, found in Walley's woods on the east side of Lost Lake outlet. A delightful little plant, its trim habit, firm evergreen leaves, and cluster of waxy fragrant blossoms are all attractive features.

## Family 112. Monotropaceæ. Indian-Pipe Family

### 582. INDIAN PIPE; CORPSE-PLANT

MONOTROPA UNIFLORA L.

Rather common compared with its abundance in most parts of the state, growing in rich sandy woodlands on both sides of the lake; occasional in Green's woods, but most abundant on the east side of the lake in the large woods about Aubeenaubee Creek. Sometimes only one or two plants are found together, but more commonly the plants grow in large clumps. The plant is in some

cases at least perennial, and one can often find young plants in early summer at the base of last year's stalks. The roots form a queer tangled mass. An attempt was made to grow the plants in a flower-pot from a mass of roots with the young shoots, but it was unsuccessful. The single plants mentioned above are probably young plants and the clumps older, the clumps probably increasing in size from year to year. It is remarkably independent of seasons, individual clumps coming up at almost any time during late spring, all summer and during autumn until frosts. On account of its waxy whiteness and attractive form it is always a pleasure to find a clump of these odd plants. The transparence of its tissues makes it an exceptionally good subject in which to study the embryo sac. It is unfortunate that these plants turn black on drying, as this prevents them from making attractive herbarium specimens, and they do as badly in alcohol and formalin. An attempt to preserve the natural colors by killing with boiling water met with slight success.

Although it bears its minute seeds in large numbers, apparently very few germinate, else it would be a much more common plant. The peculiar habit of the plant's straightening up immediately after flowering, so that the vase-like pods stand erect, is evidently a device for securing the wide distribution of the seed. These escape from pores or chinks in the upper part of the pod, and are probably distributed by wind, for which their minute size adapts them.

### 583. FALSE BEECH-DROPS; HAIRY PINE-SAP

**HYPOPITYS LANUGINOSA (Michx.) Nutt.**

A few patches on each side of the lake; some magnificent clumps were found in the big woods along Aubeenaubee Creek, on a dry hill. There is a fine large patch consisting of many clumps in Walley's woods on the low bluff at the edge of the outlet marsh. This patch persisted and appeared to be increasing in size from year to year. It was discovered in 1906 and was still thriving in 1909. The plants vary considerably in coloration, some being rather pale. Those at Lake Maxinkuckee are usually brilliantly colored; the lemon-colored blossoms and coral-red stems along with its velvety surface, make it an unusually attractive plant, but, like the Indian pipe, it turns black in drying. It has a long flowering season, from June to October, but this does not refer to the same clump, but to different clumps and localities. All we have found at the lake were rather late in blossoming, from the beginning to the middle of September.

## Family 113. Ericaceæ. Heath Family

### 584. LEATHER-LEAF; DWARF CASSANDRA

CHAMAEDAPHNE CALYCULATA (L.) Moench

Common in Hawk's marsh, as a low shrub forming a zone between the tall shrubs and the grasses. Found also at the tamarack west of the lake, but not so abundant. Passing out of flower by May 20.

Although not so handsome or striking as *Pieris floribunda*, a relative that has found a well-deserved place in landscape gardens, this little shrub has many charms and a place of its own in the scheme of decoration of the swamps. It is an exceedingly hardy plant, growing as far north as Newfoundland and Alaska; still it is what the landscape gardener calls a "broad-leaved evergreen," a group represented by the holly, box, and the like, and usually living in only mild climates. In addition to its graceful sprays of foliage, consisting of leaves becoming gradually smaller and smaller toward the tips of the branches, and which become purplish in winter, one of its greatest charms is its racemes of flower buds which are conspicuous throughout the winter, so well advanced in development that they seem ready to bloom at any time.

### 585. WILD ROSEMARY; MARSH HOLY ROSE; MOORWORT

ANDROMEDA POLIFOLIA L.

Rather abundant among the sphagnum of Hawk's marsh. A low, rather inconspicuous evergreen shrub. The leaves curl up strongly along the margins, especially in cold weather.

There is an air of refinement and daintiness about the marsh rosemary, with its whitish rolled-up leaves and chaste, drooping vase-shaped blossoms, that makes the finding of it an unusual pleasure. It is a hardy plant so far as temperature and rigorous winters are concerned, growing as far north as Alaska and British Columbia. It is a pity it does not grow in our marshes and swales as well as in the cold tamarack bogs. Noted in blossom in Hawk's marsh about the middle of May (May 20).

### 586. TRAILING ARBUTUS; MAYFLOWER

EPIGAEA REPENS L.

Rare; only a few plants found in a sandy woodland near some tamaracks southwest of the lake. Generally speaking this is a rare species in the state, being found only in a few of the northern counties and in Monroe county, where it is abundant in one locality.

587. SPICY OR CREEPING WINTERGREEN

GAULTHERIA PROCUMBENS L.

Common in woods west and south of the lake, as Green's, Walley's and Zechiel's; abundant along the railroad by the birch swamp; plentiful west of the dunes; and abundant in a small but dense patch at the edge of a sandy wood about a mile down the outlet. The spicy berries, which are one of the most delicious morsels which the woodlands afford, are an uncertain crop. They are never markedly abundant about the lake, and one sometimes can find but few where a good crop might reasonably be expected; then again one may find a good crop in some unexpected spot.

## Family 114. Vacciniaceæ. Huckleberry Family

588. BLACK OR HIGH-BUSH HUCKLEBERRY

GAYLUSSACIA BACCATA (Wang.) K. Koch

Common; scattered through rather open sandy woodlands, especially common at the edges of woods. Common along the east side of the outlet of Lost Lake, and forming a pretty thick fringe of the marsh about the head of the lake. Leafing out well April 26. In flower by May 14. Fruit ripe from July 27 to the latter part of August. The fruit is sweet and of a spicy flavor but full of hard seeds. The fruits are borne scattered and sparsely.

589. LOW BLUEBERRY; BLUE HUCKLEBERRY

VACCINIUM VACILLANS Kalm

Rather rare; a few plants were found on the brow of a gentle slope at Long Point, at the end of the forest near Chadwick's pier. The whole region here has been changed and cleared out and they are now gone. A few were also found along the continuation of the same ridge by Lost Lake among the Gaylussacias. The berry is considerably superior in flavor to that of Gaylussacia.

590. LARGE CRANBERRY; AMERICAN CRANBERRY

OXYCOCCUS MACROCARPUS (Ait.) Pursh

A few straggling plants occur in a gully in Walley's woods east of Lost Lake outlet; they were never seen in fruit. A patch formed a broken ring next to the water in the center of Hawk's marsh. These plants grew quite densely in the wet sphagnum. They bore very little fruit during the early part of the survey, but in later years, 1904, 1906, and later, bore rather profusely and seemed to be increasing in productiveness. It was reported that

there were originally large and profitable cranberry patches in the county, as in the bogs of several other counties of northern Indiana, but, owing to drying out of swamps, these have mostly disappeared.

## Family 115. Primulaceæ. Primrose Family

### 591. WATER PIMPERNEL; BROOKWEED

SAMOLUS FLORIBUNDIS H. B. K.

A few plants found in wet ground south of the lake. A common plant throughout the state in wet places, with thin leaves and an abundance of minute white blossoms.

### 592. WHORLED LOOSESTRIFE

LYSIMACHIA QUADRIFOLIA L.

Scattered through dry woodlands; some along the Long Point road; some seen in woods south of the lake. A rather inconspicuous plant, both in leaf and flower.

### 593. BULB-BEARING LOOSESTRIFE

LYSIMACHIA TERRESTRIS (L.) B. S. P.

We have no notes on this species, but its presence at the lake is attested by an herbarium specimen collected by Dr. Scovell. It is not a conspicuous plant, and on that account probably escaped frequent observation. It usually grows in wet places, as at the margins of swamps and lakes, and thrives best in black loamy soil. It usually bears an abundance of elongate starchy tubers, somewhat resembling a miniature sweet potato in shape.

### 594. FRINGED LOOSESTRIFE

STEIRONEMA CILIATUM (L.) Raf.

Common in low flat ground scattered among grasses; noted in the flat marsh south of Outlet Bay and in the low ground along Aubeenaubee Creek. A fairly well-known coarse herb, bearing rather large but homely yellow flowers which are shed about a day after blossoming, or at the slightest touch, soon after they have opened.

### 595. PRAIRIE MONEYWORT

STEIRONEMA QUADRIFLORUM (Sims) A. S. Hitchc.

We have no notes on this species and it was probably not common. A specimen was collected by Dr. Scovell, and its identification is not absolutely certain. It has been reported from neighboring counties.

596. TUFTED LOOSESTRIFE

NAUMBURGIA THYRSIFLORA (L.) Duby

Not very common; a few plants nearly in flower on the east side of the lake along Aubeenaubee Creek, May 28, 1901; noted at the same place on subsequent occasions. The dense head of golden yellow flowers, forming a compact ball, makes this a rather striking plant when in bloom.

597. STAR-FLOWER; CHICKWEED WINTERGREEN

TRIENTALIS AMERICANA Pursh

Rather rare; only a few plants found in sphagnum in Hawk's marsh, where it was in bloom May 20, 1901. A rather inconspicuous, but attractive, shapely little plant.

598. SHOOTING STAR; AMERICAN COWSLIP

DODECATHEON MEADIA L.

A few plants found in flower north of the lake near the shore, on a hill near Lakeview Hotel, also a few plants west of the lake. In 1909 a large patch was found on the west side of the railroad about two miles south of the lake. It is plentiful in woods near Twin Lakes. The dense cluster of rosy pink blossoms, which in their general shape remind one somewhat of a cyclamen, makes this one of the most attractive plants of the region. In flower near the lake May 21, 1901.

## Family 116. Oleaceæ. Olive Family

599. WHITE ASH

FRAXINUS AMERICANA L.

Rather uncommon on the west side of the lake where the soil is too sandy for it to thrive well. Scattered through woodlands on the east side. One of the most valuable trees of the region. Trees sometimes vary considerably in time of blossoming; of two neighboring trees one may bloom nearly two weeks ahead of the other. One of the latest, if not the very latest, of our native trees to put out leaves in spring. The leaves are retained until rather late in the fall when they turn yellowish and purple. Trees about the lake still retained their leaves October 7.

600. RED ASH

FRAXINUS PENNSYLVANICA Marsh.

We have no notes on this species; a specimen was collected by Dr. Scovell, probably in low woods south of the lake. It is not an especially common form within the state.

### 601. BLUE ASH

FRAXINUS QUADRANGULATA Michx.

One small tree found near a pond north of the lake January 3, 1904. Probably a diligent search in that region would reveal more trees as it is a well distributed species in Indiana. It usually grows in the upland forest. A farmer living east of the lake reported that he had three kinds of ash on his farm, white ash, water ash and blue ash.

### 602. BLACK ASH; HOOP ASH

FRAXINUS NIGRA Marsh.

Common in swamps and low ground on both sides of the lake. Abundant in the low woods south of the lake between Farrar's and Overmyer's, and east of the lake near Vajen's. Formerly a common tree throughout the state in swamps and woodland ponds. The tree reaches a large size and the wood is in most cases of a remarkably straight grain, splitting easily into thin slabs. This makes it especially desirable for the manufacture of barrel staves. The trees by Overmyer's swamp usually bore a great abundance of fruit, and this, which blows off the trees during the winter, sometimes covers the ice of the lake in the immediate vicinity. We have, however, never seen young ash seedlings along shore in great numbers as one often sees sycamore, maple and willow. The black ash is subject to the attacks of various fungi and some of the trees had the younger branches greatly distorted, resembling witches' brooms.

## Family 117. Gentianaceæ. Gentian Family

### 603. ROSE-PINK

SABBATIA ANGULARIS (L.) Pursh

Not common about the lake; a small patch in the sandy soil north of Lost Lake and some along the railroad by the birch swamp. All the plants seen at Lake Maxinkuckee were a rich pink, but in a large patch in a sandy flat marsh near Knox, Indiana, in 1909, there were several plants bearing white flowers. The flowers are very handsome and showy, and a well-grown plant of either color in bloom, attracts the eye for a considerable distance. Flowers in July and August.

### 604. FRINGED GENTIAN

GENTIANA CRINITA Froel.

Fairly common in moist or wet sedgy places about the lake, but usually scattered, not forming compact patches. Found by

Lakeview Hotel, along Long Point, Lost Lake marsh, Green's marsh, east border of Lost Lake outlet, and common along the edges of a sedgy meadow about three-fourths of a mile down the outlet. The same patches persisted year after year in Green's marsh, and probably in other places. This well-known and attractive flower is somewhat remarkable for its inconspicuousness until in full bloom. The stiffly erect stems and buds make almost no show whatever until the flower has actually burst into bloom. At the lake it begins blooming about the middle of September or a little before, and in sheltered locations continues until after frost has cut down all less hardy plants.

### 605. STIFF GENTIAN; AGUE-WEED

GENTIANA QUINQUEFOLIA L.

Rare about the lake; only one small clump of plants found; this was at the base of the bank near the lake shore, on the east side north of McOuat's. This was noted in blossom October 9, 1900. The patch still persisted in 1906 when it was noted in flower October 28. Flowers small, but numerous.

### 606. SOAPWORT GENTIAN; BLUE GENTIAN

DASYSTEPHANA SAPONARIA (L.) Small

Common in flat level places; the most abundant gentian about the lake; common among the cranberries and wintergreen in Walley's woods east of the outlet. Abundant along the railroad track about half-way to Delong and forming a big patch of blue when in flower along by the holly swamp west of the railroad. Frequent also in Walley's woods by the birch swamp. Not quite a "closed gentian" but half closed, opening up a little during the middle of the day and showing the pale plaits between the corolla lobes proper, but the rest of the day closed tightly. Prettier, in a way, than the closed gentian. It is fertilized, partly at least, by bumblebees that crawl down into the sac-shaped bloom; when the bee comes out of the flower it always closes the flower; this may be an accident, due to his clumsy getting out, but looks as if it were most carefully and deliberately done, and the flower seems to remain closed afterward. Field notes mention chrysalises in the pods but the note is too brief to recall fully the situation. In flower from September 28 until October 24.

### 607. YELLOW GENTIAN

**DASYSTEPHANA FLAVIDA (A. Gray) Britton**

Probably not common in the immediate vicinity of the lake, as we have no notes concerning it. There is, however, one herbarium specimen in the collection obtained by Dr. Scovell in 1900. It has been reported from neighboring counties.

## Family 118. Menyanthaceæ. Buckbean Family

### 608. BUCKBEAN; MARSH OR BEAN TREFOIL

**MENYANTHES TRIFOLIATA L.**

Scattered on Hawk's marsh among the sphagnum, where it was noted in blossom May 20, 1901. It was also abundant east of Norris Inlet, where it was seen ripe June 22.

## Family 119. Apocynaceæ. Dogbane Family

### 609. BLUE MYRTLE; PERIWINKLE

**VINCA MINOR L.**

A patch found near Culver cemetery, from which it had escaped. It was once a general favorite for planting on sloping banks and on graves, which it soon covers densely to the exclusion of everything else. The glossy dark green leaves are rather attractive, and the plant, though it spreads in large dense patches and might easily become a nuisance on lawns, is not so much so as the ground ivy or the moneywort which one finds in similar situations. The plant has become too common to be especially desirable, and is rarely or never planted now.

### 610. SPREADING DOGBANE; HONEY-BLOOM

**APOCYNUM ANDROSAEMIFOLIUM L.**

Not especially common nor widely distributed in the neighborhood of the lake. The blossoms, which somewhat resemble those of the lily-of-the-valley in shape, and ornamented with pink stripes, are quite pretty. One of our two common species of dogbane. Is occasionally a great nuisance in cultivated fields, each section of root cut off sending up a tall shoot, like an asparagus shoot, the next day. Persistent cultivation, however, finally eradicates it. In flower south of the lake June 27, 1901.

One of the most brilliantly colored of our insects, a little beetle with bright metallic green coloration, feeds on this plant.

### 611. INDIAN HEMP

APOCYNUM CANNABINUM L.

Not very common about the lake. The small greenish flowers are not handsome like those of the other species. Found growing on a hill by Murray's and in flower along the railroad by the ice-houses June 21.

## Family 120. Asclepiadaceæ. Milkweed Family

### 612. BUTTERFLY-WEED; PLEURISY-ROOT

ASCLEPIAS TUBEROSA L.

Quite abundant about the lake, and during the flowering season one of the most conspicuous members of the native flora, the plants growing in clumps. Large clumps in blossom make a glowing mass.

On account of their great range of colors and the oddity of shape, the milkweeds form an interesting and ornamental group of plants; not on the whole adapted to the uses of the florist and dealer in cut flowers, however, on account of various peculiarities, such as the rapidity with which they wither, the sticky, milky juice, etc. We have orange, purple, white and various other shades represented. Some of the white flowered forms with chaste blossoms on long slender pedicels, though much less showy than the typical butteryfly-weed, are very attractive.

The butterfly-weed has an advantage over the other milkweeds in that it has not a milky juice. Most of the plants have orange flowers, but two near the lake, one by Arlington and one south of the birch swamps, had lemon yellow flowers.

This species has been introduced into seedmen's catalogues and has already obtained some recognition of its value as an ornamental plant. The blossoms vary somewhat in richness of color; one clump seen in Tennessee was unique in that the blossoms deepened in intensity of color as they grew older, so that while the younger heads of flowers were orange yellow the older bunches on the same plant were an intense scarlet. Such an individual would surpass the common form as an ornamental plant. The blossoms of this, as well as of the other milkweeds, abound in small insects (thrips), which hide about the recesses of the flowers, though they probably have little to do with their fertilization.

This species begins flowering toward the end of July and continues during the summer. The fruit seems to be borne rather scantily considering the abundance of flowers.

613. DECUMBENT BUTTERFLY-WEED

ASCLEPIAS DECUMBENS L.

Quite similar to the preceding, but with spreading stems and opposite leaves. Rather common on the railroad embankments, along with *A. tuberosa*.

614. SWAMP MILKWEED

ASCLEPIAS INCARNATA L.

Rather common in wet places; on shore near Long Point; abundant south of Outlet Bay, and on the shore in front of the Assembly grounds, near the depot, near Winfield's, along shore southwest of the lake, and still farther on in an old field. In flower by Scovell's cottage June 28. Some pods yet unopened October 24 on the south shore.

615. BLUNT-LEAVED MILKWEED

ASCLEPIAS AMPLEXICAULIS J. E. Smith

Not common; the only plants seen were a few forming a patch near the turn of the road where it crosses the railroad track near the thoroughfare. The plants grew in the light sand just at the edge of the rise which forms the broad hill back of the ice-houses. This plant is a lover of dry sands, and, in the great stretches of sand in counties north of Marshall, was observed to be fairly abundant. It is by far the earliest of the milkweeds to bloom, coming so long before them that it has usually finished its year's work, and its winged seeds are wrestling for their escape from the ripened gaping pod by the time the others come into bloom. Going out of bloom at the lake by June 13, 1901.

616. POKE MILKWEED; TALL MILKWEED

ASCLEPIAS EXALTATA (L.) Muhl.

A slender, woodloving form; one of the most attractive and graceful of the milkweeds, with drooping heads of white or creamy flowers. In flower near Overmyer's woods during the latter part of June; also in the clump of woods along the east shore of Lost Lake outlet.

617. COMMON MILKWEED; SILKWEED

ASCLEPIAS SYRIACA L.

The most common and well known milkweed in the state; found everywhere in dry ground about the lake. Although so common it

does not generally become a nuisance as it confines itself pretty well to waste places. There is a good deal on the north side of the lake, north of Edwards' south fence, near the mouth of Aubeenaubee Creek and southward. Rather abundant on the railroad embankment north of the lake; patches near Scovell's and in front of the Barnes cottage.

In flower, one of the least attractive of the milkweeds. Some plants, which bear immense numbers of flowers, and large dense heads of blossoms in all stages of development, offer a pleasing view when seen at a distance, but the flowers are of a neutral gray-purple, soon turning yellowish, and of a peculiar rank odor. Plants along the railroad between the lakes bore astonishingly large crops of flowers.

This milkweed, like the others, has a complicated mechanical device for effecting fertilization; the pollen masses are borne in pockets and united in pairs by a hair-like connective, and it appears to be necessary for some insect to trip on the hairs to pull out the pollen masses in order to secure fertilization. This plant seems to be a sort of drug shop among the insects; one frequently finds around it flies and bees which have been entangled and perhaps stupefied by the juices of the plant. It is also frequented by red long-horn beetles of a carnivorous nature, which attack and decapitate flies; they may haunt the plant for the insects which visit it. The milkweed butterfly is another well known visitor.

The mechanism by which fertilization is brought about seems to be a case of over-inventiveness. A remarkably small number of flowers produce any fruit, and a hundred flowers will rarely produce as many as a half-dozen pods. Some of the plants along the railroad were exceptionally fruitful.

In autumn, when the pods open, many of the seeds of the lower part of the pod escape soon but many toward the tip of the pods are held fast in some manner by the tips of the bristles, so that they project, waving and fluttering in every breeze and loosening one by one, making a dense clump of these plants in late autumn one of the most picturesque bits of scenery to be encountered.

The silky bark or fiber of this plant is one of the materials which the oriole uses to build its nest.

### 618. WHORLED MILKWEED

#### ASCLEPIAS VERTICILLATA L.

Not common. Occasional plants are found on banks along the railroad; more were found along the Assembly grounds hill than

anywhere else. The narrow leaves, arranged in whorls, give it a shapeliness and symmetry which makes it rather attractive. The flowers, while not conspicuous, are rather pretty. The pods are quite slender and elongate. Noted in flower in the latter part of August.

### 619. GREEN MILKWEED

**ACERATES VIRIDIFLORA (Raf.) Eaton**

Rather rare in the vicinity of the lake; a few plants found along the railroad track a little south of the Outlet bridge. It occurs more abundantly by the railroad track in the vicinity of Plymouth, though it is by no means common there. It is usually found in a dry sandy soil. The dense heads of blossoms which are green are so symmetrically and evenly arranged that the different parts of the flowers usually fall in line, making circles of light and dark or fulness and openness, which gives a pleasing sense of symmetry and an impression of unity, so that one does not notice the peculiarities of the individual flowers so much as that of the umbel as a whole. Flowering late in June.

### 620. FLORIDA MILKWEED

**ACERATES FLORIDANA (Lam.) A. S. Hitchc.**

Our only record of this plant is that of an herbarium specimen collected by Dr. Scovell. It should be fairly common, as conditions and range are well satisfied by the area about the lake. It is found about lakes in neighboring counties.

## Family 121. Convolvulaceæ. Morning-glory Family

### 621. MAN-OF-THE-EARTH; WILD POTATO VINE

**IPOMOEA PANDURATA (L.) Meyer**

A few vines in blossom seen along a fence west of the lake. Vines of what appeared to be this species were pretty common on the east side of Long Point, but they did not seem to thrive in the soil there, and did not blossom. It does not appear to be a bad weed in the vicinity of the lake.

In many parts of the country this plant is a great nuisance. The vines shoot up quickly in spring, and, fed by an enormous root, grow rapidly and twine about and smother growing crops. The root, while it contains considerable starch, is hard and woody; one was cooked a whole day to discover whether it would in any way resemble the sweet potato, to which it is closely related, but it remained as tough as a bit of wood.

### 622. HEDGE BINDWEED

**CONVOLVULUS SEPIUM L.**

The most common of the wild morning-glories about the lake. It is not a nuisance in this region, as it is confined mainly to the railroad embankment, where it grows in the ballast, trailing over the bank or twining about other herbs. It begins flowering in early June and continues throughout the summer.

### 623. UPRIGHT BINDWEED

**CONVOLVULUS SPITHAMAEUS L.**

A rather small dwarfed bindweed, found somewhat frequently along the railroad track, especially in the neighborhood of the Outlet bridge where it grows in the ballast on each side of the track. Though fairly common in parts of the state, it is neither so abundant nor of such rank growth as to become as great a nuisance as several of the other species occasionally do.

## Family 122. Cuscutaceæ. Dodder Family

### 624. FIELD DODDER

**CUSCUTA ARVENSIS Beyrich**

During the early years of the survey this was not an especially common plant; occasional plants were found on clover in Green's meadow. Of late years it has increased considerably, and in 1909 clover fields near Culver were badly infested, the masses of dodder showing in the distance as great yellow patches. Where it has gained a foothold it threatens to become a bad weed and difficult to control or eradicate.

### 625. COMMON DODDER; LOVE VINE

**CUSCUTA GRONOVII Willd.**

Rather common on herbs and low shrubs such as golden-rod and willow along the shore of the lake. Found along the south shore of Outlet Bay and in the strip of marsh by the lake below Farrar's. Not an especially conspicuous plant. Young willows are occasionally killed by it. As it confines its attention to uncultivated plants, it does not assume the economic importance that the field dodder does.

### 626. GLOMERATE DODDER

**CUSCUTA PARADOXA Raf.**

Not noted about the lake until 1909, when a large patch was found some distance down the outlet. The plant had here obtained

foothold among tall rank weeds, such as wild sunflowers and the like, and had attacked them so successfully that a large patch of the plants had been killed out, and it appeared as if the area had been blighted or frosted; much of the dodder had ripened or nearly developed its fruit, while much was still in flower in September.

This is the most conspicuous and handsome of the dodders; a mass of the waxy white flowers almost as large as the fist or a heavy rope-like spiral encircling the solid stem of the weed, like flowers springing directly out of the trunk, is both odd and attractive. As this dodder confines its attentions to wild weeds there is no likelihood of its ever becoming a nuisance.

## Family 123. Polemoniaceæ. Phlox Family

### 627. DOWNY PHLOX

PHLOX PILOSA L.

Quite abundant in sandy places along the railroad, especially some distance south of the birch swamp. The plants frequently grow in such close patches as to give the impression of flower beds. Begins flowering in April. Noted in flower near the tamaracks west of the lake May 22, 1901. Not so attractive nor fragrant as the wild blue phlox, but has a much longer flowering season, blooming more or less through summer until autumn.

### 628. WILD BLUE PHLOX

PHLOX DIVARICATA L.

Scattered through woodlands, especially on the east side of the lake back some distance from the shore. In flower northeast of the lake in border of woods and in woodlands April 30, 1901, and in Farrar's woods May 27. It continues blooming through May and June. The blossoms have not the body nor firmness of some of the other phloxes, but their delicate texture and faint fragrance make them one of the best loved wild flowers of the state, where a common name is sweet william. Although the flowers are usually some shade of blue or purple, forms with pure white flowers rarely occur; in such cases the whole plant is usually lighter in color. Easily transplanted and often found in dooryards and wild gardens.

In addition to the flower-bearing plant there are sterile ones with broad leaves, so unlike the narrow-leaved flower-bearing plants that they are hardly recognizable.

629. BLUE-BELL; GREEK VALERIAN

POLEMONIUM REPTANS L.

Found south along the railroad; possibly more common than our notes would indicate as it is generally common throughout the state in damp places. The lower leaves remain green all winter.

## Family 124. Hydrophyllaceæ. Water-leaf Family

630. VIRGINIA WATER-LEAF

HYDROPHYLLUM VIRGINIANUM L.

Rather common, especially in shady rich gullies on the east side of the lake. Found in flower in Vajen's gully May 28, 1901. It has a long flowering period, continuing in blossom until well into the summer. The pale flowers are conspicuous. The curiously mottled leaves which come up in early spring are interesting and attractive.

631. APPENDAGED WATER-LEAF

HYDROPHYLLUM APPENDICULATUM Michx.

Common in moist shaded places, in rich ground on the east side of the lake. Found in flower in Vajen's gully May 28, 1901. Quite similar to the preceding species in habits and distribution. The leaves were showing well by March 31.

## Family 125. Boraginaceæ. Borage Family

632. HOUND'S-TONGUE

CYNOGLOSSUM OFFICINALE L.

Common, especially in rather dry soils in open places on the east side of the lake. It seems especially fond of growing on rather gently sloping gully sides. Young leaves shoot up early in the spring soon after the frost is out of the ground; it begins blooming in May, and continues to produce flowers and burrs throughout the summer. The burr-like seeds remain on the plant late into winter or until they are swept off by some passing animal. Often a nuisance in pastures, the burrs becoming entangled in the wool of sheep.

633. BURSEED

LAPPULA LAPPULA (L.) Karst.

An introduced weed becoming rather common in waste places in some parts of the country, especially on the east side of the lake. Some plants found in blossom along the railroad June 26, 1901.

### 634. BEGGAR'S-LICE; VIRGINIA STICKSEED

LAPPULA VIRGINIANA (L.) Greene

Quite common in rich thick woods on the east side of the lake, so that one can hardly pass through without getting well loaded with the burrs. Found also in the low woods south of the lake, by Overmyer's field. The plants do not grow in deep shady woodlands, but as soon as enough clearing is done to let in sunlight they frequently spring up in great numbers, especially in rich mold, about brushpiles, etc. One of the worst of our burrs, the little nutlets catching and clinging to wool, clothes and hair in great numbers and with much tenacity. Fortunately the plant does not appear to thrive well in cleared, well-sodded pastures or in cultivated ground.

### 635. SPRING SCORPION-GRASS

MYOSOTIS VIRGINICA (L.) B. S. P.

A few plants found in flower back of the Scovell cottage, during the month of May. Later on it was found in blossom almost everywhere about the lake in dry ground.

### 636. CORN GROMWELL

LITHOSPERMUM ARVENSE L.

Quite common; found almost everywhere on the hill west of the ice-houses, and along the railroad, also about the cottages on Long Point. The plant is becoming quite widely scattered in waste places and fields. In flower by the cottages the last of April. Later on it was found north and northwest of the lake on dry hills. It continues blooming until late in summer.

### 637. HAIRY PUCCOON

LITHOSPERMUM CAROLINENSE (Walt.) MacM.

Quite common in sandy ground; found on the bank by the Assembly grounds and north of the lake. The rather large golden yellow flowers, which are quite fragrant, make it a very conspicuous and handsome plant.

### 638. HOARY PUCCOON

LITHOSPERMUM CANESCENS (Michx.) Lehm.

Found in the same situation as the preceding, but it blossoms earlier and has a smaller and scentless flower. Noted in blossom May 2, 1901. It continues in blossom well into summer, but the later flowers are fewer and more scattered in the cluster.

## Family 126. Verbenaceæ. Vervain Family

### 639. WHITE OR NETTLE-LEAVED VERVAIN

**VERBENA URTICIFOLIA L.**

Scattered in waste places; the least common species about the lake excepting *V. bracteosa*. It grows in situations similar to those occupied by *V. hastata* except that it does not grow in such damp places. It closely resembles that species except that it is much more delicate in habit and paler throughout, and corresponds in many respects to *hastata* as the "white blackberry" and white flowered red clovers do to the more common forms. Plants with purplish flowers are occasionally found. This species is said to hybridize with all the other common forms.

### 640. BLUE OR WILD VERVAIN

**VERBENA HASTATA L.**

Common in the region surrounding the lake. Scattered along shore by Duenweg's, on the flat beach east of Lakeview Hotel, between the breakwater and shore by the Palmer House, along shore near Overmyer's woods, and beyond Norris Inlet. It grows most thickly on flat moist tracts of country, where it is often so abundant as to turn the whole landscape a sober blue in early autumn. In moist years it is especially subject to mildew, and one often sees great areas where this plant is abundant, whitened by the mildewed leaves of the Vervain.

### 641. HOARY VERVAIN; MULLEIN-LEAVED VERBENA

**VERBENA STRICTA Vent.**

Not very common; in waste places along the railroad near Culver. A little found near Long Point road back of the Miller cottage. It grows best in dry rather sandy ground. The dense spike of deep purple flowers is more striking than the slender spikes of most of the other species.

### 642. LARGE-BRACTED VERBENA

**VERBENA BRACTEOSA Michx.**

Not common; the first plants were found near an old homestead south of Culver, where they were found in blossom early in June. Later it was found along the railroad, where it was becoming rather common. Probably native, as the lake region lies well within its range. Its behavior and distribution about the lake, however, are much like those of a plant recently introduced.

## Family 127. Labiatæ. Mint Family

### 643. AMERICAN GERMANDER; WOOD SAGE

TEUCRIUM CANADENSE L.

Very common along the beach, scattered among the various other beach plants, and somewhat above high-water mark. Most common on the west and south sides of the lake, extending from the old pumping station nearly to Norris Inlet; found also on the east shore.

### 644. MAD-DOG SKULLCAP

SCUTELLARIA LATERIFLORA L.

Scattered in moist places about the lake. Found at Long Point, near Farrar's, along shore by McSheehy's and Duenweg's, near Overmyer's, and on the beach beyond Norris Inlet.

### 645. MARSH SKULLCAP

SCUTELLARIA GALERICULATA L.

Rather common in marshy places about the lake.

### 646. WHITE HOARHOUND

MARRUBIUM VULGARE L.

Scattered in waste places. Found by Green's, and south of the lake on the way to Delong. The leaves show very early in spring; probably some leaves remain green all winter. Originally a garden herb, it has become a weed on rather barren slopes and thin pastures, but never disturbs cultivated soil.

### 647. CATNEP; CATNIP; CATMINT; GIANT-HYSSOP

AGASTACHE NEPETOIDES (L.) Kuntze

Not common. Some plants were seen on the east side along the Maxinkuckee road. Occasional in open woodlands. One of the largest and most robust of the mints.

### 648. CATNEP; CATNIP; CATMINT

NEPETA CATARIA L.

Rather common, scattered; on a bank near the railroad bridge at Culver and on a hill north of the lake; common also on a hillside in Green's woods. It is rather surprising how this introduced plant which has no special means of distributing its seeds (unless the wind carries them while enclosed in the light dry calyx), is now to be found everywhere in the country, sometimes rather remote

from dwellings. In spite of its powers of distribution, it never becomes a bad weed, but is content with waste places and fence corners. About Lake Maxinkuckee it shows a marked preference for slopes.

The plant is quite hardy; the leaves stay green all winter, even during very severe winters, and are apparently unhurt by freezing. Seedlings come up thickly about the old plants either in autumn or early spring. The blossoms, which are a favorite with honey bees, are present from July until frost, and a great number of seeds are produced.

### 649. GROUND IVY

GLECOMA HEDERACEA L.

Occasional in waste places; a small patch along the shore near the Morris boathouse, east of the depot grounds; another patch near Knapp's; found growing on a bank in woods along the Tippecanoe River.

An introduced plant, common about old homesteads. As in the case of the catnep its broad distribution is rather hard to account for; one sometimes finds it on banks in open woodlands far from any dwelling. Small fragments of the plant, however, will root and spread, and the plant is often a nuisance in swards and grassy places as it soon crowds everything else out. It and the moneywort or yellow myrtle are very much alike in this respect.

There is a variegated-leaved form in cultivation which is more attractive; but this species needs discouragement rather than encouragement everywhere. Noted in blossom by Knapp's about the middle of May. The small blue flowers are borne abundantly throughout the spring—from March until the end of May.

### 650. HEAL-ALL; SELF-HEAL

PRUNELLA VULGARIS L.

Common about the lake in both dry and moist grounds. Begins blooming in May, and continues, especially in moist grounds, until after frosts have killed most other flowers. Noted in flower as late as October 25. Found on each side of the lake, east of Lost Lake, and especially common on the ridge south of the road along the shore of Outlet Bay. As its popular name suggests, it was once in great repute among herb doctors and was a famous ingredient of homemade salves. Common in fields and open woods everywhere, so familiar and apparently native that it is difficult to think of it as an introduced plant.

651. DRAGON-HEAD

DRACOCEPHALUM VIRGINIANUM L.

Quite common along the railroad between the two lakes, on the bank west of Lost Lake outlet, and in Green's and Walley's woods; found also in a swamp west of the railroad south of Murray's. One of the most striking of our plants when in flower, the dense spikes of rather large pale-purple flowers catching the eye at a distance. Known in some places as obedient plant; according to Britton the corolla temporarily remains in whatever position it is placed. The plant is well worthy of cultivation for its ornamental value.

652. MOTHERWORT

LEONURUS CARDIACA L.

Scattered in waste places about the lake, both on the east and west sides. In flower near the old Keen homestead June 13. It remains blooming through the summer, into September. A hardy plant, the radicle leaves remaining green all winter. Like so many of our mints, an importation from Europe. The exceedingly prickly calyx teeth may help, by sticking to fur or clothing, to distribute the seed. They are, however, without barbs, and prick rather than cling.

653. HEDGE NETTLE

STACHYS PALUSTRIS L.

Common along the shore of the lake, occupying much the same locations as does *Teucrium canadense*, to which it bears considerable general resemblance; found at the tip of Long Point, by Darnell's, and at the Barnes cottage. Noted in blossom from June 27 to September 30.

654. HORSE-MINT; WILD BERGAMOT

MONARDA FISTULOSA L.

Scattered, in dry soil. A common plant, usually found in quite thick patches in fence corners in many parts of the state but apparently not so abundant about the lake. There was a good patch by McSheehy's pier, and some on Long Point hill. One of the early plants to shoot up and put forth leaves in spring; from then on scarcely noticeable among the abundant greenness until its clusters of blossoms, forming lines of somber gray along roadside fences, and hovered over by butterflies and heavy clumsy bumblebees, usher in the autumn days. The old heads, like small round sponges, or perhaps more like miniature inverted wasps nests, show

conspicuously above the snow during the winter days, and in a sense and reality that only a few select other plants do, stand as memorials of a vanished autumn and give a definite character, an almost piquant personality to featureless stretches of snow.

### 655. HORSE-MINT

**MONARDA PUNCTATA L.**

Found only on the wide sandy stretch back of the icehouses and between the lake and Culver. Here it was quite common. The lurid mottled flowers and showy white or purplish bracts make it an unusually conspicuous plant. It thrives best in dry shifty sand.

### 656. PENNYROYAL

**HEDEOMA PULEGIOIDES (L.) Pers.**

Common in woodlands, as on Long Point and Green's woods by Lost Lake. Patches of this plant are perhaps more conspicuous in winter than at any other time when the leafless, fruit bearing stems project above the snow, still retaining something of the pleasant odor which the plant possesses in summer.

### 657. MOUNTAIN-MINT

**KOELLIA VIRGINIANA (L.) MacM.**

Rather common about low flat plains like those about the Inlet and by Lost Lake. Found south of Winfield's and in flat ground near the tamarack west of the lake. Rather pleasantly fragrant.

### 658. NARROW-LEAVED MOUNTAIN-MINT

**KOELLIA FLEXUOSA (Walt.) MacM.**

We have no notes on this species, and it did not come frequently under observation. However, we have an herbarium specimen, and it is rather abundant along the railroad about one and a half miles north near Hibbard. It is probably rather common in dry hills some distance back from the lake.

### 659. CUT-LEAVED WATER HOARHOUND

**LYCOPUS AMERICANUS Muhl.**

Rather common along the west shore of Lake Maxinkuckee and other moist places, as about the edge of Lost Lake on the east side. The plant is quite conspicuous in winter when the leafless stalks are surrounded by the globular clusters of calyces enclosing the fruit.

### 660. SPEARMINT

MENTHA SPICATA L.

Found in patches on the beach on each side of the lake, on shore by Murray's, and on the beach beyond Norris Inlet. On the east shore there is a long continuous patch on the sandy beach. One of the most delightfully fragrant of the mints.

### 661. PEPPERMINT

MENTHA PIPERITA L.

Patches of this plant are found in various places along the shore of the lake, both on the east and west sides. A large patch was found growing in low ground in waste places some little distance northeast of the lake. Found growing at Long Point, north of the icehouses, near the Culver railroad bridge, etc. Has a long flowering period, from July to September, and propagates freely by underground runners.

In some parts of the state, about the small lakes, this is becoming an important crop. The black soil of the flat lake plains which are too low to drain, and which are for this reason unsuitable for any other crop, yields good financial returns when set out to peppermint. We saw such peppermint fields around small lakes north of Maxinkuckee and were told they were profitable. When the peppermint has reached its growth, the distiller comes around with a portable still and distils out the oil, which brings good prices. The refuse left after distilling is said to make good hay, keeping horses sleek and glossy and in excellent condition.

Some of the moist waste places about the lake might yield profitable returns if this plant were cultivated on them.

### 662. AMERICAN WILD MINT

MENTHA CANADENSIS L.

Common in moist ground along the shore of the lake, on both sides, as Long Point and near the Maxinkuckee road. Plentiful by McSheehy's pier, back of Winfield's, near the Culver railroad bridge, on the flat east of Lakeview Hotel, in the marsh south of Farrar's, at the edge of Overmyer's woods, and along the beach below Norris Inlet. One of the few native species of the genus, nearly all our members of this genus having been brought over from Europe.

## Family 128. Solanaceæ. Potato Family

### 663. LOW HAIRY GROUND-CHERRY

**PHYSALIS PUBESCENS L.**

Of sparing, irregular occurrence. It comes up usually in rich new ground after the first plowing, and is found especially in the new ground of cornfields or potato patches, where it grows up rather tall and then spreads extensively like a miniature tree. Late in autumn before frosts have killed the plants they may be found with ripe fruit close to the center of the plant and on the ground underneath, hidden by the leaves, while as one advances toward the peryphery of the broadly spreading plant he encounters fruit in all stages of development, and possibly a few flowers. The fruit is delicious, when dead ripe a clear translucent yellow, a mass of perfect sweetness with little or no night-shade flavor.

On October 24, 1904, several of these plants were found pretty full of fruit, in a cultivated field (new ground) by Hawk's marsh.

### 664. TALL HAIRY GROUND-CHERRY

**PHYSALIS PRUINOSA L.**

We have no notes on this species; it is, however, represented by an herbarium specimen collected in the vicinity of the lake. The ground cherries are so difficult of identification that it is almost impossible to keep field notes concerning them without devoting a great deal of attention to the group.

### 665. PRAIRIE GROUND-CHERRY

**PHYSALIS LANCEOLATA Michx.**

In flower along the railroad June 4, 1901. In the late autumn of 1904 a plant, which was probably this species, was noted on the bank of the lake near McSheehy's. The plant was rather tall, and bore yellow berries which, while not wholly free from the rank odor and taste so common among members of this genus, were much better eating than most of them.

### 666. VIRGINIA GROUND-CHERRY

**PHYSALIS VIRGINIANA Mill.**

Occasional about the lake. We have an herbarium specimen but no specific records or notes.

### 667. BLACK NIGHTSHADE; DEADLY NIGHTSHADE

**SOLANUM NIGRUM L.**

Quite common everywhere in open places in moderately dry ground. Quite variable in size. On the shore it was found near

the icehouses, between the railroad bridge and depot, and in front of the Palmer house. On October 24 and 25, 1904, many small plants about two inches high were found in flower both in cultivated ground near Hawk's marsh and east of the lake. It was impossible to say from their appearance whether they were young or dwarfed plants. The plant has a long flowering season, from July until killed by frost, and bears ripe fruit, green fruit and blossoms at the same time; in fact, it really acts much like a miniature tomato. It is probable the fruit that ripens early which gives rise to plants bearing fruit later on in the same season. Some of the plants, growing on almost bare rock, bore flowers and fruit when they had only three or four leaves.

This is often called "deadly nightshade", and is supposed to be virulently poisonous by many people, and a gentleman residing in Culver credited it with poisoning his lambs. On the contrary the fruit is said by others to be entirely harmless, and to be used in some sections of the country for making pies.

### 668. HORSE-NETTLE

SOLANUM CAROLINENSE L.

Rather rare; a few plants along the railroad. Occasionally found in fields, where it is a great nuisance. This is rather far north in the state for it. Rather common from the central part of the state southward.

### 669. BITTERSWEET; BITTER NIGHTSHADE

SOLANUM DULCAMARA L.

Found October 24, 1900, in the tamarack northwest of the lake. Found also at Fletcher's Lake. Introduced into the country as an ornamental plant, its abundance of scarlet berries being showy. Seed, distributed by birds, grow abundantly in moist places in some parts of the state. It is common in peaty bogs about Plymouth, and bears two distinct colors of flowers, some plants bearing pale, almost white flowers, and others deep blue.

### 670. THORN-APPLE; JIMSON-WEED

DATURA STRAMONIUM L.

Along shore at Arlington and in the Fish Commission station yard. Not common. Once a common weed of barnyards, this plant seems to have become much less so of late years.

## Family 129. Scrophulariaceæ. Figwort Family

### 671. GREAT MULLEN

VERBASCUM THAPSUS L.

Quite common in open dry ground everywhere about the lake; exceedingly abundant in old pastures and neglected fields. The first plant found in blossom in 1901 was on the railroad, on June 29. Seen in blossom at the tamarack on October 24, 1904. The downy woodpecker is fond of pecking at the heads of these plants in autumn, perhaps for larvæ, perhaps for seed.

### 672. BUTTER-AND-EGGS

LINARIA LINARIA (L.) Karst.

Represented by a specimen taken near the Lakeview hotel, August 25, 1900. Apparently once a favorite in gardens, now frequently found marking the sites of old homesteads or old flower gardens. Here it maintains itself year after year, glowing in the distance like a patch of gold. It does not appear ever to spread much and become a nuisance, but remains in the same place without much increase. It continues blooming after heavy frosts, and seems to have an unusual degree of resistance to cold. A favorite old-fashioned name is golden candlestick.

### 673. BLUE OR WILD TOAD-FLAX

LINARIA CANADENSIS (L.) Dumort

Found going out of flower back of Smith's west of the ice-houses May 25, 1901. This is the only place it was found, but it was rather plentiful there.

### 674. MARYLAND FIGWORT

SCROPHULARIA MARYLANDICA L.

Our records show one herbarium specimen of this species.

### 675. HARE FIGWORT

SCROPHULARIA LEPORELLA Bicknell

Quite common in rather dry ground all about the lake; among numerous places noted it was found in Green's woods, at Long Point, and on the hill by McSheehy's pier. Noted in flower May 28, 1901, by the railroad in front of the Assembly grounds. The branching form and numerous seed capsules make it and the preceeding noticeable species and easily recognized plants in winter. When in blossom it is a favorite resort of hummingbirds.

676. SNAKE-HEAD

CHELONE GLABRA L.

Occasional in wet, somewhat shady places. Found near Overmyer's hill, October 2, 1900, where it was well in leaf May 12, 1901; in Green's flat; by Chadwick's; and in Walley's woods. Abundantly in flower north of the lake along the railroad, August 19, 1906. Sometimes called "wild snap dragon."

677. BLUE-EYED MARY; INNOCENCE

COLLINSIA VERNA Nutt.

Noted in flower in the woods northeast of the lake June 5, 1901, in moist shaded places. It is one of the daintiest of our wild flowers. Sometimes the lower part of the corolla is pinkish instead of blue. The contrastive coloration of the flower is striking and the plants generally grow in masses suggesting flower-beds.

678. SQUARE-STEMMED MONKEY-FLOWER

MIMULUS RINGENS L.

Local in distribution; there was quite a number of plants in the bayou or excavated channel by Winfield's. A specimen collected June 25, 1900, was labelled, "in marsh near Culver." It is generally rather common throughout the state in moist places and along woodland streams.

679. CLAMMY HEDGE-HYSSOP

GRATIOLA VIRGINIANA L.

Found in flower in damp places along the Long Point road near Chadwick's. Noticed first in flower June 13, 1901, specimens collected June 17. It is commonly found about the edges of shallow, dried up pools in clayey ground, and the whole plant possesses a delicate, pleasant fragrance.

680. LONG-STALKED FALSE PIMPERNEL

ILYSANTHES DUBIA (L.) Barnhart

Found at the edges of pools, usually in muddy places, much the same situations as those in which *Gratiola virginiana* occurs. It somewhat resembles *G. virginiana* in habit, but has long-stemmed purplish blossoms, and lacks the fragrance of that species.

681. WATER SPEEDWELL; PIMPERNEL

VERONICA ANAGALLIS-AQUATICA L.

Found along ditches on the east side of the lake in the neighborhood of Aubeenaubee Creek.

### 682. MARSH OR SKULLCAP SPEEDWELL

VERONICA SCUTELLATA L.

Probably not abundant. We have an herbarium specimen, but no notes. Generally reported as not abundant in the state.

### 683. THYME-LEAVED SPEEDWELL

VERONICA SERPYLLIFOLIA L.

Common throughout the state in the grassy borders of woodlands. Not generally common about the lake; a few fine little patches in a grassy place by Hawk's fence northwest of Lost Lake where the bank slopes down to the lake plain. A plant of wide distribution, said to be found in Europe, Asia and South America. Although so modest a plant that it usually escapes observation, it is in several ways full of attractiveness and charm. The trailing stem, with its orderly arranged leaves, remaining green and fresh the year round, and the dainty blossoms, so small that they require slight magnification to make them show up at their best, are both features that make the finding of it a pleasure. But its chief charm is its constancy of blossoming. In this respect no other plant, not even the chickweeds, which bloom more or less during the winter, can quite compare with it. It is usually possible to find it in blossom at least every bright day in the year. It has been found blooming out doors, in sheltered locations both Christmas and New Years in northern Indiana. Each individual flower lasts only a short time to be followed by a heart-shaped pod.

### 684. PURSLANE SPEEDWELL

VERONICA PEREGRINA L.

Scattered in grass on Long Point near the Plank cottage, where it was in flower May 5. Found also south of the lake. A thick-leaved, homely plant, common in cultivated ground, especially in heavy clay soils.

### 685. CORN SPEEDWELL

VERONICA ARVENSIS L.

Common in pastures and swards; a rather inconspicuous plant with minute dainty blue flowers. In flower May 5, at Maxinkuckee Assembly entrance and near the hill by the Outlet. An introduction from Europe which has spread rather rapidly over the country, but which will probably never become a very great nuisance.

686. CULVER'S-ROOT

LEPTANDRA VIRGINICA (L.) Nutt.

A few plants found at the open edges of woods. Some found in 1904 in woods at the south end of the lake a little beyond the corner of Busart's field. The symmetrical form of this tall plant with its whorled leaves and dense spike of whitish flowers, makes it a stately and attractive plant. In flower during July and August, sometimes continuing until late in autumn.

687. FERN-LEAVED FALSE FOXGLOVE

DASYSTOMA PEDICULARIA (L.) Benth.

Rather common, scattered through dry woods north of Lost Lake. Noticed in flower during the month of September, 1900.

688. DOWNY FALSE FOXGLOVE

DASYSTOMA FLAVA (L.) Wood

Not so abundant as some of the other species of the genus; found scattered through dry, rather open, woods near Lost Lake.

689. ENTIRE-LEAVED FALSE FOXGLOVE

DASYSTOMA LAEVIGATA Raf.

We have no notes on this species, but its presence is attested by an herbarium specimen collected in July, 1900.

690. SMOOTH FALSE FOXGLOVE

DASYSTOMA VIRGINICA (L.) Britton

Found near the Lakeview Hotel, a little way from the lake. A very handsome, conspicuous species; the large golden-yellow flowers glow through the woodland shadows with a brightness that attracts the attention for a considerable distance.

691. SMALL-FLOWERED AGALINIS

AGALINIS PAUPERCULA (A. Gray) Britton

Common in the low marshy flats surrounding Lost Lake; noted especially in low ground east of Lost Lake outlet near Walley's. Forming large patches in grassy ground at the northern end of Green's marsh where it gave its color in August and September to a considerable area, looking much like a large flower-bed. Individual plants with their numerous slim erect branches, narrow leaves, and fair-sized rose-purple blossoms on slender pedicels have a peculiar airiness and grace.

692. SCARLET PAINTED-CUP; INDIAN PAINT-BRUSH

CASTILLEJA COCCINEA (L.) Spreng.

Several specimens found in blossom with bright lemon-yellow bracts, at the edge of Inlet marsh, October 19, 1904. The ground had been mown over where the plants were found, and this probably explains why they were in blossom at this season.

The brilliant scarlet erect bracts, concealing the blossom of this plant, make it an interesting oddity as well as an attractive object, and render "paintbrush" a very appropriate name. It is usually a spring flower with us, its proper flowering season being from May until into July.

693. SWAMP LOUSEWORT

PEDICULARIS LANCEOLATA Michx.

In flower back of Winfield's at the edge of the lagoon-like channel, August 31 and September 28, 1900; also near the Lakeview Hotel; found also southeast of the lake where a specimen was collected August 22, 1900. A good deal was noted in flower in marshes by the tamarack on September 22, 1907. Grows in quite damp places.

Our two species of Pedicularis are interesting in that one is an early spring flower and the other is better known as a flower of the fall. This species continues blossoming until into October.

The chief attractiveness of the latter perhaps is that it is a reminder of the blossom of the spring.

694. LOUSEWORT; WOOD BETONY

PEDICULARIS CANADENSIS L.

Fairly common in woodlands; began to peep up out of the ground, the buds bright purplish pink, April 7, 1901. In flower, Walley's woods, May 2. One of the early spring flowers, its dense spike of pale yellow blossoms rather attractive.

FAMILY 130. LENTIBULARIACEÆ. BLADDERWORT FAMILY

695. PURPLE BLADDERWORT

VESICULINA PURPUREA (Walt.) Raf.

Rather common in the south end of Lost Lake near its outlet. Noted in flower September 18, 1900. The most symmetrical plant of the genus—its leaves whorled so that in general shape it resembles a Chara or a Nitella. It has numerous large bladders and handsome purple flowers. With the progress of autumn (October

27 and later) it falls to the bottom and curls up in a peculiar fashion, the leaves coiling up circinately, like fern-leaves, and it thus winters over. It grows among a dense vegetation of spatterdock, milfoil and hornwort.

### 696. HUMPED BLADDERWORT

UTRICULARIA GIBBA L.

Frequent in sand along the shore on the west side of Lost Lake. A small, inconspicuous species. Noted in flower August 2, 1906.

### 697. FLAT-LEAVED BLADDERWORT

UTRICULARIA INTERMEDIA Hayne

Among the numerous bladderworts found in Lost Lake marsh a few thought to be this were found close to shore. They were quite rare, and did not reach the fine development noted in plants collected at Eagle Lake in an adjoining county, where the species reached great perfection. The Lost Lake plants were dwarfed and not well developed. The plants are exceedingly variable in appearance, the aquatic form with slender, inconspicuous leaves, the creeping land form with broader, firmer, more conspicuous leaves, arranged symmetrically on each side of the stem. The bladders are larger than in any others we have noted, and are white in color, borne on leafless stems and usually along or under ground. We never found any animal remains in them. The interior is beset with large peculiar glands.

April 25, 1901, growing in good shape, with large bladders, in Green's marsh; May 19, first flowers seen; May 24, abundantly in blossom.

This species makes firm winter buds, much smaller than those of *macrorhiza*.

### 698. LESSER BLADDERWORT

UTRICULARIA MINOR L.

Abundant in the north end of Lost Lake and in the flat marsh north of it. A small inconspicuous species. Noted in flower the latter part of May and on through the summer. Winter buds small, about the size of pinheads or a little larger.

### 699. GREATER BLADDERWORT

UTRICULARIA MACRORHIZA LeConte

Common in Lost Lake, especially in the upper end, but not growing in such great masses as in one of the Twin Lakes farther

north. Common in the ponds and ditches in Green's marsh; abundant also in the outlet of Lost Lake near Walley's. It forms considerable masses of vegetation in the lake, some of the plants being over three feet long with numerous long branches. It was found also in a permanent pond east of the lake north of the Maxinkuckee road. The great number of bladders make it a curious object. The bladders are usually light green, like the rest of the plant, but in some cases they are dark purple, in which case they are especially conspicuous. They are sometimes so deep a purple as to be entirely opaque.

The bladder is a curious contrivance bearing a remarkable resemblance in general outline to a water-flea (*Daphnia*), the long bristles reaching out from the mouth resembling the anterior appendages of the crustacean. These bristles probably act as guides to the trapdoor which rises easily to let small creatures through but drops down after they have entered.

### 700. RECLINED BLADDERWORT

**LECTICULA RESUPINATA (B. D. Greene) Barnhart**

Not common; a small patch found by the water's edge on the east shore of Lost Lake below the Bardsley cottage. A dainty little plant with attractive purple flowers noted in flower from the middle to the latter part of August, 1906.

## Family 131. Orobanchaceæ. Broom-rape Family

### 701. SQUAW-ROOT

**CONOPHOLIS AMERICANA (L. f.) Wallr.**

A plant of this species was seen in a gully northeast of the lake, April 11, 1907. The yellowish, thick, cone-like growth forming a dense spike of flowers and rising directly out of the root of an oak, was a striking object. In some parts of Tennessee where this plant is common it is known as "Devil's popcorn."

### 702. BEECH-DROPS

**LEPTAMNIUM VIRGINIANUM (L.) Raf.**

Found quite abundantly on the east side of the lake, both in the spring of 1901, April 6 and 11 (old last year's plants), and in the winter of 1904.

## Family 132. Bignoniaceæ. Trumpet-creeper Family

### 703. TRUMPET-CREEPER

BIGNONIA RADICANS L.

Found growing wild in a flat rich level field east of the lake near Maxinkuckee. It was also found near the mouth of the outlet of the lakes. In some parts of the state the plant is a general nuisance, and is known as "Devil's shoestring." Planted for ornament in some parts of the state.

### 704. CATALPA; LARGER INDIAN BEAN

CATALPA SPECIOSA Warder

Although this tree is planted quite frequently and now and then a seedling is seen, it could hardly be said to be established. Seedlings are, however, becoming somewhat more abundant, and are occasionally seen in waste places and along the railroad. There are several trees on Long Point.

## Family 133. Phrymaceæ. Lopseed Family

### 705. LOPSEED

PHRYMA LEPTOSTACHYA L.

Rather common in Green's woods and probably common in other dry woods about the lake. A tall weed with a good deal the aspect of a smartweed. Upon blossoming, the head bends downward against the stalk, as the common name suggests. The plant with its reflexed fruit looks quite burry, and the seeds are distributed somewhat by catching in fur and clothing. It is not, however, a bad bur.

## Family 134. Plantaginaceæ. Plantain Family

### 706. RUGEL'S PLANTAIN

PLANTAGO RUGELII Dcne.

Rather common in open grassy places. Abundant along the railroad near Winfield's. This, along with *Plantago major*, is one of the most pestiferous weeds we have, often obtaining foothold in meadows and crowding out grass and clover. In such situations it increases and spreads with great rapidity, and is quite difficult to eradicate. It is often obtained in dirty clover seed.

### 707. RIBWORT; ENGLISH PLANTAIN

PLANTAGO LANCEOLATA L.

Not very common; a few plants along the railroad north of the ice-houses, also near the Lakeview Hotel; apparently of recent introduction. Noticed in flower May 24, 1901, and June 12. More common in the vicinity of railroads. In some parts of the state spreading and becoming a bad weed.

### 708. LARGE-BRACTED PLANTAIN

PLANTAGO ARISTATA Michx.

Not common; and probably of recent introduction. Only two patches found, one by the Gravelpit and the other by Murray's. In flower June 17 and later. A conspicuous plant when in fruit.

## Family 135. Rubiaceæ. Madder Family

### 709. BLUETS; INNOCENCE

HOUSTONIA COERULEA L.

Rather common in one place on the west side of the railroad in an open grassy area, near a swamp southwest of Murray's. Rather scattered in distribution in the state, but it is sometimes present in large patches. One of the most attractive of our spring flowers and easily transplanted to the garden or flowerpot where it continues to thrive and blossom for some time.

### 710. BUTTON-BUSH

CEPHALANTHUS OCCIDENTALIS L.

Quite common about the edges of the lake where the shore is swampy, as on the south shore of Outlet Bay, and south of Green's; also in the swamp adjacent to the lake between Farrar's and Overmyer's. Button-bushes also form the borders of woodland ponds, both south of the lake (Zechiel's, Farrar's and Walley's), and, the numerous woodland ponds, east of the lake. They generally grow in such tangles that the form of the individual bush is not noticeable, but down in the neighborhood of the Busart road, some little distance from the lake, a clump of these bushes which had reached the dimensions of small trees (15 or 20 feet high) grew in a level flat which had no underbrush and did not appear at any time to be a pond. Here the exceedingly crooked trunks, giving the impression of immense age and dwarfishness, had a peculiarly grotesque effect. Usually the bases of the bushes when in ponds are skirted by long moss, and among moss in such situa-

tions one often finds the very handsome leafy liverwort *Porella pinnata*. None of this, however, was found at Lake Maxinkuckee.

A local and very appropriate name is "Pincushion", the stigmas and styles resembling pins stuck into a cushion. It is also called bear wallow and many of the old settlers say that the bushes grow where bears used to wallow.

The bushes frequently have branches in 3's. The fragrant and attractive heads of blossoms are much frequented by honeybees.

### 711. PARTRIDGE-BERRY; TWIN-BERRY

MITCHELLA REPENS L.

Rare; two small patches found northeast of the lake in woods by ponds a little way from the lake; these patches bore a good many fine berries. Another patch was found in 1907 on an island down the outlet, a rounded hill rising above the flat level plain. Another patch was found north of Plymouth on the bank of Yellow River. Not at all common so far north in Indiana.

This little evergreen creeping vine is, in a quiet unobtrusive way, one of the most attractive members of our flora that gives much delight many days in the year. Through June and July the pretty blossoms, borne in pairs, and almost velvety inside—odd from the fact that some have the stamens projecting and others the pistils—are present and add to the attractiveness of the plant. There is hardly a day in the year when the pretty scarlet, two-eyed berries are not present, the berries of autumn remaining until July and sometimes through the entire summer. The berries grow rather scattered, and it is difficult to find a patch thickly enough beset to make much display.

On the Washington market the negroes have the berries for sale in bunches. These can be obtained during the autumn, and by placing them in a proper vessel, such as a glass fish globe, and preventing evaporation, they will keep until far into the next year.

If it could be induced to thrive and bear heavily this would be one of the most desirable plants to introduce into cultivation, especially for florists, for the production of bouquets or cut flowers. It would be admirable for clothing mossy banks.

### 712. CLEAVERS; GOOSE-GRASS

GALIUM APARINE L.

Found along the railroad in front of the Assembly grounds, in flower May 18, 1901. Not particularly common. In general it is to be found in rich, moist black ground. The lower shoots of

the plant stay green all winter, and after the snows have gone one of the earliest bits of green to catch the eye is its dainty whorl of leaves. The seed is a peculiar structure, a horny cellulose hemisphere hollowed on the side. Both the bristly fruit and prickly bits of stems adhere to clothing like burrs, and make a tangle of this plant unpleasant to walk through.

### 713. VAILLANT'S GOOSE-GRASS OR CLEAVERS

GALIUM VAILLANTII DC.

Found in the marsh between Farrar's and Overmyer's. It appeared to be rather common in this place.

### 714. HAIRY BEDSTRAW

GALIUM PILOSUM Ait.

We have no notes on this species but have a herbarium specimen. It is usually found growing in dry sandy soil.

### 715. WILD LIQUORICE

GALIUM CIRCAEZANS Michx.

Found common in woods south of the lake. It is rather common through the northern part of the state, scattered in woodlands, especially on gentle slopes in dry wooded hillsides. Collected June 26, 1901.

### 716. NORTHERN BEDSTRAW

GALIUM BOREALE L.

Dr. Hessler (Proc. Ind. Acad. Sci. 1896, 123), reports this species as "common on the southern edge of Lake Maxinkuckee." We have no notes concerning it.

### 717. WILD MADDER; STIFF MARSH BED-STRAW

GALIUM TINCTORIUM L.

Not rare. In flower June 7, 1901, along the railroad between the lakes. Noted also in the tamarack swamp west of the lake.

### 718. SMALL BEDSTRAW

GALIUM TRIFIDUM L.

Found along Lost Lake August 1, 1900. In flower in the tamarack marsh west of the lake May 22, 1901.

### 719. CLAYTON'S BEDSTRAW

GALIUM CLAYTONI Michx.

We have no notes on this species, but it was collected by Dr. Scovell in the region of the lake.

720. SHINING BEDSTRAW

GALIUM CONCINNUM Torr. & Gray

Found in woods near the lake; in flower June 26, 1901, also collected in 1900. A mass of this plant in flower, while not especially conspicuous, has a charm and attractiveness in its own way difficult to find among any other of our native plants. The delicate fluffy tangle of slender stems and dainty foliage beset with innumerable little white blossoms, gives a lightness and airiness of effect something like that produced by a favorite of old gardens brought over from Europe for this same feature, and fancifully named "baby's breath."

## FAMILY 136. CAPRIFOLIACEÆ. HONEYSUCKLE FAMILY

721. AMERICAN ELDER

SAMBUCUS CANADENSIS L.

Not especially common, but occasional clumps are found in moist places. It does not seem to attain very large size in this region. One clump was noted at a swamp between Murray's and Farrar's, and it is probably found scattered in other places. In this latitude the lower leaves, when protected by dead leaves or snow, remain green all winter. It comes out into leaf early; some plants noted out well in leaf by May 2. Berries were observed on some of the plants as late as October 25.

The plant is occasionally affected by a fungus which produces abnormal swellings and a curving of the stem; from these diseased portions pustules full of yellow spores arise in great numbers.

A plant of numerous uses; not always fully appreciated.

722. MAPLE-LEAVED ARROW-WOOD

VIBURNUM ACERIFOLIUM L.

Common in Farrar's and Overmyer's woods near the lake, in dry ground. Particularly attractive when in its purplish autumnal coloration.

723. SHEEP-BERRY; BLACK-HAW

VIBURNUM LENTAGO L.

Not particularly common. A few trees scattered through woods by Farrar's and by the Inlet. Some fine fruit found by Lost Lake, Green's woods, in 1904. Commonly known through the state as "Black-haw." The fruit is superior in size to that of the real black-haw, *V. prunifolium*, and is borne in great abundance. The contents of the seeds is bitter and exceedingly astrin-

gent. The leaves of the trees in the vicinity of the lake are usually very badly mildewed.

724. FEVER-WORT; HORSE-GENTIAN

TRIOSTEUM PERFOLIATUM L.

Scattered through dry woodlands. Found in flower at Long Point June 10, 1901. It is probable that both this and *T. aurantiacum* Bicknell are present about the lake as they have been only recently separated, and both were once regarded as different forms of the same species. The coarse leafy herb with inconspicuous dingy brown flowers is not very striking until in autumn when its brightly colored berries, forming a circle around the stem at each joint, serve to attract attention.

725. SWAMP FLY-HONEYSUCKLE

LONICERA OBLONGIFOLIA (Goldie) Hook.

Rather rare; one plant found on the south shore of the lake. Throughout the tamarack swamps of northern Indiana one comes frequently across a honeysuckle which is probably this species.

## Family 137. Valerianaceæ. Valerian Family

726. EDIBLE VALERIAN; TOBACCO-ROOT

VALERIANA EDULIS Nutt.

Rare in the state; Dr. Hessler found it "common in a wet meadow on the southeast edge of Lake Maxinkuckee." (Proc. Ind. Acad. Sci., 1896, 123.)

## Family 138. Cucurbitaceæ. Gourd Family

727. WILD CUCUMBER; WILD BALSAM APPLE

MICRAMPELIS LOBATA (Michx.) Greene

Occasional, scattered along the shore of the lake. The largest patch is at the ice-houses where a mass of vines covers a clump of shrubs; found also on the ice-beach near Norris Inlet and near Norris's, and on the east side of the lake near McOuat's boat-house. Seedlings noted about May 6. Up well by May 13, 1901. This species is occasionally planted as an ornament and the flowers on summer evenings scent the air with a heavy but pleasant odor much like that of sweet alyssum. In low rich soils it often clambers over low shrubs, making in the midst of the flowering season, great arbors of snowy blossoms. The calyces, after being weathered and the seeds dropped, become a peculiar dainty lacework.

## Family 139. Campanulaceæ. Bellflower Family

### 728. HAREBELL; BLUE BELLS OF SCOTLAND

CAMPANULA ROTUNDIFOLIA L.

Occasional on the lake shore, especially where high banks come down to the water's edge, as at Murray's, between Kreutzberger's pier and the depot, along the east side on slopes, near the Gardiner cottage, etc., also on the railroad embankment by Green's. Found abundantly in flower June 22, 1901. It flowers quite late in the autumn, long after frosts. Noted in flower through the autumn of 1904 until as late as November 7. This plant was found thriving on almost bare rocks in the summer of 1908, at Put-in-Bay, and would seem to be a very desirable plant to put on slopes. It added greatly to the attractiveness of the railroad embankment along the road.

### 729. MARSH OR BEDSTRAW BELLFLOWER

CAMPANULA APARINOIDES Pursh

Scattered in wet grassy places, as in Green's marsh and the Inlet marsh; probably quite common. The plant, though it grows two feet high, is inconspicuous and easily overlooked, even when the dainty flowers are fully open. The delicate plant clambering over stiff sedges or supporting itself by half-climbing low willows, reminds one somewhat of one of the bedstraws. The white blossoms, though not large, strike one as rather large for the plant.

### 730. TALL BELLFLOWER

CAMPANULA AMERICANA L.

Rather common in woodlands east of the lake. A well known, tall, rather graceful plant, remaining in blossom until frost. Hardly a "bellflower" in the strictest sense; though the wheel-shaped corollas are not unlike the drooping graceful bells of the other species, they stick to the side of the stem more like targets.

### 731. VENUS' LOOKING-GLASS

SPECULARIA PERFOLIATA (L.) A. DC.

Very abundant in sand in Green's field east of Lost Lake outlet. Seen in flower along Long Point road June 14, 1901.

## Family 140. Lobeliaceæ. Lobelia Family

### 732. CARDINAL-FLOWER

LOBELIA CARDINALIS L.

Although the conditions seem in every way favorable, this plant does not appear to be particularly abundant. Some plants, however, were seen on the east side of the lake. In the neighborhood of some of the small Indiana lakes, and along the Kankakee, this species forms large, showy patches in autumn.

### 733. GREAT LOBELIA; BLUE CARDINAL-FLOWER

LOBELIA SYPHILITICA L.

Abundantly growing in low places, such as Green's marsh, along the railroad by Winfield's, south of Farrar's, in the Academy grounds, on the southwest shore of the lake, Overmyer's woods, and on the beach beyond Norris Inlet. It begins blooming a little after the middle of August and continues until after pretty heavy frosts. The latest we have it noted is October 7. Some of the books credit it with a long flowering period, from July to October, but with us it is essentially an autumn flower, and when occuring in considerable abundance, it makes quite showy patches of bloom. It is usually dark blue, but varies through faint pink to white.

### 734. SPIKED LOBELIA

LOBELIA LEPTOSTACHYS A. DC.

Occasional in dry sandy places. A slender, graceful form with rather small blue flowers. One of the earliest of our lobelias to blossom, and with those accustomed to think of lobelias as flowers of the fall, one of the first forerunners of the autumn.

### 735. KALM'S LOBELIA

LOBELIA KALMII L.

Somewhat common; scattered in flat wet meadows such as that surrounding Lost Lake. A tall, slender species bearing rather small flowers, much like *leptostachys* in general habit.

## Family 141. Cichoriaceæ. Chicory Family

### 736. CAROLINA DWARF DANDELION

KRIGIA VIRGINICA (L.) Willd.

Found somewhat abundantly on the sandy hill west of the ice-house. Found in bloom May 24, 1901. A good many plants past flowering at that date, some still in flower.

737. CYNTHIA; VIRGINIA GOATSBEARD

CYNTHIA VIRGINICA (L.) D. Don

Scattered about the edges of woodlands; collected at Long Point June 7, 1901. First noted in flower May 20. A well known plant throughout the state, growing scattered through shady woodlands. It has a long flowering period, from May to October, and was observed in flower on the east side of the lake September 26, 1907.

738. DANDELION

LEONTODON TARAXACUM L.

Common, but not so abundant about the lake as to become a nuisance. In many parts of the state, especially about large cities, it has become a bad weed; with the city as a center it invades the country districts, and may obtain such a foothold in pastures or meadows as to crowd out almost everything else. It blossoms almost the whole year round in favorable situations, and both at Ft. Wayne and Chicago it has been found blossoming under the snow. In Jackson Park, Chicago, plants were noticed flowering and fruiting almost the whole winter through, but the fruit formed under snow was not usually perfected so that it would grow, though a small proportion was. The buds under the snow would not fully expand, but remain closed, as they do in summer on cloudy days. At the ice-house, in the depot grounds, and on the east side of the lake were the places of its greatest abundance in the region about Maxinkuckee. The latest date on which it was noted in blossom was December 9.

739. SPINY SOW-THISTLE

SONCHUS ASPER (L.) Hill

Quite common, scattered in waste places. In flower June 21, 1901, along the railroad near the ice-house, and some seeds nearly ripe. One plant east of the depot near the shore, and some at the Military Academy grounds. In flower as late as November 7, 1904, between Kreutzberger's pier and the depot.

740. PRICKLY LETTUCE

LACTUCA VIROSA L.

Somewhat common in waste places and along shore, as at Long Point, north of the Barnes cottage, on the hills near the depot grounds, etc.

This plant seems to have entered the state about 1891 or 1892, when it was first noticed in cities and in waste places. From the

cities, where it was for a year or two one of the most conspicuous members of the flora on account of its abundance, it proceeded out along the country roads in every direction, and fears were entertained that it would become a noxious and abundant weed. After a year or two of general abundance, however, it disappeared from nearly everywhere except dumping grounds and waste places, where it is still found in tolerable abundance. The type form of *virosa* first appeared near the lake about 1908, and during that and the following year was still confined to the railroad. This plant has the compass-plant habit markedly developed, the majority of the leaves turning on the edge and pointing roughly north and south. Found north of the Barnes cottage, by Darnell's, by Lakeview Hotel, and in numerous other places. Noted in flower as late as October 30.

741. HAIRY OR RED WOOD-LETTUCE

LACTUCA HIRSUTA Muhl.

Uncommon; found in rather dry places.

742. HAIRY-VEINED BLUE LETTUCE

LACTUCA VILLOSA Jacq.

Occasional at the edges of woodlands, especially where moist.

743. TALL BLUE LETTUCE

LACTUCA SPICATA (Lam.) Hitchc.

A tall slender form growing in the rich moist borders of woodlands. Rather scattered; only occasional plants seen.

744. CANADA HAWKWEED

HIERACIUM CANADENSE Michx.

Scattered in dry sandy woods north of Lost Lake, and in similar situations about the lake.

745. HAIRY HAWKWEED

HIERACIUM GRONOVII L.

Along shore in dry soil near the Barnes cottage.

746. WHITE LETTUCE

NABALUS ALBUS (L.) Hook.

Found growing along the edge of Long Point hill near Chadwick's, autumn of 1906. In flower late in September. Rather common at the edges of dry woodlands, as some portions of Farrar's woods.

747. TALL RATTLESNAKE-ROOT

NABALUS TRIFOLIOLATUS Cass.

Occasional along the edge of the forest in Green's woods by Lost Lake.

748. GLAUCOUS WHITE-LETTUCE

NABALUS RACEMOSUS (Michx.) DC.

Found in flower at the outer edge of the marsh on the east side of Lost Lake outlet, September 18, 1900. There were several plants at that place.

## Family 142. Ambrosiaceæ. Ragweed Family

749. HORSEWEED; GREAT RAGWEED

AMBROSIA TRIFIDA L.

Not very common; a few plants seen west of the lake near the railroad, in waste ground south of Culver. A common plant in mucky flats in many parts of northern Indiana. In some parts of the country it reaches an immense size and grows so thickly that it is difficult to make one's way through the dense patches. It thrives especially on prairie soils and rich black land along rivers. Various birds, among them chickadees and English sparrows, feed on the seeds during the winter.

750. RAGWEED

AMBROSIA ELATIOR L.

Common; scattered almost everywhere except in forests and sedgy lake plains. One of the most common plants of the state. Although botanists in general speak of it as a "pernicious weed" farmers in general regard it with indifference, probably because it is an annual which requires the whole summer to mature, and gives way readily to cultivation. It is only in wet years, when maize and other crops cannot be cultivated well, that it seriously affects cultivated grounds. It is generally most abundant in crops and stubble of wheat where there has been a poor stand, and in young clover fields and meadows, especially in autumn. Here it is an unmitigated nuisance, because cattle eat it, causing the milk to have a decidedly bitter and sickening flavor. Its habit of growing in fallow ground is regarded by some farmers as a point in its favor, as it shades the ground and a heavy crop of ragweeds is looked upon as a desirable crop to plow under. The woody stems furnish much more humus to the soil than straw.

751. WESTERN RAGWEED

AMBROSIA PSILOSTACHYA DC.

Noted in one place only, on the west side of the railroad embankment between the lakes, or a little south of the Outlet of Lake Maxinkuckee. Probably introduced by the passing of trains. In 1904 there was a good patch in the same place. This is a rare plant in Indiana, and was first reported in the state by Dr. Robert Hessler, who found it in Marshall County, very likely the identical patch referred to here, and from Marion County. There is another long patch along the Baltimore and Ohio railroad between Lapaz and Bremen, Indiana.

752. AMERICAN COCKLEBUR

XANTHIUM AMERICANUM Walt.

The most common and abundant plant at the base of the ice beaches and along the sandy shore on the west side of the lake. Not nearly so common on the east side of the lake, and not noted on the shore of Lost Lake at all; not common back from the lake. It was also found in Walley's marsh along the railroad. In many parts of the state this is one of the most pernicious weeds, especially where sheep are pastured. The seeds germinate almost any time through the summer until killing frosts in autumn. In the spring the seeds begin germinating early in June. Each burr bears two seeds, and it is a common opinion among farmers that one of the seeds germinates one year and the other the next. Occasionally one sees plants of the same age from a single burr, but this is not commonly the case. The burrs or seeds are often eaten by fox squirrels and perhaps by other rodents.

## Family 143. Compositæ. Thistle Family

753. TALL IRON-WEED

VERNONIA ALTISSIMA Nutt.

Rather common in moist ground near the lake, as along the shore of Outlet Bay, etc. They were still in blossom September 28, and where it had been mown along the railroad back of Winfield's. Here it made a second growth and bloomed much later than its ordinary season.

754. WESTERN IRON-WEED

VERNONIA FASCICULATA Michx.

In flat moist ground, among the other species (*altissima*) but apparently more abundant. Although quite common here the ver-

nonias are not so conspicuous a part of the flora as in many parts of the state, and nearly all are confined to moist or wet ground. In some places iron-weeds grow in upland pastures and become a nuisance but this is not the case about the lake. In flower from July 26 to September 13; seeds ripening by September 22. Some of the plants had galls formed at the bases of the flowers.

### 755. JOE-PYE WEED; TRUMPET-WEED

EUPATORIUM PURPUREUM L.

Quite common; noted on the grassy marshy flat south of Outlet Bay, west of the Palmer House, on the marshy shore south of the lake, in the low woods by Overmyer's field, and in Farrar's woods. In some parts of the state this plant is so abundant that the patches, where they grow in low flats, form a single mass of purple in early autumn.

Though sober in hue of blossom, this tall stately plant, handsome in the symmetry produced by its large whorled leaves and the mass of flowers in its ample corymb, adds to the attractiveness of the landscape on autumn days. When it grows in clumps of half a dozen stalks, each reaching to the height of 10 to 15 feet and topped with a large flat-topped cluster of flowers, it is one of the most conspicuous features of the landscape. It is becoming less common as lands are being drained and pastured.

### 756. BONESET

EUPATORIUM PERFOLIATUM L.

Quite common in low flat places where not too sedgy. Noted in Green's marsh, back and north of Winfield's, in the flat east of Lakeview Hotel, between the wall and water line at the Palmer House, on the Academy grounds, on Overmyer's springy hill, and by Norris Inlet. Common on the way to Hibbard. In the height of the flowering season about August 19; going out of flower by September 13. Often so abundant on the flat moist prairies as to give the dingy gray color of its blossoms to the whole landscape. "Boneset tea" is a famous remedy in parts of the country for malaria and other indefinite and vague disorders going under that name.

### 757. WHITE SNAKE-ROOT

EUPATORIUM URTICAEFOLIUM Reichard

In low woods south of the lake, a rather common but widely scattered plant in shady woodlands; one of the daintiest of our autumn flowers.

758. PRAIRIE OR HAIRY BUTTON-SNAKEROOT

LACINARIA PYCNOSTACHYA (Michx.) Kuntze

Scattered among the grasses and sedges on low grounds east of Lost Lake outlet. Common on the way from Lake Maxinkuckee to Bass Lake where in places it was so abundant as to give its color to the entire landscape, August 11, 1906.

759. LARGE BUTTON-SNAKEROOT

LACINARIA SCARIOSA (L.) Hill

A few plants found in dry ground near the Lakeview Hotel. One of the handsomest plants of autumn. Rather abundant on a hillside along the outlet. The plants growing here were remarkably well developed and handsome, forming large pyramids of bloom. The corymbs sat almost on top of the ground. These plants were richly worthy of a place in any garden.

760. DENSE BUTTON-SNAKEROOT

LACINARIA SPICATA (L.) Kuntze

In low wet places, similar to those in which *L. pycnostachya* is found. Neither of the plants is particularly abundant. The wand-like stems, towering straight and tall above the surrounding level sea of grasses and sedges, are very striking. The plants were found scattered in low grounds east of Lost Lake outlet.

761. BLUE-STEMMED OR WREATH GOLDEN-ROD

SOLIDAGO CAESIA L.

Found on the hill by the ice-houses, in flower September 28, 1900, also on the ice-beach by a pond south of the lake (between Farrar's and Overmyer's), and high on a hill by Overmyer's field. One of the most graceful and delicate of our golden-rods. It grows best in moist shady places. It was noted out finely in blossom October 4, 1906. A perfect but miniature plant only four inches high was noted in flower at Long Point in 1907.

762. BROAD-LEAVED GOLDEN-ROD

SOLIDAGO FLEXICAULIS L.

Specimens were collected in the vicinity of the lake. It is a rather well distributed form throughout the state, often found in considerable abundance on the shady banks. Its delicate zigzag stem and thin, toothed leaves, overtopped with a small delicate panicle, give it a delicate gracefulness not common among golden-

rods, which despite its comparative commonness, makes the stumbling upon it one of the most pleasant of woodland surprises.

### 763. HAIRY GOLDEN-ROD

**SOLIDAGO HISPIDA Muhl.**

Occasional in dry places. It was noted rather common at Twin Lakes.

### 764. BOG GOLDEN-ROD

**SOLIDAGO ULIGINOSA Nutt.**

Occasional in swamps and wet places about the lake.

### 765. SHOWY OR NOBLE GOLDEN-ROD

**SOLIDAGO SPECIOSA Nutt.**

A common species in dry sandy ground along the road at Long Point and the railroad south of the lake. Peculiar narrow-panicled specimens were found back of Lakeview Hotel. Collected in flower near Chadwick's September 25, 1900. Leaves well up by May 7, 1901. The upright panicle of this species is not so graceful as that of the horizontal panicle of many species, but the rich clear yellow of the flowers makes it one of the most handsome and clean-looking of our golden-rods. The upright taper of the panicle reminds one of a torch or flame.

In flower from August 14 until after September 29. Abundant along the Erie Railroad at Plymouth.

### 766. WRINKLED-LEAVED GOLDEN-ROD

**SOLIDAGO RUGOSA Mill.**

A very rough-leaved coarse-looking golden-rod, somewhat resembling *S. ulmifolia*. Occasional in dry open places.

### 767. ROUGH-LEAVED GOLDEN-ROD

**SOLIDAGO PATULA Muhl.**

Not common; scattered in grassy or sedgy marshes, sometimes in woodlands; one plant by the ice-houses September 28, 1900; a small patch on shore near the green boathouse. A coarse homely species. In blossom in late September.

### 768. ELM-LEAVED GOLDEN-ROD

**SOLIDAGO ULMIFOLIA Muhl.**

One of the most common species; very abundant on Long Point, where it grew in the shady woodlands thick enough to give almost a mass effect when in bloom; found also between Kreutzberger's

pier and the depot pier. The time of greatest abundance of flowers was about September 29, 1900. Leaved out finely by May 10, 1901. Individually it is not a showy species, the branches of the racemes being too narrow to give much display.

### 769. EARLY OR SHARP-TOOTHED GOLDEN-ROD

SOLIDAGO JUNCEA Ait.

The earliest and one of the most attractive of our golden-rods, coming into flower in midsummer and continuing well into autumn. Occasional at the edges of copses and on hillsides, giving an autumn touch to summer landscapes. Occasional on the open spaces about the cottages on the south end of Long Point.

### 770. CANADA GOLDEN-ROD

SOLIDAGO CANADENSIS L.

One of the most widely distributed and best known golden-rods of the state. Quite variable in size and fulness of flowering. The dense plume-like panicle and its fragrance make it one of our most handsome golden-rods, though the stem and leaves are coarse and weedy. Scattered about the lake, usually in moist but not wet situations. Considerable on the flat area southwest of Outlet Bay, some on the hill by the ice elevator, near Winfield's, and by Overmyer's springy hill. Some east of the lake between Aubeenaubee Creek and the Maxinkuckee road. Between Lake Maxinkuckee and Bass Lake this species along with *S. riddellii* was so abundant as to turn whole landscapes yellow. The flower clusters are often attacked and eaten by black beetles and frequently it is difficult, late in the year, to find racemes not thus marred. Found blossoming as late as October 26, by Green's marsh in 1904.

### 771. LATE GOLDEN-ROD

SOLIDAGO SEROTINA Ait.

A few plants near Norris Inlet, by the green boathouse, in moist soil. Found blossoming October 2.

### 772. GRAY OR FIELD GOLDEN-ROD; DYER'S WEED

SOLIDAGO NEMORALIS Ait.

Common on Long Point near the Plank cottage. A rather short, dense flowered, very brilliant species, becoming common along roadsides in some parts of the state. The numerous achenes crowned with white pappus make it rather conspicuous when in fruit.

### 773. WESTERN ROUGH GOLDEN-ROD

**SOLIDAGO RADULA Nutt.**

Rare; a few plants found east of the lake. Dr. Hessler has also reported this species from Lake Maxinkuckee.

### 774. STIFF OR HARD-LEAVED GOLDEN-ROD

**SOLIDAGO RIGIDA L.**

A few plants found on Long Point. The individual flowers are much larger than any other of our golden-rods but they are rather few in number and the plant as a whole is too stiff and awkward to be particularly attractive. The plant is to be found chiefly along roadsides and railroads.

### 775. RIDDELL'S GOLDEN-ROD

**SOLIDAGO RIDDELLII Frank**

A few plants back of Winfield's and a small patch on shore near Norris Inlet. There was a large patch in a sedgy flat down the outlet and some by the tamarack. On the way to Bass Lake this species in places gave color to whole landscapes. In flower from August 14 to September 22. Easily recognized by the arrangement of its leaves which give the general impression of being 3-ranked; an approximation in general habit to the sedges among which it grows. The flat-topped corymb of flowers, though rather small, is quite handsome, the blossoms having a peculiar clearness and translucence.

### 776. BUSHY OR FRAGRANT GOLDEN-ROD

**EUTHAMIA GRAMINIFOLIA (L.) Nutt.**

Scattered along the beach at Long Point, at Green's, and east of Lakeview on a flat beach. A very homely weed, but the flowers are fragrant. The leaves are often marked with oval black spots, probably the result of the attack of some fungus. Noted in blossom during September.

### 777. SLENDER FRAGRANT GOLDEN-ROD

**EUTHAMIA TENUIFOLIA (Pursh) Greene**

Less common than *E. graminifolia;* scattered along Long Point beach. In flower during the latter part of September.

### 778. LARGE-LEAVED ASTER

ASTER MACROPHYLLUS L.

Not at all common; a few plants found in the damp shaded woods near the lake, near Overmyer's. In blossom October 11, 1900.

### 779. SKY-BLUE ASTER

ASTER AZUREUS Lindl.

Quite common on dry hillsides on both sides of the lake, and along the railroad. In flower on the bank by Murray's, September 20. September 29, found between Kreutzberger's pier and the depot pier, and by Lakeview Hotel. A very beautiful species. In flower quite late (November 13) along the railroad, 1904. Although not so large as some of our asters, this, with its graceful habit and delicate coloring, is one of the most attractive asters we have.

### 780. COMMON BLUE WOOD ASTER

ASTER CORDIFOLIUS L.

Very abundant in places, in dry open woodlands on each side of the lake; on September 28, 1900, the base of Long Point was nearly blue-white from a little distance, due to the abundance of these asters. October 9, plenty on the east and southeast side of the lake in wooded places. One of the commonest and prettiest of our species. The flowers, though rather small, are borne in such abundance that the plant makes considerable display. In freshly opened flowers the disk flowers are yellow, but they soon turn to purple. Although the flowers are quite firm they wither quickly on being cut, so that they are much better admired on the stalk. Some dwarf plants only four inches high, but perfect and in blossom, were collected on the east side. Noted in flower from August 3 to October 28.

### 781. LATE PURPLE ASTER

ASTER PATENS Ait.

Not at all abundant, but well scattered in favorable situations. It grows best in rather moist open ground. Found south of Winfield's in front of the Assembly grounds, and in other low places. Found also near shore on the depot grounds, on the springy flat south of the lake near Overmyer's and by the green boathouse. One of the largest and most attractive of our asters, and nowhere very common. Well worthy of cultivation, especially in nooks of wild gardens. First noted in blossom as early as August 19, a rather uncommonly early date; remaining in bloom until October 2. Often continues blooming until after light frosts.

### 782. PURPLE ASTER; NEW ENGLAND ASTER

ASTER NOVAE-ANGLIAE L.

Rather common in patches in a few moist places, near Winfield's, along the moist ground west of that place, a considerable patch in the gully-like depression by Lakeview Hotel, by the green boathouse, and across the railroad from the birch swamp. This plant has considerable variation; a small form was collected, and the rose-colored form was present but quite rare. This species, especially the rose-colored form, is one of the most beautiful of our autumn flowers. A common name in some parts of the state is "Fall Rose" which is markedly inappropriate. *Aster novae-angliae* is well worthy of cultivation and its variability suggests that it would yield readily to attempts to produce various forms, as the Japanese have done with the chrysanthemum.

### 783. RED-STALK OR PURPLE-STEM ASTER

ASTER PUNICEUS L.

Found on the east shore of the lake, in the vicinity of the ice-beach pond south of Van Schoiack's. It is a large handsome species which continues blooming until quite late in autumn.

### 784. SMOOTH ASTER

ASTER LAEVIS L.

Occasional on the west side of the lake in dry ground along the railroad. A rather handsome species.

### 785. RUSH ASTER

ASTER JUNCEUS Ait.

Occasional in wet places about the lake.

### 786. SMALL WHITE ASTER

ASTER VIMINEUS Lam.

At the railroad bridge near Culver; abundant in flat woods south of the lake by Overmyer's, and beyond these farther east; east of Norris Inlet, along shore. Noted in flower from September 28 to October 8.

### 787. WHITE HEATH ASTER; FROST-WEED ASTER

ASTER ERICOIDES L.

Rather common; found near shore at Long Point, abundant in the prairie-like flat by the ice-house, at the south and west of Win-

field's, on shore in front of the flat south of the lake, at the beginning of the flat woods south of the lake by Overmyer's, on the beach east of Norris Inlet, and common about Lost Lake. While the individual flowers are not particularly handsome, the mass effect where many dense plants grow together is quite attractive. This is one of the most variable of our asters in form, abundance of flowers, size of plant and in almost every other respect. In many parts of the state it is common along dry roadsides and in old fields. Some plants are very showy, looking like great masses of snow. In flower about the lake from September 13 until November 12.

### 788. POOR ROBIN'S PLANTAIN

ERIGERON PULCHELLUS Michx.

Scattered on moist banks; not very common. Found in Green's marsh and on Long Point; found in flower May 20 to June 10. The earliest of our fleabanes to blossom, and an exceedingly pretty plant when in flower, with delicate pink-tinted daisy-like flowers. Unlike most of its relatives it is not abundant enough to become a nuisance, and does not invade meadows to any great extent.

### 789. PHILADELPHIA FLEABANE

ERIGERON PHILADELPHICUS L.

Scattered in open places, near the edge of the lake. In flower north of Green's marsh and on the lake shore May 18, 1901. Flowers pretty; smaller and more delicate than those of the preceding. This plant, too, is too scarce to become a nuisance.

### 790. WHITE-TOP; SWEET SCABIOUS

ERIGERON ANNUUS (L.) Pers.

Scattered in open places; very abundant in cultivated fields. In blossom from June 15 until October 28, and the rosettes rather conspicuous during the winter. Occasional along the beach, by Norris Inlet and Green's.

This, along with its close relative, *E. ramosus*, is one of our most pestiferous weeds. It does not trouble cultivated crops to any great extent, but often appears in great abundance in meadows, crowding out timothy and clover, making ragged unsightly fields, making the crop valueless, and filling the air with flying seeds which are more irritating when they fill the nostrils and eyes than even those of the butterweed (*Erechtites*).

### 791. DAISY FLEABANE

ERIGERON RAMOSUS (Walt.) B. S. P.

Quite similar to *E. annuus* and of the same distribution, but more often found along the edges of woodlands. Apparently not so common as the preceding.

### 792. HORSE-WEED; CANADA FLEABANE

LEPTILON CANADENSE (L.) Britton

Common along shore and elsewhere; often almost completely occupying old neglected fields. Fields full of these weeds were found on both sides of the lake, but it does not appear to be a bad weed. One of the most variable in size of our plants, perfect specimens ranging from about three inches to nearly six feet high. It occurs on shore all around the lake. Like the other common erigerons the young plant passes the winter in the form of a rosette, the most attractive stage of the plant, for during autumn and spring this rosette usually assumes a rich purple color. It sometimes continues blossoming quite late in autumn. In 1904 they were noted in flower as late as November 13.

### 793. TALL FLAT-TOP WHITE ASTER

DOELLINGERIA UMBELLATA (Mill.) Nees

Quite common in flat open places south of Farrar's along the road, in moist ground. A tall homely weed.

### 794. STIFF-LEAVED ASTER

IONACTIS LINARIIFOLIUS (L.) Greene

Found only on the bank east of Lost Lake south of the Bardsley cottage, where it was quite abundant.

### 795. PLANTAIN-LEAF EVERLASTING

ANTENNARIA PLANTAGINIFOLIA (L.) Richards

Rather common, in patches in various open dry situations. April 9, buds show well. April 22, nearly in flower southwest of the lake along the railroad. April 30 some in flower north of the lake. May 4, fully in blossom. Found also back of Lakeview Hotel.

An interesting feature of this species is the fact that the plants of a patch are usually either all pistillate or all staminate, each patch having arisen from one or a few plants by means of underground stolons. The plants are exceedingly variable in size and

general appearance and occasionally have purplish bracts. In some places called "Indian tobacco."

796. BROAD-LEAVED CAT'S FOOT

ANTENNARIA CALOPHYLLA Greene

Not common; we have no notes. A specimen, however, was collected by Dr. Scovell. A small patch was found at Long Point, near Chadwick's.

797. FRAGRANT LIFE EVERLASTING; SWEET BALSAM

GNAPHALIUM OBTUSIFOLIUM L.

Quite common on dry hillsides, though by no means so conspicuously abundant as in many parts of the state; found on the hill north of the ice-houses and along the shore of the lake, and on Long Point. In some parts of the country it has a high medicinal repute; the dried plants are smoked, like tobacco, as a remedy for catarrh.

798. ENTIRE-LEAVED ROSIN-WOOD

SILPHIUM INTEGRIFOLIUM Michx.

Rather common in flat prairie-like areas; frequent along the railroad south of the lake.

799. PRAIRIE DOCK; PRAIRIE BURDOCK

SILPHIUM TEREBINTHINACEUM Jacq.

On the hill between Kreutzberger's pier and the depot pier, also tolerably abundant in the sedgy flat up by Lakeview Hotel. Rather abundant along the railroad in moist spots. A patch of more than an acre down along the outlet was well grown over with this plant. When wounded, it yields a copious supply of whitish resin.

800. AMERICAN FEVER-FEW

PARTHENIUM INTEGRIFOLIUM L.

Not common; a few plants observed along the railroad some distance south of the lake in the autumn of 1912. An odd flower for a composite; at some distance the inflorescence reminds one somewhat of that of the mountain mint.

801. OX-EYE; FALSE SUNFLOWER

HELIOPSIS HELIANTHOIDES (L.) Sweet

Common in small patches at the edges of copses or in fence corners. Except for the deeper orange hue of its blossoms, it

bears a very close general resemblance to some of the numerous wild sunflowers of the region, and the name "False Sunflower", is very appropriate.

### 802. YERBA DE TAJO

VERBESINA ALBA L.

A very abundant beach plant along the east shore of Long Point, and found occasionally down as far as beyond the Inlet, and by the Palmer house, by Lakeview hotel and the railroad bridge near Culver. It is found just a little back of the waterline. Not much found on the east shore of the lake. In some parts of the state this plant is rare or absent; in others common. Although it is said to be a weed in warm regions, it never becomes obnoxious in Indiana, as it is usually of rather small size and is generally confined to the margins of rivers and lakes or ponds. With us it has a long flowering season—from July to October—and a large plant will produce a great number of seed. Although rather inconspicuous, it is, when attentively considered, an attractive plant, the blossoms being very neat and dainty. Late in autumn, especially in rather barren and infertile sandy spots along shore, exceedingly dwarfed plants frequently occur tipped with a single blossom. One was noted only one-half inch in height, with seven leaves and one blossom. The plant remained in bloom as late at October 30, 1900.

### 803. BLACK EYED SUSAN

RUDBECKIA HIRTA L.

Rather common, both in dry and wet ground; blossoms quite late sometimes, until killed by frost; found in flower south along the railroad June 15, 1901; several plants noted in flower October 24, 1904, some along the road by Romig's, some toward the tamarack marsh.

One of the most attractive of summer and autumn plants; frequently found in dry meadows, but never abundant enough to become a nuisance.

### 804. TALL CONE-FLOWER

RUDBECKIA LACINIATA L.

Occasional in moist places, but not so common as in many parts of the state where it usually thrives in small clumps in moist shady places. A cultivated double-flowered form is the well-known Golden Glow of gardens.

In addition to the rudbeckias above mentioned another, probably *subtomentosa*, grew along the southwest shore of the lake between Murray's and Farrar's, but it was seen on a hurried trip in that region and no herbarium specimens were secured.

### 805. GRAY-HEADED CONE-FLOWER

**RATIBIDA PINNATA (Vent.) Barnhart**

Not common; noted along the railroad east of the depot and near the lake September 29, 1900. Although this species is apparently indigenous it has a habit in many parts of the country of growing usually on roadsides, as if introduced.

### 806. PURPLE CONE-FLOWER

**ECHINACEA PURPUREA (L.) Moench**

Not common; only one patch found on a hill some distance down the outlet in 1909. This was not found during the preceding years of the survey and had somewhat the appearance of having arisen recently from perhaps a single stray seed of a few years before; one plant could easily have been the parent of the entire colony. Although the leaves are coarse and homely, giving a weed-like aspect to the plant before blooming, the flower-head, with its long drooping purple rays and spine-like orange-colored disk flowers, is a striking object.

### 807. COMMON SUNFLOWER

**HELIANTHUS ANNUUS L.**

An occasional escape from cultivation near Culver.

### 808. FEW-LEAVED SUNFLOWER

**HELIANTHUS OCCIDENTALIS Riddell**

Not particularly common; a few plants were found scattered along the hill east of Lost Lake outlet, near Green's field, and a few south along the railroad. Leaved out well by May 12, 1901. It grows in dry sandy soil.

### 809. TALL OR GIANT WILD SUNFLOWER

**HELIANTHUS GIGANTEUS L.**

Found by Lakeview Hotel in the sedgy flat September 29, 1900. Rather common in moist places in rich ground. Common between Culver and Hibbard.

### 810. ROUGH OR WOODLAND SUNFLOWER

HELIANTHUS DIVARICATUS L.

Not rare; noted on shore in front of the Palmer House grounds. Leaved out well and growing finely May 10, 1901.

### 811. HAIRY SUNFLOWER

HELIANTHUS MOLLIS Lam.

Found on a bank on the east side of Lost Lake, also in open places between the lakes. Noted in flower September 19, 1900. Common on the bank back of Green's field at the beginning of Lost Lake outlet, growing in the dry sandy soil.

### 812. PALE-LEAVED WOOD SUNFLOWER

HELIANTHUS STRUMOSUS L.

Occasional in dry places west of the lake.

### 813. STIFF-HAIRED SUNFLOWER

HELIANTHUS HIRSUTUS Raf.

Represented by an herbarium specimen. No special notes were made, the numerous species of sunflowers about the lake resembling each other so closely that it was difficult to recognize them in the field.

### 814. WING-STEM

RIDAN ALTERNIFOLIUS (L.) Britton

Scattered in fair abundance on the east side of the lake back from shore, in rather open woodlands, generally in gullies or on their sides.

### 815. TALL TICKSEED

COREOPSIS TRIPTERIS L.

Found south along the railroad; up well and leaved out finely by May 12, 1901. Usually growing in small scattered clumps at the edges of thickets. The heads are not especially showy, coming as they do at a time of year when sunflowers, black-eyed susans and the like are in full sway. Unlike most flowers of the sunflower group, those of this plant are decidedly fragrant.

### 816. STIFF TICKSEED

COREOPSIS PALMATA Nutt.

East side of Lost Lake outlet, on a dry sandhill. Up well May 12, south along the railroad. Not very common; it seems to be con-

fined to the localities just mentioned. It seems to be increasing somewhat along the railroad, and in 1904 was found on the bank of the lake near the depot grounds. Occasional along the railroad northward.

### 817. LARGER OR SMOOTH BUR-MARIGOLD

BIDENS LAEVIS (L.) B. S. P.

Occasional on the west shore of the lake. In general it is usually found in wet places, as on edges of the lakes and streams. Abundant by Winfield's, and by the low woods near Overmyer's. Found by McSheehy's pier, by Darnell's, north end of Long Point, by the Assembly grounds, and by Norris Inlet. It does not appear to be so much of a nuisance as some other members of the genus.

### 818. SMALLER OR NODDING BUR-MARIGOLD

BIDENS CERNUA L.

One of the most abundant of the bur-marigolds; found scattered along the west shore of the lake; most abundant about the edges of the flat marshes, a belt surrounded Green's marsh and the marsh about Lost Lake, and the borders of the marshy region along Lost Lake outlet; also, along the edges of Inlet marsh. In these places, after the plants had ripened and turned brown, it formed a very conspicuous marginal belt. It was still in blossom October 24, although the older heads had begun nodding by September 26. In addition to the large, more conspicuous blossoms, the plant has very minute flower-heads in the axils of the leaves, consisting of only a few florets apiece. The nodding habit of the fruiting head is rather peculiar; it may be an adaptation to enable the seeds to attach themselves to the backs of small mammals running through the grass.

### 819. PURPLE-STEMMED SWAMP BEGGAR-TICKS

BIDENS CONNATA Muhl.

Quite common in marshy places and along the west shore of the lake. Also on shore at the Academy grounds and behind the ice-beach east of the Inlet. Common at Long Point, behind the ice-beach beyond Norris Inlet, and south of the Scovell cottage. Although not so great a nuisance as some of the forms which grow in cultivated grounds, this species with its numerous bristling seeds is very undesirable.

### 820. BEGGAR-TICKS; STICK-TIGHT

BIDENS FRONDOSA L.

Rather common along shore and in moist places, as at Long Point on the north shore, at Lakeview Hotel, by Overmyer's woods, and by Norris Inlet. It is not so abundant as one might naturally expect, and does not appear to be very much of a nuisance in cultivated grounds about the lake, as the sandy soil is not well suited to its best development. In many parts of the state, especially in moist rather heavy or loamy soils, this broadly branching plant is one of the greatest nuisances. It does not crowd out and choke down other plants as badly as many of our other weeds, is easily uprooted by cultivation, and, so far as its effect on crops is concerned, is not nearly so bad as ragweed, dogbane and numerous other common weeds which readily occur to mind. Its chief objectionable feature is its numerous bristling seeds which catch in large masses to clothing. It is especially common in low-ground cornfields and in patches of buckwheat.

### 821. SPANISH NEEDLES

BIDENS BIPINNATA L.

Abundant near Delong, but none found close to the lake during the early years of the survey. In 1906, however, a patch was found by the ice-houses, evidently newly introduced. In the northern part of the state this does not appear to be a native plant, but usually makes its appearance first along railroads, and in some of the northern counties appears to be largely restricted to such locations.

### 822. TALL TICKSEED-SUNFLOWER

BIDENS TRICHOSPERMA (Michx.) Britton

A few plants scattered along the west shore of the lake. Where protected it blossoms quite late. A few plants were found still in flower along Lost Lake and the tamarack marsh October 24, 1904. In low flat prairies in some parts of the state these plants grow in great numbers, and when in flower in autumn, form continuous and immense patches and belts of solid gold massed together, that can be seen for several miles.

In 1900 a few plants were seen along shore by McSheehy's and by the Monninger and Meyer cottages. In 1906, on the way to Bass Lake, considerable patches were seen, also on the way to Hibbard. Of recent years it appears to be increasing rapidly by Hawk's marsh. In 1908 and 1909 it formed an unbroken patch of

about an acre which made a continuous bed, forming one solid blaze of yellow. It was also found at Long Point and by the ice-houses; most of the plants about the lake probably came from prairie hay used at the ice-houses.

We are so accustomed to see this plant in masses that we rarely think of the individual plant. A well grown plant in rich muck is one of the most striking objects, the plant branching from the very base, making a broad cone, which when in full bloom is almost a solid mass of gold. One of the plants near the ice-house showed this effect to perfection and revealed the possibilities of the plant as an ornament.

### 823. WATER MARIGOLD

MEGALODONTA BECKII (Torr.) Greene

In 1900 this was common in the lake off from the ice-houses, and scattered elsewhere through the lake as off from the Gravel-pit, by the green boathouse near Norris Inlet, and in Lost Lake. It was one of the most conspicuous and attractive plants found in the large patch by the ice-houses, the plants sticking up from the bottom like cattails in their dense cylindrical form and rounded ends. The species grows in water to the depth of twelve feet.

With the advent of cold weather the green tips break off and drop to the bottom, where they sweep about hither and yon as currents drive them. With the coming of spring these tips, which remain a fresh lively green all winter, put out rootlets from the nodes, strike into the soft mud at any suitable place and start their new growth. Bits are often washed ashore during spring storms.

This plant is a remarkable instance of adaptation and convergence. In plant form it resembles Myriophyllum, which it is a good deal like in habit, more than anything else. Cabomba, a plant of the water-lily family, is also strikingly like it in general appearance. The emersed leaves, however, approach more nearly the normal form.

The seeds have long holdfasts, three to six in number, usually four, and it would appear at first thought that these were useless as they would be likely to catch only on such animals as muskrats, which would carry them to places on shore where they would not be likely to survive.

However, in the summer of 1909, we saw at Lake-of-the-Woods, Indiana, a large snapping turtle, "mossback," with the long hairlike algæ of its carapace stuck full of beggar ticks, possibly of this species. It is possible that the plant relies to some extent on such turtles for the distribution of its seed.

### 824. GALINSOGA

GALINSOGA PARVIFLORA Cav.

This dainty little plant made its arrival at Lake Maxinkuckee about 1909, where it was found on the depot grounds near the flower-beds. The seed had probably been brought with other plants from Sewickley, Pa., where the railroad company keeps its nurseries. The plant is comparatively new to the state; it is not mentioned in Dr. Stanley Coulter's list of Indiana plants published in 1899. Some plants were seen along streets of Fort Wayne in 1901. The delicate thin leaves and minute daisy-like blossoms, which bloom from early summer until frost, make the plant rather attractive to the attentive eye, though so inconspicuous as to be easily overlooked. The plant is a native of tropical America and has spread from the east coast, where it was first introduced, almost entirely across the continent. In some parts of North Carolina it has almost "taken the country," covering densely all broken ground such as flower-beds, etc. It is there a decided nuisance and generally known as "Rabbit Tobacco."

### 825. YARROW

ACHILLEA MILLEFOLIUM L.

Rather common; scattered, usually in dry ground and along roadsides. It is not so conspicuously abundant here as in many parts of the state. The leaves stay more or less green all winter, and the new leaves are among the first bits of bright green to appear in spring. It begins flowering early in summer and continues late in the autumn, even after the lighter frosts. Seen in flower near the lake as late as November 21, 1904. In many parts of the state this species takes possession of old orchards and untilled open land, such as old pastures. Pink- and rose-colored flowers occasionally occur, and there is a red-flowered form in cultivation. Although tough-rooted this plant yields readily to cultivation, and never becomes a bad weed.

Being an introduced plant, usually associated with dooryards, it suggests humanity, and home-likeness wherever it is found.

### 826. MAYWEED; FETID CAMOMILE

ANTHEMIS COTULA L.

Not conspicuously common in this region. A good sized patch was seen by the Bardsley cottage near Lost Lake, which continued in flower until killed by heavy frosts. Still in flower November 13, 1904.

Once very common along roadsides, forming a fringe on each side, and in trampled places, especially in schoolyards, and neglected dooryards. In dooryards where it has gained foothold it is an exceedingly annoying weed, very difficult to keep down and giving a very sorry appearance to any region it infests. It occasionally is to be found in meadows, but it does not persist in cultivated ground.

827. OX-EYE DAISY

CHRYSANTHEMUM LEUCANTHEMUM L.

A few plants south of the lake along the railroad. One of the handsome plants of our region, although often a nuisance in meadows where it has obtained a foothold.

828. TANSY

TANACETUM VULGARE L.

A good-sized patch along the road near Culver. Noted in flower as late as November 12, 1904. It seems to spread by roots rather than by seed, and is generally not found far from houses.

829. TALL OR WILD WORMWOOD

ARTEMISIA CAUDATA Michx.

Common along the ridge east of Lost Lake outlet near the boundary line between Green's and Walley's. Not found elsewhere to any extent.

830. FIRE-WEED

ERECHTITES HIERACIFOLIA (L.) Raf.

Scattered; quite common along shore, not abundant elsewhere; quite variable in size. Some on the Academy grounds, some between Kreutzberger's and the depot, and near the water's edge at Long Point; growing in cracks in Howe's stone wall, and near Overmyer's field.

Interesting in its occurrence. Generally a not frequently seen weed, but as soon as a forest is cleared out these plants spring up in great patches, bearing immense crops of seed, and filling the air, and incidentally the eyes and noses of those who live in the region, with the pappus. The plant has a peculiar rank smell which it gives off at a touch, so one can hardly pass through a patch where these plants grow without becoming aware of their presence. When the plants die down in autumn they burn like tinder, and may be the cause of more or less extensive conflagrations. The plant receives its name from the fact that it springs up abundantly where

ground has recently burned over, although this does not occur in places where large areas have burned off but rather after small fires in brush piles. After a few years of tillage this plant disappears or becomes rare. It thrives best in rich forest mould after the trees have been removed.

831. PALE INDIAN PLANTAIN

MESADENIA ATRIPLICIFOLIA (L.) Raf.

Found in damp places east of Lost Lake outlet.

832. TUBEROUS INDIAN PLANTAIN

MESADENIA TUBEROSA (Nutt.) Britton

Occasional in moist prairies about the lake.

833. BALSAM GROUNDSEL

SENECIO PAUPERCULUS Michx.

Scattered; not very common; up and nearly in flower along the road west of Chadwick's May 8, 1901. In flower, collected May 23.

834. COMMON BURDOCK

ARCTIUM MINUS Schk.

On a hill near the ice-house, and by the old ice elevator; September 29, 1900, seeds sprouting by railroad bridge near Culver. The seeds usually sprout in the spring, but also frequently germinate in autumn. Disagreeable and unsightly as a patch of burdocks is, it never becomes a bad weed in fields or meadows but thrives only in neglected and waste places about dwellings. No other plant has better means of distributing seed, which is by both burr and pappus; still it is not generally distributed except in the places above mentioned. It may be that it requires unusually rich soil for its development; at any rate the soil in a burdock patch is usually black and rich, and other plants are usually killed out by the shade of the broad leaves.

835. COMMON BUR THISTLE

CIRSIUM LANCEOLATUM (L.) Hill

Somewhat common, but not particularly abundant, in old fields, pastures, etc.; noted in flower October 25, 1904, west of the lake. In some regions in pastures it is a bad weed, but is generally not hard to eradicate, as it usually dies after the crown has been cut off. The seed is the favorite food of the goldfinch, and birds

perched on old heads of this plant, sending silken parachutes a-flying, is in many parts of the state a characteristic bit of autumn scenery.

836. TALL OR ROADSIDE THISTLE

CIRSIUM ALTISSIMUM (L.) Spreng.

A few plants found on the east side of the lake, along the road in moist places north of Aubeenaubee Creek and at the springy flat near Overmyer's field. Noted in blossom as late as October 25, by Aubeenaubee Creek. A rather handsome plant, and never common enough to become a nuisance. The tall stem is hollow, forming a large tube, but it splits rather easily.

837. SWAMP THISTLE

CIRSIUM MUTICUM Michx.

Found by the Lakeview Hotel and in the springy flat near Overmyer's field. Scattered generally in swamps. A harmless plant, not very persistent and only weakly prickly, with handsome flowers.

838. CANADA THISTLE

CIRSIUM ARVENSE (L.) Scop.

Growing along the shore by Long Point, only a few plants; quite abundant in an old field northeast of the lake along the wagon road, and along a ditch on the way to the drained lake. The most pernicious weed in our area, rapidly spreading and very difficult to eradicate.

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