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SPECIAL PAPERS NO. 1.

SANDUSKY FLORA.

A CATALOGUE

OF THE

FLOWERING PLANTS and FERNS

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AND THE PENINSULA AND ISLANDS
OF OTTAWA COUNTY,

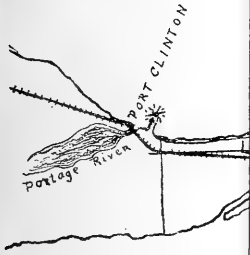
By E. L. MOSELEY, A. M.

PUBLISHED BY THE ACADEMY OF SCIENCE,
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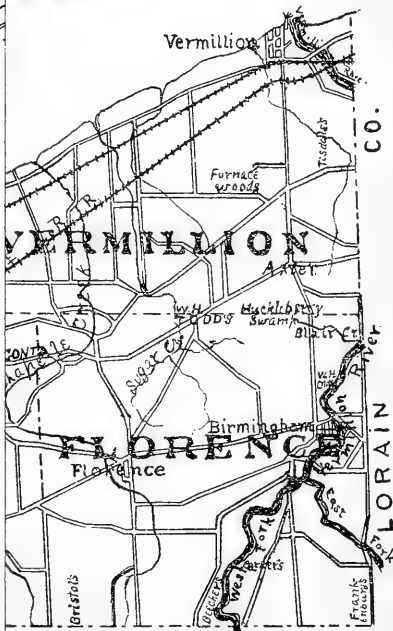
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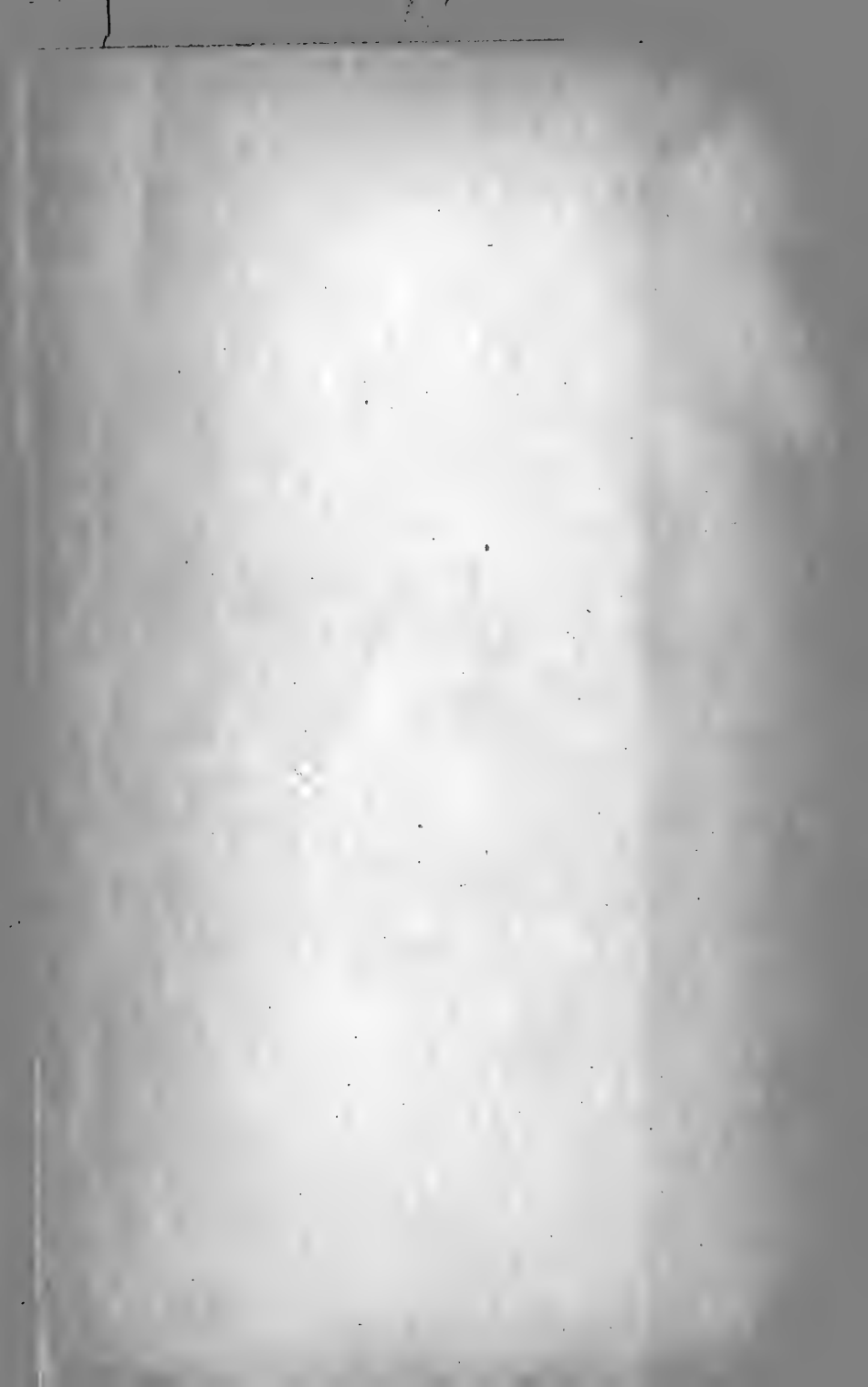






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TO THE MEMORY

OF THE

MEMBER OF THE ACADEMY

WHOSE DEATH IS ANNOUNCED,

AS THE PROOF OF THE LAST PAGES OF THIS "SPECIAL PAPER"

ARE BEING RETURNED TO THE PRINTER,

MANNING F. FORCE.

GENERAL, JURIST, SCIENTIST, AND ABOVE ALL, A MAN WHOM

NO DESIRE FOR WEALTH OR FAME COULD DIVERT

FROM THE FAITHFUL SERVICE OF HIS

FELLOW MEN, THIS WORK IS

DEDICATED.

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SANDUSKY FLORA.

The flora of the Sandusky district is a rich one. We believe there is no other local collection of Ohio plants that approaches within three hundred species of the number collected in the past seven years, in Erie county and the eastern part of Ottawa county, and now preserved at the Sandusky High School. Of the many local lists published in other states, we have seen none that give so many native species as have been found near Sandusky, although several of them cover much larger areas and represent the labors of many botanists working for long periods of time. Some of these lists, moreover, include territory that is regarded especially rich in plants.

The "Flora of Buffalo and its Vicinity," by David F. Day, presents the names of all the plants which have been detected within fifty miles of Buffalo, a territory many times as large as Erie county, Ohio, and including on the one side the whole of the Niagara river with its profusion of flowers and ferns, and, on the other mountains with an altitude of 2300 feet above the sea. "The Cayuga Flora" by William R. Dudley, published as a Bulletin of the Cornell University, covers an area 65 miles in extreme length and is based on numerous collections, the first of which was made in 1827. The "Plants of Monroe county, New York, and Adjacent Territory," published by the Rochester

Academy of Science, in addition to Monroe county, which is about three times as large as Erie county, Ohio, includes portions of five other counties and gives twenty species reported by early botanists, but no longer found. All of these districts border on Lake Ontario and one of them on Lake Erie also.

The whole of England contains but about 1200 native phenogams; surpassing the little district about Sandusky by less than a hundred species.

Although several hundred native plants not found in Erie county grow in one place or another in Ohio, yet so well is the flora of the state represented here, that it is probably not too much to say that excepting the counties bordering on the Ohio river and those that contain sphagnous swamps or bogs, there are few counties in the state where a botanist, unfamiliar with the territory would be likely to find in a single day's search more than half a dozen native species that do not grow somewhere in Erie county. The surpassing richness of the Sandusky flora is not due to the fact that it includes islands within its territory, for scarcely any of its species are confined to the islands, nor is it in very large measure due to the fact that it includes species that are confined to the lake shore but rather to peculiarities of climate and geological features, both of which depend to some extent on the proximity of the lake.

CLIMATIC INFLUENCE OF LAKE ERIE ON VEGETATION.

The Catalogue of Canadian Plants in six volumes includes the whole territory lying north of the Great Lakes and extending from the Atlantic to the Pacific. The Sandusky district contains 165 native species and varieties not given in the Canadian catalogue besides a

number of others which in Canada are confined to Pt. Pelee or Pt. Pelee Island, spots only a few miles distant from the islands of Ottawa and Erie counties, Ohio. The Sandusky district contains 67 native plants not known to grow anywhere in Michigan and many others which in Michigan are confined to the southwestern part where the climate is tempered by Lake Michigan. But what seems quite as remarkable is the fact that the Sandusky district contains 305 native plants not known to grow within fifty miles of Buffalo, while the Buffalo district has about 244 native species and varieties not given in the Sandusky list. But even this great difference between two regions bordering on Lake Erie is largely due to climate, for the summer at Buffalo is not only cooler but lasts less than three-fourths as long as at Sandusky. Since the prevailing winds have traversed Lake Erie for nearly its whole length before reaching Buffalo the mean temperature in summer there is about 3° lower than at Sandusky. In the spring the difference is even greater than in summer, being about $5\frac{1}{4}^{\circ}$ lower in April and May. This is due to the fact that when the ice breaks up it is blown to the east end of the lake and remains so crowded there as to prevent navigation three weeks or more after Sandusky Bay has been clear. The average date of the last killing frost in spring in Sandusky, is April 14; at Buffalo, May 20, that is 36 days later. Moreover, Sandusky is protected by its position from cold north-west winds in autumn, while Buffalo is not, so that the first killing frost at Sandusky does not come on an average until October 23, but at Buffalo October 5, that is 18 days earlier.

Like an east and west mountain range, Lake Erie protects the plants on its south side from cold north winds while they get the full force of winds from the south, but with the vegetation on the north side it is the reverse. Moreover, the heat given out by the

water in winter as it freezes, modifies the climate of the adjacent land. It would seem that an equal amount of heat should be absorbed by the ice in melting, and thus the winter prolonged into spring, but for the region about the western end of the lake this is not true, because a great part of the ice is blown away toward the east end of the lake, whose period of cold is prolonged thereby. And so it comes that the climate on the south side of Lake Erie is not only milder than that on the north side but much milder than that at the east end, and, if we reckon the length of summer from the average date of the last killing frost in spring to the average date of the first killing frost in autumn, we find the summer at Sandusky to last 192 days and at Buffalo only 138 days.

The counties of Ohio lying to the east of Erie county and bordering on the lake have a climate somewhat less mild than that of the Sandusky region for their land rises more abruptly from the water, and the prevailing winds pass over more of the lake before reaching them. In Erie county the land within a few miles of the lake is mostly much less than a hundred feet in elevation. The temperature at Sandusky in spring and summer averages about one and a half degrees higher than at Cleveland, and one degree higher than in the eastern part of Erie county, four miles back from the lake shore where Mr. W. H. Todd has recorded observations for the government for many years.

It is interesting to observe that the protection from frost afforded by Lake Erie scarcely extends beyond the counties that border upon it and, as a result we have many plants in these that have not been reported from any other county north of the middle of the state, and quite a number that have been found nowhere else in Ohio except in the southern part, within forty miles of the Ohio River. Even so far south as Columbus, the

last killing frost in spring occurs on an average six days later than at Sandusky and the first killing frost in autumn five days earlier.

CLIMATE OF THREE CITIES

ON LAKE ERIE AND ONE A HUNDRED MILES SOUTH OF
IT FROM TIME OF ESTABLISHMENT OF WEATHER
BUREAU IN EACH PLACE TO END OF 1897.

		Sandusky.	Cleveland.	Buffalo.	Columbus.
WEATHER BUREAU ESTABLISHED.		1878.	1869.	1870.	1878.
MEAN TEMPERATURE.	January.....	26.2	26	25	28.4
	February.....	29.4	26	25.3	32.1
	March.....	34.7	33	30.5	38.1
	April.....	47.7	46	42.5	51.2
	May.....	59.5	58	54.2	62.0
	June.....	68.8	68	65.4	71.3
	July.....	73.6	72	70.2	74.9
	August.....	71.6	70	69.1	72.3
	September.....	65.6	64	62.5	66.1
	October.....	53.7	52	51.2	53.7
	November.....	41.2	40	38.4	41.2
	December.....	32.8	31	30.5	33.3
	Annual.....	50.4	48.8	47.1	52.1
Lowest Minimum.		-16	-17	-14	-20.3
Highest Maximum		100	99	95	103
Av. date last killing frost in spring		April 14.	May 1.	May 20.	April 20.
Av. date 1st killing frost in fall.		Oct. 23.	Oct. 11.	Oct. 5.	Oct. 18.
Av. rainfall in inches.....		34.69	34.82	39.66	38.74
Av. relative humidity.....		72.07	72.0	74.5	71.4

GEOLOGY.

The physical feature of Erie county which causes most difference between its flora and that of the counties to the east is the existence of prairies in its southern and western part. These prairies are of two

sorts, each having its characteristic plants, while many species not known to grow farther east in the state are found on both of them.

Extending over the greater part of the township of Oxford, and over portions of the townships of Milan, Huron, Perkins, Margarettta and Groton is a nearly level prairie which probably at one time formed the bottom of the glacial lake that preceded Lake Erie and later of a bay or bays partly shut off from the lake by sand bars which still exist. Underlying most of this prairie is the Ohio shale, which in many places is close to the surface. The ground requires tiling to produce good crops. The other prairie lies north and west of the village of Castalia, extending to the western boundary of the county. The soil of this is different from the other, being a calcareous deposit from the water of the Castalia springs. Within the memory of men still living a great deal of this prairie was under water much of the time. A considerable portion of the region extending south of Castalia for a distance of over fifty miles has no surface streams, but the water descends through the joints of the limestone and flows through subterranean passages which it has made in the soluble rock of the Waterlime formation. This water charged with lime carbonate issues from the ground in numerous bold springs in the vicinity of Castalia, which owes its name to this circumstance. These springs are the largest and most beautiful in Ohio. The slope from Castalia to Sandusky Bay is very gradual and before any artificial drainage was established, the region was a marsh filled more or less with the calcareous water whose deposits have formed over thousands of acres to a depth of many feet. In some places these deposits are indurated forming a tufa, in others, soft making a shell marl containing the remains of millions of *Limnea* and *Planorbis* of the same species as live in the bay now. The tufa is composed mostly of petrified *Chara*

and other plants. The shape and venation of leaves is well preserved, one of the most common kinds being that of *Hypericum kalmianum* which grows over much of the surface. On this prairie as well as on the Oxford prairie grow many plants not found east of the Huron river either in Erie county or the counties beyond.

Sandusky and Margaretta as well as Marblehead Peninsula and Kelley's Island are underlaid by Corniferous limestone which comes near the surface over much of this region. In many places, especially on Marblehead, the covering of soil is only a few inches or a fraction of an inch deep and consists of partially decomposed vegetation and lime carbonate derived from the underlying rock. Quite a number of species are characteristic of this calcareous soil. Catawba Island, as it is called, and the islands of the Put-in-Bay group have a similar character but the rock is older, belonging to the Waterlime formation. Over the greater part of Sandusky and in many places on the islands, the limestone is covered with clay of variable thickness, but in many parts the soil is too thin for trees to attain a large size, for even if they could obtain nourishment enough, they are likely to be uprooted by a strong wind. The glacier that passed over this region left traces that still show in hundreds of places, including some grooves on Kelley's Island and Marblehead which so far as we know are unsurpassed elsewhere in the world. It is interesting to observe that the grooves on the different Islands, on the Peninsula and in Sandusky and Margaretta have the same direction, running about twelve degrees south of west, or parallel with the axis of Lake Erie, excepting a few which have quite a different direction and indicate a movement of the ice at a different time. Where the superimposed drift has protected the rock from weathering, it not only retains the deep grooves but shows everywhere a highly polished surface marked with fine parallel lines.

In many places in Sandusky this polished limestone requires no quarrying to serve admirably for basement floors. So level is the rock and the overlying drift that for miles around the city, the eye can scarcely detect any elevations or any depressions with the exception of slight ones made by small streams.

Many of the rare plants of Erie County grow in sand, especially in the sand deposits east of the village of Milan and along the sand ridges that stretch east and west in Margareta township and along the border of the prairie in the southern part of Perkins township. These were formerly lake beaches and just below the sand ridge that extends south-west from Castalia is a ledge of limestone which shows very plainly the action of the waves, though it is now four miles from the water. When the lake had settled to a lower level, it must have beat against the foot of this ledge, undermining the rock and causing it to break away in large masses, as it is doing now at the west end of Rattlesnake Island and elsewhere. These detached masses often settled but a few feet, leaving deep but narrow chasms between them and the parent cliff, and these chasms are but partially filled even to the present day with dirt washed in from above. In places, trees grow out of them and the walls are bedecked with ferns. The rich woods covering the side of this hill, which I have called Margareta Ridge, the sandy fields at the top and the prairie below afford a variety of plants found nowhere else in the county and a large number of species unknown in the counties farther east.

The Huron River divides Erie county into an eastern and western part. Few of the plants which grow in Erie county and not in Lorain or Cuyahoga counties are found east of this river. West of it are no natural surface streams that continue to flow all summer and except near the river no ravines. The

valley of the Huron and its tributaries therefore afford some species not found nearer Sandusky, but as it is cut through shale, it is not so rich as the valleys farther east. At Berlin Heights, the Old Woman Creek has cut a picturesque ravine through the Waverly sandstone and into the Ohio shale. Here grow several interesting plants not found farther west. But still deeper ravines have been formed in Florence township by the Vermillion River and its tributaries, the walls mainly of shale, but in the southern part of the township also of sandstone. Here have been found many species of sedges and other plants that do not seem to grow along the Huron or west of it, though most of them grow in the counties to the east where there are still deeper ravines in the sandstone. The walls of these ravines like the walls of a cellar are warmed slowly in summer, so that on the north side of steep, wooded slopes, are some cooler spots than any near Sandusky and hence many plants which are more common farther to the north and east.

The lake shores and marshes furnish quite a number of species not found in the interior of the state. Cedar Point consists of low sand ridges thrown up by the lake and separating it from Sandusky bay and its marshes for a distance of seven miles. Throughout most of its length the plants are comprised in few species but toward the end it is wider and probably older, having a richer soil and more varied flora. Although more accessible from Sandusky than any other good collecting ground and appearing not to have a great number of species, yet so many rare forms grow there in one place or another that it is not improbable that some plant not on our list at all may yet be found there. Seven years ago, before the work of making a herbarium had been commenced, the writer thought he had found on Cedar Point about all the species that grew there, but each year he has added

something from that region, which he had never found before either there or elsewhere. In the number of rare species, Cedar Point is surpassed by Marblehead, though the latter has a larger area. Altogether the Sandusky district has furnished more than a hundred species and varieties that were not known to be growing wild any where in the state, previous to their discovery here.

FLORA OF THE ISLANDS AND ITS ORIGIN.

With the exception of some of the little ones, the islands of Ottawa county, and Kelley's—the only island belonging to Erie county,—have been visited many times and at different seasons. Of the plants growing on six of the islands in the lake, separate lists have been kept and an attempt made to make them complete. These lists are not published except as a part of the general list of plants comprised in the Sandusky flora, but a fair idea of the results may be obtained from this by bearing in mind that all the plants marked common or abundant have been found on one and, in nearly all cases, on more than one of the islands, except a few which are noted otherwise. The names of plants not common on the mainland but occurring on Kelley's Island and two or more of the Put-in-Bay group are followed by the word—Islands. If found on Kelley's island and only one other, or not on Kelley's the names of the islands on which the plant has been found are given. The number recorded for each island is as follows :

Kelley's Island.....	461.
Put-in-Bay.....	439.
Middle Bass.....	306.
North Bass.....	282.
Rattlesnake.....	192.
Green Island.....	115.

It will be seen that the numbers correspond pretty well with the size of the islands, the largest island having the greatest number of species, the next in size the next greatest number, etc. The different islands are very similar in character, consisting of limestone covered more or less with clay and without any permanent streams. The difference in physical features and the difference in flora between the islands are much less than between parts of the mainland of Erie county separated by shorter distances. The entire number of different species is 612. Fourteen of these are Naiadaceae growing in the water of bays or along the shore, most of them at Put-in-Bay and North Bass. The islands are poor in ferns, the whole number of species being only eight, of which Kelley's has six, Put-in-Bay three, all scarce, Green Island two, Middle Bass and Rattlesnake one each, and North Bass none. We have found on them no orchids and no Ericaceae. Kelley's island, owing to its extensive commerce and cultivation, together with the protection from frost afforded by the water, has many naturalized species, especially along the south shore, two or three of which have not been noticed elsewhere. Excepting these and three rare sedges, and one rare golden rod, the islands appear to have no plants that have not been found also on the mainland of Erie county or on Marblehead, —not so many species as are afforded by each township of Erie county, excepting Groton. However, in view of the fact that the islands have no permanent streams, no ravines, no alluvial soil and little or no sand except the barren sand in some places along the shores, their flora is probably as varied as that of equal areas on the mainland where these defects exist. Their combined area is only about ten square miles.

It has been supposed that the lake, which after the melting of the southern portion of the glacier overspread a larger area than Lake Erie does now, sub-

sided until what are now the islands appeared above its surface. This view is doubtless correct, but there is now much evidence to show that it continued to subside until the islands formed part of the mainland and afterward rose and isolated them again, and is still rising and likely to submerge them again. The old beaches which may be traced for long distances running nearly parallel to the present shores of the Great Lakes, must have been level at the time they were formed, but they are not now level, and there has therefore been a tilting of that part of the earth's crust which includes the basins of the Great Lakes, as there has been of many other parts. These beaches all have gentle slopes, toward the south and south-west, indicating that in this part of North America, there has been an uplifting of the land toward the north north-east or a depression toward the south south-west or both. The effect of this tilting of the basins of these lakes has been to raise the water on the south and west as compared with that on the opposite sides, just as the tipping of a saucer partly filled with water would do. The fluctuation of the water due to variable winds and rainfall make such comparisons difficult, but Mr. G. K. Gilbert found by comparing the heights above the normal level of Lake Erie in 1895, of a certain point in Cleveland, and a certain point at the head of the Welland canal with the heights of the same two points as carefully determined in 1858, that the point near the north-east end of the lake rose 0.239 foot as compared with the point in Cleveland. This is a small amount and in view of the difficulty of determining the normal level and measuring the exact height of any point on the land above it even by measurements many times repeated, it might well be attributed to some inaccuracy in the measurements if it were an isolated case. but it is not. Similar comparison of points on Lake

Ontario and on Lake Huron and Michigan also, indicate tilting, and tilting in the same direction as at Lake Erie and not only that but the amount corresponds with the distance apart of the two points compared. Furthermore the direction of the tilting indicated by these measurements is the same as that indicated by the dip of the old lake beaches. We are therefore forced to the conclusion that the basins of the great lakes have been considerably tilted and that this tilting has been going on in the present century. As the outlet of Lake Erie is at that end of the basin which has been raised more than any other part, the result has been to deepen the water throughout, but especially at the opposite end where the islands are situated. The spreading of the waters over the land should be here more noticeable for another reason also, viz.; because the shores are so low. We should therefore expect to find here in the form of submerged forests and other things that could not have formed under water, evidence of the spreading of the waters of the lake over the land, and so we do.

OLD TREES KILLED BY RISE OF THE WATER.

By the high water that prevailed in 1858 to 1860 large trees were killed in many places where the waves could not reach them. Mr. George Hine, who owns land bordering the marsh east of Sandusky, had hickory trees two feet in diameter killed in this way. On Kelley's Island large sycamore trees standing on the border of the south marsh, on Put-in-Bay elm and sycamore, on Middle Bass big trees growing by the marsh near Rehberg's, and at Toussaint and elsewhere along the shore between Port Clinton and Toledo old walnut trees, were killed at this time by high water keeping the ground too wet around their roots. Persons who came to Erie county in the forties remember seeing about the marshes connected with the bay many

dead trees which they believed to have been killed by high water, and old residents of Put-in-Bay and Kelley's Island have told me the same thing about trees there. It is probable that these trees were killed in 1838 when the water was nearly as high as in 1858, though it did not remain high so long. Hundreds of walnut stumps are still standing along the border of the marshes east of Sandusky where even now, although the water is lower than usual, it is too wet for walnut trees to grow. One that stood recently on ground only six inches above the present lake level measured 5 feet 4 inches in diameter. We may infer from this that during the life of this tree, probably over three hundred years, the water was not so high as in the present century.

SUBMERGED FORESTS.

Stumps and logs with roots attached have been found under water and show that when the trees grew the water must have been considerably lower than it has been during the present century. In the lake at Deisler's bathing beach, Put-in-Bay, was a sycamore stump that was dangerous to persons swimming, as it did not show above the water, and had to be blasted out. Other stumps in the water not far from where this one stood may still be seen. Near the Black Channel in Sandusky bay are cedar stumps standing upright with roots in place and completely submerged, except at such low stages of the water as rarely occur, when a little of the tops project. About a mile west of Venice many buried cedar stumps have been found below the level of the lake.

Besides stumps a large amount of submerged timber that fell without being cut has been found where it fell, and much of it is to be seen now. The greatest quantity is in the Huron marsh connected with Sandusky Bay. In parts where the water and mud are not very deep the logs may be easily seen in such numbers

and variety as to show that a forest was once there, but in the deeper water they are also abundant and are often struck by the pole of a hunter pushing his boat through the marsh. When in a very dry season, the ditch was dug through the marsh in order to float boats from the club house out to open water, logs of sassafras with the roots on, and a cedar with branches were found at the bottom, *i. e.* 3 or 4 feet below the present lake level. Even in the deeper parts a few logs are still to be seen partly above the water, having been supported by roots, or roots and branches until the marsh had grown up under them. A cedar out about 60 rods from land where the muck is five feet deep, has roots extending down into it at least three feet. It is 17 inches in diameter, and has about 60 rings. A pine log two feet in diameter and with 91 rings lies where the muck is over six feet deep. It has roots running down some distance and 30 years ago was not yet prostrate but the other end stuck up as much as seven feet above the water, and formed a landmark for fishermen. This is out about 80 rods from the present shore of the marsh. A walnut tree that forks into two huge and crooked branches whose ends are buried in the muck must have grown near where it lies, but this also, though a mile or more from the pine log, is some 80 rods out from shore, and the water at this place is now seven feet deep. It is still 23 inches in diameter and probably required nearly two centuries to grow. Observations on these trees were made March 5th and 6th, 1898, when the readings of the water gauge at Cleveland show the lake to have been $3\frac{1}{2}$ feet lower than the high water mark. During the life of these trees the lake must have been at least eight feet lower than it has been during much of the time for the last forty years.

A great quantity of submerged timber still retaining roots and branches was removed from the water in

front of the club house on Put-in-Bay by Mr. Vroman. There were soft maple, oak and sycamore, some of the logs four or five feet in diameter.

SUBMERGED STALAGMITES.

In several of the caves at Put-in-Bay nearly half a mile from shore, is deep water which rises and falls with fluctuations in the level of Lake Erie. The floors of these caves are covered with stalagmites, and the roofs were formerly studded with stalactites. In three caves I have seen stalactites hanging down in the water and in two stalagmites rising in the water. In one cave about thirty stalagmites may be seen on a submerged floor of a few square rods extent. They are, most of them, nearly cylindrical in shape, and represent merely the cores of larger stalagmites which once probably formed a crust over the whole floor, the remainder having been dissolved away. Those in the deeper water appear to have been dissolved more than those in the shallower parts. Many were standing in water from $2\frac{1}{2}$ to $3\frac{1}{2}$ feet deep, March 12 and 13, 1898. As stalactites and stalagmites would not form under water, the water from which the calcium carbonate was precipitated to form them must have flowed to a lower level than where the lowest stalagmites now exist. We may therefore infer that during the period of their formation, which certainly lasted many years, and probably some centuries, the lake was at least five feet lower than the mean level of the past forty years.

If these caves were formed in preglacial times, the argument still holds good, for if the lake had been as high or higher than now ever since the melting of the glacier and stalagmites had existed in the caves then, they would have been dissolved long ago. The stalagmites visible now are evidently not preglacial. Where the water does not cover the floor of the caves they are forming at the present time.

RIVER CHANNELS BELOW THE LAKE LEVEL.

In the Huron marsh off the mouth of Plum Brook, a setting pole may be pushed down 12 feet. This may be done along a line extending from the mouth of the creek out into the marsh, but a few rods on either side the pole goes down only two or three feet. When the stream cut this channel Lake Erie must have been at least 12 feet lower. Not only has the lake spread its waters over all the lowland through which this creek formerly flowed, and other creeks, whose submerged channels could doubtless be found by searching, but it has extended far up into the valleys of all the streams. This effect must result from the rise of the lake, for the streams had cut their valleys below the general level of the country, though not below the level to which the water had to flow while the cutting was going on. The Portage, the Sandusky, the Huron, and the other so-called rivers as well as all the smaller streams that enter this part of the lake, have the lower portions of their valleys filled by the water of the lake. Into the valley of the Old Woman Creek the lake has extended two miles farther than the present shore line, into the valley of the Huron five miles measured in a straight line from the present shore, into the Sandusky 22 miles beyond the Cedar Point light house, and more than 25 miles measured in a straight line from Rye Beach, for it is probable that the Black Channel at the east end of what is now Sandusky Bay is a part of the old river channel, also that the "Harbor" between Marblehead and Catawba is part of the old valley of the Portage, the lake having spread over the land to the west of Catawba and made an opening for the river at Port Clinton. This is not as yet quite certain, but there is no uncertainty about the valley of the Huron; it is still uninterrupted from the village of Huron on the lake shore to the place five miles inland where the flowing stream meets the water of the lake. The valley was

cut by the river when its waters continued to descend to Huron and beyond, but this must have been when the lake was not less than 32 feet lower than now, for the bottom of the channel is 32 feet below the present lake level at a point more than four miles from the lake, and the depth of the water above the mud is between 17 and 32 feet all the way from this place to the lake.

Even Mud Creek, a small tributary of the Huron, has all the lower part of its channel deep below the present lake level. The entire drainage area of this creek is only about four square miles, yet its waters reach the present level of the lake nearly a mile measured along the valley of the stream above its junction with the Huron, and at a bridge about three-fourths mile up the valley the water and mud are 12 or 14 feet deep.

EVIDENCE OF THE WATER'S DEEPENING IN THE PRESENT CENTURY.

Records of the lake level kept at different places show that at four times in the first half of the century the water was lower than at any time in the last half. In 1810 and in 1819 it was lower than any time since 1820, in 1841 and 1846 lower than at any time since the latter date. In the absence of any record of exact measurement of lake levels west of Cleveland we have, nevertheless, evidence that the water about Sandusky and the islands was lower in the early part of the century. Mr. Shook, now living at Port Clinton, remembers that in 1828 Mr. Ramsdell made hay of the wild grass that grew on what is now the harbor west of Lakeside, and that there was very little water then where it has since been four feet deep. Similar statements are made by other persons regarding this and other places in this region.

When Harrison's army passed near Huron in 1813

a corduroy road about 60 rods long was built across Mud Creek bayou, which, it is said, had been submerged for many years, when, in 1867, the water being temporarily very low, Mr. Carpenter removed many of the logs.

A survey made in 1887 of the Huron marsh at the east end of Sandusky bay shows that a tract of land one-half mile square, surveyed in 1809 has since become marsh with the water and mud 12 to 18 inches deep, and for two miles west of it, as far as it was surveyed, the shore line has moved south about five rods. These changes are certainly *not* due to erosion. Elsewhere about Sandusky bay and along the shore of the lake land has disappeared, partly from erosion and partly because of the rising water covering it and giving the waves new points of attack. The western part of the city of Sandusky has suffered much from the encroachment of the bay and along nearly the whole shore west to Martin's Point and beyond land has disappeared. So it is also along the lake. The surveys show that for seven miles west from the Vermillion River the lake has encroached upon the land between 20 and 34 rods since 1809. From the Huron River to Dr. Esch's place, about one and one-half miles west, the shore line has moved south a distance varying from 18 to 28 rods, west of this not so much. Since 1809 more than 500 acres have been lost to Erie county along the lake and in the eastern part of the bay, and many acres more between Sandusky and the western limit of the county. On the north side of the bay, too, the water has extended, open water covering ground where cat-tails once grew. John Stone of Put-in-Bay, and Warren Smith of Sandusky, remember when rushes grew over much of Sandusky Bay where now is open water. Until the middle of the century an island known as Peninsula Point extended across nearly the whole breadth of what is now the mouth of the bay. For the

length of a mile its height was 20 to 25 feet or more, and along the west side was clay covered with six inches of black soil bearing shell bark hickory trees and white oaks two and one-half feet in diameter. The last of this large island disappeared in 1860.

Gull Reef, north of Kelley's Island, has for many years been the greater part of the time under water. As late as 1850 it was an island on which stood a fish shanty and a tree that probably took a hundred years to grow.

DERIVATION OF THE ISLAND FLORA.

The facts stated in the preceding paragraphs suggest the possibility of many of the plants now on the islands having spread over them when a land connection existed between them and the mainland. Mr. Gilbert and others have concluded from a study of the old lake beaches that when the melting of the ice to the north opened an outlet for the glacial lake at Niagara the waters went down till it occupied only one-sixth the area that Lake Erie does now, and extended no farther west than Erie, Pa. We have seen that the submerged forests and stalagmites in the region about Sandusky and the islands prove a lower condition of the water when these were formed than has existed in the present century, and that the submerged river channels in this region indicate that the depression of the land as compared with the water has amounted to not less than 32 feet. A lowering of the water 22 feet would make it possible to walk from Kelley's island to Catawba, and 30 feet from Put-in-Bay to Catawba, excepting for a narrow channel, like a river which is deeper than the rest. We would be entitled, therefore, to conclude, even without a knowledge of observations made in other regions, that the islands were connected with the mainland in postglacial times. With this conclusion it is much easier to harmonize the facts

ascertained regarding the plants now growing on the islands than to see how all of them could have been transported across several miles of water.

The seeds of many plants are provided with such means of transportation as would render their safe passage over a few miles of water an easy matter. Some produce fruit that is swallowed whole by birds and the pulp digested but not the seeds. The latter may thus be transported over land or water and propagate the species miles away from the parent plant. A mountain ash found growing on Rattlesnake Island in a thicket where birds roost was doubtless carried there in this manner. Some seeds like those of thistle have down so light that the wind may carry them long distances. Some are capable of floating for a time and then germinating. Some seeds are so small that they are likely to be carried in the mud that sticks to the feet of rails or other birds that frequent marshy places. In several instances a single specimen of orchid has been found growing on some springy bank or damp place in the woods of Erie county and not another of the same kind within many miles. In two instances the single specimens are the only ones we have ever found in the county. These probably came from seeds that stuck to the feet of woodcocks or other birds that transported them from some distant bog. *Ammania coccinea* and some other mud-inhabiting species were probably transported in this way to the shore of Sandusky bay from much farther south for they are not known to grow elsewhere within more than a hundred miles.

When the ice forms a bridge between the islands and the mainland it would seem that weeds or their seeds might be blown across it or be carried across in the hair of animals. Seeds might also have been transported in former times by the Indians in their boats. In the present century the flora of the islands has been

materially increased through the agency of man. Several cultivated plants have run wild and become well established there, including several species which are seldom found flourishing in the wild state so far north. The islands seem to have their full share of weeds and most of these have probably been introduced with impure seed. Others have probably been transported in baled hay and in packing material, and some, like the hore-hound, by sticking to people's clothes.

So numerous are the ways in which seeds may be transported that it would seem quite possible for the islands in the course of a few thousand years to have acquired all the plants that grow on them without any closer connection with the mainland than now exists. When, however, we consider more carefully these means of transportation in relation to all the species on the islands, we find it difficult to understand how some of them could have reached the islands in any of these ways.

A tornado passing first over the land and then the islands might carry seeds of any sort, but it would require more than one tornado to distribute seeds to all the islands and if any of the islands owed part of their plants to this agency we should expect to find on them some species well distributed which do not grow on the other islands at all, but this is not the case, with the exception of some species recently introduced by man. Other winds would not be likely to carry so far any but the lightest of seeds. Violent winds coming from the south where the mainland is nearest are generally accompanied by rain.

Any plant whose seeds are safely transported in the alimentary canal of birds might reach the islands in this way. Of the species that grow in muddy or marshy places and produce small seeds likely to be transported in mud on the feet of woodcocks, etc., not

many occur on the islands and some of the islands have no places which such birds frequent.

Men who have often crossed the ice in winter say it would be impossible for seeds to be blown along on the ice all the way to the islands. Not only is the ice apt to be rough in many places, but it is crossed by numerous drifts of snow and is always intersected by long cracks in which seeds would lodge. Cakes of floating ice might transport seeds some distance, but would usually be prevented from landing them on distant shores by other ice getting in the way, and the freezing of the seeds to the floating ice would prevent them from blowing off. However, some littoral species may have reached the islands in this way. In those instances in which animals have succeeded in swimming so far, any seeds that were clinging to their hair at the start would probably be washed off on the way. Yet many species that rely upon mammals for transportation from place to place are there and give evidence of having been there longer than civilized man. These plants mature their seeds from four to six months before the ice would permit an animal to cross to the islands, and some of them have lost all their seeds by that time.

The following list gives the names of some of the plants on the islands whose seeds are adapted to transportation in the hair of animals: *Desmodium canescens*, *Desmodium paniculatum*, *Agrimonia eupatoria*, *Geum album*, *Geum virginianum*, *Circaea luteiana*, *Osmorrhiza brevistylis*, *Osmorrhiza longistylis*, *Sanicula marylandica*, *Sanicula marylandica* var. *canadensis*, *Galium aparine*, *Galium boreale*, *Galium circaezans*, *Galium triflorum*, *Coreopsis trichosperma* var. *tenuiloba*, *Echinosperrum virginicum*.

Colonel James Smith in the narrative of his captivity with the Indians, 1755-59, says: "These islands are but seldom visited; because early in the spring and

late in the fall it is dangerous sailing in their bark canoes; and in the summer they are so infested with various kinds of serpents, (but chiefly rattlesnakes,) that it is dangerous landing." It is not probable then that the Indians planted anything there, or that any great number of seeds were introduced by them accidentally.

The difficulty of seeds floating to the islands, is two-fold. The prolonged soaking in the absence of definite currents to carry them in that direction is sufficient to destroy the vitality of many kinds. The shores of the islands do not afford conditions suited to the growth of many of the species found in the interior. On Green and Rattlesnake islands there is not a single spot where it seems possible for a plant to start from seeds washed ashore, except such as grow on bare rocks. Six kinds of oak and three of hickory grow on the islands. If all these kinds came from nuts that drifted ashore, one would expect to find somewhere on the shore of some island a tree so situated as to suggest the possibility of its having originated in this way, but not a single one has been found. These are long lived trees, and if within the period represented by the growth of a large oak or hickory, there has not been a single instance of a nut drifting ashore and finding a suitable place to grow it may well be doubted, if in several thousand years there would be opportunities for all the different kinds to reach so many different islands. The fact that acorns left in the water soon lose their power to germinate increases the difficulty, yet it is not easy to see how, except by floating, acorns or pig-nuts would be likely to reach the islands as long as they were separated from the mainland as far as they are now.

The weeds that have followed civilized man from the Old World, or have spread since the cultivation of the land from other parts of this, grow on

the islands as well as the mainland. That they have reached the islands mainly through man's agency is shown by the fact that those islands which have the most extensive commerce have the greatest variety of weeds. Green Island, being still wild, may be left out of consideration, but the greater part of Rattlesnake is cultivated, and there many kinds of weeds grow with a luxuriance that tries the patience of the owner. Yet there are fourteen kinds of weeds that grow on all four of the other islands, which are not to be found on Rattlesnake, without counting a number that need a damper soil than there prevails. Not only are most of these fourteen common on all the islands that enjoy much commerce, but among them are included a number of the most abundant weeds in this part of North America. The list is as follows: *Lepidium virginicum*, *Abutilon avicennæ*, *Melilotus alba*, *Medicago lupulina*, *Bidens frondosa*, *Sonchus asper*, *Xanthium canadense* var. *echinatum*, *Marrubium vulgare*, *Amarantus albus*, *Amarantus blitoides*, *Acalypha virginica*, *Juncus tenuis*, *Bromus secalinus*, *Panicum sanguinale*. Why are these species, elsewhere so abundant, not represented on Rattlesnake Island? For many years the island has been cultivated and the conditions suitable to the growth of these fourteen kinds of weeds, most of which have abounded for many years all around Lake Erie, but the island has been the abode of only a single family and its commerce, therefore very limited, and the seeds have not found any way to reach the island, or, if they floated to it, no way to get up onto soil where they could grow.

If a large portion of the plants on the islands have reached them in ways which may be called accidental and not by means that may be seen operating in the present century, then we ought to find deficiencies in the flora of certain islands due to the failure of certain species to reach them. Some plants that are well

distributed on certain islands should be altogether wanting on others where the conditions for their growth are just as suitable. Moreover we should expect to find that some species not adapted to passing over the water had failed to reach any of the islands. But what we do find is the reverse. Every native species that is well distributed in similar soil on the mainland grows also on the islands and in no case, we believe, is a native species common over one island and lacking on others where similar conditions exist.

The leading facts bearing on the origin of the island flora may be summarized as follows: Within the present century the waters of Lake Erie and of the bays and marshes connected with it have encroached upon the land in the vicinity of Sandusky, covering many hundreds of acres of what was, at the time of the first surveys, solid ground. Trees several centuries old have been killed by high water in the present century. Submerged forests have been found in different parts of the region, submerged stalactites and stalagmites in the caves of Put-in-Bay, and submerged river valleys both east and west of Sandusky. When the trees grew and the stalagmites and valleys were formed, the land must have been above the level of the lake. The valleys are now deeper below the surface of the lake than is the lake bottom between the islands and the mainland. At the time they were formed, therefore, the lake did not separate the islands from the mainland. The flora of the islands is different from what we should expect to find, if all the species growing there had reached them by being transported across the water. It is probable then that many species have been on the islands since a time when these formed part of the mainland.

We may picture to ourselves woods such as grow at Lakeside now stretching north to Put-in-Bay and Kelley's island, interspersed here and there with prairies, perhaps, like those on the Peninsula now. We may

well believe the picture to represent what was once a reality. How long ago this was we cannot tell. Some observations make it seem probable that it was not a great many centuries ago, perhaps less than twenty. Sometime we may find better means of judging.

SOUTHERN AND WESTERN PLANTS WHICH GROW NEAR LAKE ERIE.

Owing to the long summer enjoyed by places situated on the south shore of Lake Erie, many plants grow here which are not found farther north. As the country farther east lacks prairies such as occupy a considerable part of Erie county, quite a number of species appear to reach their eastern limit here. Since a number of the species are both southern and western, no separation of southern and western species is attempted in the following list. Many of the southern species grow east of the southern part of Lake Michigan, and some of them in southern Minnesota, where the summer isotherms reach a higher latitude than in the eastern part of the country. The species in the list are believed to be wholly wanting or of rare or local occurrence in that part of North America, which lies east and north of the meridian and parallel of Cleveland. Few of them are found in northern Ohio anywhere east of Erie county. The plants whose names are followed by an asterisk I have not found, but Mr. David F. Day, of Buffalo, who collected at Toledo in 1865, tells me that he found them there.

Echinacea purpurea is inserted in the list because of a Toledo specimen in the herbarium of the Ohio State University.

Viola pedatifida.

Hypericum gymnanthum.

*Hibiscus militaris.**

Aesculus glabra.

Polygala verticillata ambigua.

Desmodium lineatum.

Desmodium illinoense.

*Petalostemon candidus.**

<i>Silphium trifoliatum.</i>	<i>Phlox maculata.*</i>
<i>Solidago speciosa angustata.</i>	<i>Hydrophyllum macrophyllum.</i>
<i>Vernonia altissima.</i>	<i>Phacelia purshii.</i>
<i>Asclepias sullivantii.</i>	<i>Cuscuta chlorocarpa.</i>
<i>Petalostemon violaceus.*</i>	<i>Cuscuta decora.</i>
<i>Psoralea melilotoides.</i>	<i>Conobea multifida.</i>
<i>Geum vernum.</i>	<i>Gerardia auriculata.</i>
<i>Pyrus angustifolia.</i>	<i>Gratiola sphaerocarpa.</i>
<i>Spiræa lobata.</i>	<i>Seymeria macrophylla.</i>
<i>Ammannia coccinea.</i>	<i>Tecoma radicans.</i>
<i>Eryngium yuccæfolium.</i>	<i>Lippia lanceolata.</i>
<i>Thaspium barbinode angustifolium</i>	<i>Pycnanthemum muticum pilosum.</i>
<i>Valeriana pauciflora.</i>	<i>Scutellaria nervosa.</i>
<i>Actinella acaulis glabra.</i>	<i>Scutellaria versicolor.</i>
<i>Aster shortii.</i>	<i>Euphorbia dentata.</i>
<i>Coreopsis aristosa.</i>	<i>Salix glaucophylla.</i>
<i>Echinacea purpurea.</i>	<i>Iris cristata.</i>
<i>Eclipta alba.</i>	<i>Smilax ecirrhata.</i>
<i>Eupatorium altissimum</i>	<i>Trillium sessile.</i>
<i>Helianthus grosse-serratus.</i>	<i>Carex conjuncta.</i>
<i>Helianthus hirsutus.</i>	<i>Carex shortiana.</i>
<i>Helianthus mollis.</i>	<i>Carex stenolepis.</i>
<i>Helianthus occidentalis.</i>	<i>Carex granularis haleana.</i>
<i>Helianthus parviflorus.</i>	<i>Carex mnhlenbergii enervis.</i>
<i>Helianthus tracheliiifolius.</i>	<i>Cyperus refractus.</i>
<i>Kuhnia eupatorioides.</i>	<i>Rhynchospora cymosa.</i>
<i>Liatris pycnostachya.*</i>	<i>Aristida gracilis.</i>
<i>Liatris squarrosa intermedia.</i>	<i>Melica diffusa.</i>
<i>Prenanthes aspera.</i>	<i>Poa brevifolia.</i>
<i>Prenanthes crepidinea.</i>	<i>Triodia cuprea.</i>
<i>Rudbeckia triloba.</i>	<i>Equisetum robustum.</i>

A "List of Plants Observed Growing Wild in the Vicinity of Cincinnati," by C. G. Lloyd, with additions furnished by Walter H. Aiken, includes six hundred and forty-five species and varieties. Of these only fifty-one native species are lacking in Erie county. A greater number than this have been found in Lorain county, which borders Erie on the east, and might probably be found in each of the lake counties beyond.

DEFICIENCIES IN THE SANDUSKY FLORA.

Of the four counties, Lorain, Cuyahoga, Franklin and Licking, each two or three times as large as Erie, lists of plants have been published. Several hundred species are common to the four counties. Only four of these species, *Viola canadensis*, *Hieracium venosum*, *Veronica americana* and *Habenaria orbiculata*, have we failed to find in Erie county.

However twenty-five species not found in Erie county, grow in both Lorain and Cuyahoga. If we had complete lists for the counties farther east, Lake and Ashtabula, we should probably find in them a still larger number that do not grow in Erie county. Their higher hills and deeper ravines, give them a more northern flora, than one finds in the neighborhood of Sandusky. Moreover the Sandusky district contains no genuine bog or sphagnous swamp. Such a bog encircles a little lake a few miles south-east of Erie county in Camden township, Lorain county. The list of plants growing at Camden Lake and not in Erie county, is probably incomplete. For some of the names, I am indebted to Isabel S. Smith who has found the specimens in the Oberlin herbarium.

The list of other plants growing in northern Ohio is based mainly on the work of other collectors. It includes only those species which are said to grow in two or more counties bordering on the Lake. Of some of the species I have seen no specimens. Many other species have been reported and many others undoubtedly grow in one place or another, but this list together with the catalogue of plants of Sandusky and vicinity and the plants of Camden are thought to include all the native phenogams and vascular cryptogams which grow in the Lake counties, excepting such as are very rare or local.

PLANTS GROWING AT CAMDEN LAKE.

<i>Coptis trifolia.</i>	<i>Pogonia ophioglossoides.</i>
<i>Sarracenia purpurea.</i>	<i>Smilacina trifolia.</i>
<i>Nemopanthus fascicularis.</i>	<i>Calla palustris.</i>
<i>Potentilla palustris.</i>	<i>Peltandra undulata.</i>
<i>Viburnum cassinoides.</i>	<i>Scheuchzeria palustris.</i>
<i>Cassandra calyculata.</i>	<i>Carex canescens.</i>
<i>Vaccinium oxycoccus.</i>	<i>Carex debilis.</i>
<i>Menyanthes trifoliata.</i>	<i>Carex trisperma.</i>
<i>Alnus serrulata.</i>	<i>Eriophorum virginicum album.</i>
<i>Arethusa bulbosa.</i>	<i>Rhynchospora alba.</i>
<i>Habenaria orbiculata.</i>	<i>Glyceria canadensis.</i>
	<i>Woodwardia virginica.</i>

OTHER PLANTS NOT FOUND NEAR SANDUSKY, BUT
SAID TO GROW IN TWO OR MORE OF THE
COUNTIES OF OHIO THAT BORDER
ON LAKE ERIE.

<i>Adlumia cirrhosa.</i>	<i>Hieracium venosum.</i>
<i>Corydalis glauca.</i>	<i>Polymnia uvedalia.</i>
<i>Stylophorum diphyllum.</i>	<i>Solidago squarrosa.</i>
<i>Viola canadensis.</i>	<i>Solidago uliginosa.</i>
<i>Viola hastata.</i>	<i>Pyrola secunda.</i>
<i>Viola rotundifolia.</i>	<i>Rhododendron nudiflorum.</i>
<i>Acer spicatum.</i>	<i>Vaccinium stamineum.</i>
<i>Polygala polygama.</i>	<i>Monotropa hypopitys.</i>
<i>Astragalus cooperi.</i>	<i>Phlox maculata.</i>
<i>Prunus pennsylvanica.</i>	<i>Cynoglossum virginicum.</i>
<i>Waldsteinia fragarioides.</i>	<i>Melampyrum americanum.</i>
<i>Ribes oxycanthoides.</i>	<i>Pentstemon laevigatus digitalis.</i>
<i>Ribes rubrum subglandulosum.</i>	<i>Veronica americana.</i>
<i>Saxifraga virginensis.</i>	<i>Rumex salicifolius.</i>
<i>Oenothera biennis grandiflora.</i>	<i>Myrica asplenifolia.</i>
<i>Aralia hispida.</i>	<i>Alnus incana.</i>
<i>Diervilla trifida.</i>	<i>Betula lutea.</i>
<i>Lonicera ciliata.</i>	<i>Cypripedium parviflorum.</i>
<i>Cornus canadensis.</i>	<i>Pogonia verticillata.</i>
<i>Antennaria margaritacea.</i>	<i>Spiranthes latifolia..</i>
<i>Aster patens.</i>	<i>Smilax glauca.</i>
<i>Cacalia suaveolens.</i>	<i>Uvularia perfoliata.</i>

Veratrum viride.	Larix americana.
Carex umbellata.	Asplenium trichomanes.
Cyperus erythrorhizos.	Ophioglossum vulgatum.
Milium effusum.	Phegopteris polypodioides.
	Woodsia obtusa.

EXTINCT SPECIES.

The only plant no longer found in the county, but known to have formerly grown in considerable quantity, is the Pitcher Plant, *Sarracenia purpurea* Mr. W. H. Todd remembers that this used to grow in the old huckleberry swamp near Axtell, in the eastern part of the county. This swamp of a hundred acres extent, is said to have produced yearly hundreds of bushels of blueberries, and a hundred bushels or so of cranberries. About 1856 a fire started in the muck, which lasted for a year, burning in places to a depth of four to six feet. This and drainage killed all the cranberries and nearly all the blueberries, and, how many other species, nobody will ever know. It is now overgrown with a dense tangle of blackberry bushes interspersed with aspen and soft maple; the soil too light to be of much account. Had the original swamp been preserved, it would now be valuable for the berries it would produce. Only after repeated visits and prolonged searching in this wilderness by several persons, were two surviving bushes of the swamp blueberry discovered. Cranberries, which formerly grew also in a swamp near Berlin Heights, are now confined to a few square yards of ground, along a road near Milan.

Poison sumach formerly grew in the Axtell swamp. It is now all but extinct in the county. Leatherwood formerly abounded on Becher's flats along the west branch of the Vermillion River. A single specimen remains, probably the only one in the county. A sedge collected on Cedar Point several years ago, and called by Prof. Wheeler, *Cyperus Houghtonii*, was afterward lost and so is not included in our catalogue. Likewise

we omit Strawberry Blite, *Chenopodium capitatum*, seen on Green Island in 1892, but not collected, and *Hedeoma hispida*, given in a list of plants, analyzed in the eastern part of Erie county by Josephine Fish, a number of years ago. The last has been found in Lorain County by Prof. Kelsey, but perhaps is not indigenous to Ohio.

FOREST TREES.

Most of the land of Erie county is now under cultivation. Much of it was treeless when the earliest settlements were made. Nevertheless, it supports a greater variety of trees than do most of the counties of Ohio, greater, perhaps, than any similar area farther north in America. Birch, alder and tamarack, which grow farther east in Ohio, are lacking in Erie county, but it has ten kinds of oak, six of hickory, five of ash, four of maple, four of poplar, four of willow, three of thorn, two of elm, two of ironwood, two of wild crab, and one each of black cherry, chokecherry, plum, juneberry, basswood, box elder, buckeye, staghorn sumach, papaw, tulip, cucumber, red-bud, locust, coffee-tree, dogwood, pepperidge, sassafras, mulberry, hackberry, buttonwood, beach, chestnut, walnut, butternut, hemlock, cedar and pine. Besides these, there are several cultivated kinds that have become naturalized. The distribution is given in the catalogue, where the names may be found by referring to the index. Erie county has five times as many native trees as the whole of Great Britain.

THE CATALOGUE.

The catalogue that follows gives the names of the phenogams and vascular cryptogams in the herbarium of the Sandusky high school which have been collected in the region shown on the accompanying

map, i. e. Erie county, and the islands of Ottawa county, with the eastern portion of the peninsula, extending as far west as Port Clinton. Specimens of all the species and varieties have been examined by Prof. C. F. Wheeler, of Michigan, to whom I am indebted also for assistance in the determination of my earlier collections of Cyperaceæ and Naiadacæ, as well as of many puzzling forms found since.

Furthermore, a collection of most of the rarer species has been deposited in the Gray Herbarium, Cambridge, Mass., and another set in the Ohio State Herbarium, at the University at Columbus, and at both places botanists have examined them to see if there were errors in the identification.

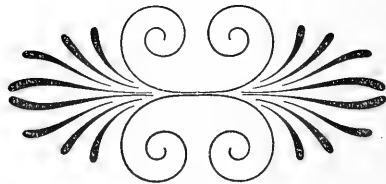
To Dr. Erwin F. Smith, of Washington, I am also indebted for valuable suggestions and assistance.

In a region where so many rare native species occur one would expect to find some exotic plants thriving, better than in most places in this latitude. As in the Philippine Islands where it has been introduced, so also in Sandusky, the tomato grows wild, coming up like a weed in many places, but especially along the bay shore, where it ripens its fruit year after year. It is difficult in some cases to say whether a species is naturalized or not. Oats grow on the shores of the islands, as well as about the docks in Sandusky, and along roads, but herbs of which all the specimens found have probably sprung directly from the seeds of cultivated plants, are not included in the catalogue. A watermelon vine with fruit was found on the shore of Cedar Point, and this and muskmelon, squash and pumpkin, on waste ground in Sandusky near the Bay. Peanuts, which are raised in small quantities by many people in and near Sandusky, have been found spontaneous in two places in the city. Snapdragon, gilliflower, candytuft, common honesty, petunia, and others, have been found growing in waste places, but

are excluded from the catalogue under the rule given above. On the other hand plants that are never cultivated in this region are included, even if merely adventive.

In nomenclature I have, in the main, followed the Index Kewensis, giving in parenthesis the names used in the sixth edition of Gray's Manual, in the few cases where those differ materially from the names of the Kew Index. Names of species not native to this part of the world, are printed in italics. An asterisk indicates that the species is at present known to grow in few, if any places in Ohio, except in the neighborhood of Sandusky.

Relative abundance is expressed by the following terms in the order named; rare, scarce, infrequent, frequent, common, abundant. When standing alone or coming first, they refer to Erie county as a whole.



CATALOGUE.

PTERIDOPHYTA.

OPHIOGLOSSACEÆ.

BOTRYCHIUM, Swartz.

- B. TERNATUM, Swartz.
 Eastern Milan, Berlin, Florence, Vermillion; infrequent. Varies greatly.
- B. VIRGINIANUM, Swartz.
 Frequent. Put-in-Bay.

FILICES.

ADIANTUM, L.

- A. PEDATUM, L. Maiden-hair Fern.
 Common. Not on the Islands.

ASPIDIUM, Swartz.

- A. ACROSTICHOIDES, Swartz. Shield Fern.
 Scarce in Perkins. Common on high banks of Huron and Vermillion Rivers.
- A. CRISTATUM, Swartz.
 Vermillion River bottoms, Florence; rare.
- A. GOLDIANUM, Hook.
 Florence and Kromer's woods, Perkins; scarce.
- A. MARGINALE, Swartz.
 Common on steep river banks.
- A. NOVEBORACENSE, Swartz.
 Infrequent.

A. SPINULOSUM, Swartz.

Frequent in rich woods.

A. SPINULOSUM INTERMEDIUM, D. C. Eaton.

Frequent. Neither this nor the species seen on Peninsula or Islands.

A. THELYPTERIS, Swartz.

Common.

ASPLENIUM, L. Spleenwort.

A. ANGUSTIFOLIUM, Michx.

Infrequent.

A. EBENEUM.

Common in Furnace woods, Vermillion, "Cedar Point," J. R. Schacht.

A. FILIX-FOEMINA, Bernh.

Common. Not on Peninsula or Islands.

A. THELYPTEROIDES, Michx.

Perkins and Florence ; scarce.

CAMPTOSORUS, Link, Walking-fern.

C. RHIZOPHYLLUS, Link.

On sides of sandstone rocks, Vermillion River, S. Florence ; on limestone, three places in Margaretta, Catawba, Kelley's Island.

CYSTOPTERIS, Bernh, Bladder Fern.

C. BULBIFERA, Bernh.

Frequent. Islands.

C. FRAGILIS, Bernh.

Common. Kelley's Island.

DICKSONIA, L'Her.

D. PILOSIUSCULA, Willd.

Vermillion River ; frequent. Big woods, Perkins ; scarce.

ONOCLEA, L.

O. SENSIBILIS L. Sensitive Fern.

Common. Not on the Islands.

- O. STRUTHIOPTERIS, Hoffman.
Vermillion River bottoms, frequent.

OSMUNDA, L.

- O. CINNAMOMEA, L. Cinnamon Fern.
Infrequent; Florence, Milan "Perkins."
O. CLAYTONIANA, L.
Common in moist woods. Not on Peninsula or
Islands.
O. REGALIS, L. Flowering Fern.
Infrequent in wet woods.

PELLÆA, Link, Cliff-Brake.

- P. ATROPURPUREA, Link.
Sandstone quarry, Furnace woods, Vermillion;
on limestone, Margaretta, Peninsula, Catawba,
Kelley's Island, Put-in-Bay.

PHEGOPTERIS, Fee, Beech Fern.

- P. HEXAGONOPTERA, Fee.
Frequent from the Huron river east.

POLYPODIUM, L., Polypody.

- P. VULGARE, L.
Rocky banks of rivers and Kelley's Island;
scarce.

PTERIS, L.

- P. AQUILINA, L., Common Brake.
Frequent.

EQUISETACEÆ.

EQUISETUM, L., Horsetail.

- E. ARVENSE, L.
Common but not observed on the Islands, except
Kelley's.

- E. LAEVIGATUM, Braun.
Frequent, at least in the western part of the county.
- E. LIMOSUM, L.
Lake marshes, Huron Tp.
- E. LITTORALE, Kuhl.*
Perkins; rare.
- E. PRATENSE, Ehrh.
Frequent.
- E. ROBUSTUM, Braun,
Common, apparently entirely supplanting *E. hyemale*. Put-in-Bay and Kelley's Island but no others
- E. VARIEGATUM, Schleicher,*
Cedar Point and elsewhere; rare.

LYCOPODIACEÆ.

LYCOPIDIUM, L., Club-Moss.

- L. COMPLANATUM, L. Ground-Pine.
East fork of Vermillion River; rare.
- L. DENDROIDEUM, Michx.
East of Milan; rare.
- L. LUCIDULUM, Michx.
Quarry in Furnace woods, Vermillion; rare.
Each of the three kinds of club-moss has been found in but a single spot, and of the last two, only a few specimens.

GYMNOSPERMÆ.

CONIFERÆ.

JUNIPERUS, L.

J. COMMUNIS, L.

Mr. Latham's woods, Catawba; very rare.

J. VIRGINIANA, L., Red Cedar.

Frequent in dry soil in various parts of Erie and Ottawa counties. Formerly abundant on the islands where its wood was one of the first sources of income to the early settlers. Many stumps two feet or more in diameter still remain on Kelley's Island, though they are being used for kindling and for boat knees. The trees grew in the thin soil overlying the limestone, and so the roots following the level surface of the rock were given off from the trunk at a right angle. Having greater strength than an artificial joint and great durability sections of these stumps make excellent knees for small boats. Large cedars grew formerly also on Cedar Point where small ones are common now.

PINUS, Tourn.

P. STROBUS, L. White Pine.

Cedar Point and Vermillion River. Both this and Red Cedar grew once where Sandusky Bay is now.

TAXUS, Tourn.

T. CANADENSIS, Willd. American Yew. Ground Hemlock.

Shores of Islands and Vermillion River; infrequent.

TSUGA, Carriere.

T. CANADENSIS; Carr. Hemlock.

Common along the Old Woman Creek at Berlin Heights and along the Vermillion River.

MONOCOTYLEDONES.

TYPHACEÆ.

SPARGANIUM, Tourn, Bur-reed.

- S. ANDROCLADUM, Engelm.
Lake marshes. Middle Bass.
- S. EURYCARPUM, Engelm.
Lake marshes. Middle Bass.
- S. SIMPLEX, Huds.
Southern Florence, Shinrock.

TYPHA, Tourn.

- T. AUGUSTIFOLIA, L.
Castalia stream, Portage River and North Bass;
scarce.
- T. LATIFOLIA, L. Common Cat-tail.
Common.

NAIADACEÆ.

NAIAS, L., Naiad.

- N. FLEXILIS, Rostk, and Schmidt.
Common.
- N. FLEXILIS ROBUSTA, Morong.*
Infrequent.
- N. GRACILLIMA, A. Br.*
"Portage River" A. J. Pieters.

POTAMOGETON, Tourn. Pond-weed.

- P. AMPLIFOLIUS, Tuckerm, Deep water; infrequent.
- P. FOLIOSUS, Raf.
East Harbor, Put-in-bay, North Bass; mostly in
shallow water.
- P. FOLIOSUS NIAGARENSIS, (Tuckerm.) Morong.*
North Bass and small streams in Erie County,
especially Mills Creek.

- P. FRIESII, Rupr.*
Sandusky Bay, Put-in-Bay; infrequent.
- P. HETEROPHYLLUS, Schreb.*
Frequent; especially the variety *longipedunculatus*. The variety *maximus* occurs at North Bass.
- P. HILLII, Morong.*
East Harbor; rare.
- P. INTERRUPTUS, Kitaibel.*
Sandusky Bay, Put-in-Bay; rare.
- P. LONCHITES, Tuckerm.
Common.
- P. LUCENS, L.*
Frequent.
- P. NATANS, L.
Common, as is also the so called variety, *prolixus*.
- P. PECTINATUS, L.
Abundant-
- P. PERFOLIATUS, L.
Frequent.
- P. PERFOLIATUS RICHARDSONII A. Bennett.
Abundant.
- P. PRAELONGUS, Wulf.*
Sandusky Bay, August Guenther. Perhaps its habit of withdrawing beneath the water, as soon as its fruit is set, has prevented us from finding much of it.
- P. PUSILLUS, L.*
Infrequent.
- P. ROBBINSII, Oakes.
Sandusky Bay; scarce.
- P. ZIZII, Roth.*
Sandusky Bay; scarce.
- P. ZOSTERÆFOLIUS, Schum.
Common.
- TRIGLOCHIN, L. Arrow-Grass.
- T. PALUSTRE, L.*
Castalia Sporting Club grounds; rare.

ZANNICHELLIA, Mitchell, Horned Pond-Weed.

Z. PALUSTRIS.

The "variety" *pedunculata* grows, or did grow in one of the rivulets flowing from the Blue Hole, Castalia; rare.

ALISMACEÆ.

ALISMA, L. Water-Plantain.

A. PLANTAGO, L.
Common.

LOPHOTOCARPUS, T. Durand.

L. CALYCINUS, (Engelm) J. G. Smith.*
In a small pond bordering the southern boundary of Sandusky.

SAGITTARIA, L. Arrow-Head.

S. ARIFOLIA, Nutt.

Oxford, Danbury; scarce.

S. GRAMINEA, Michx.*

Sandusky Bay. "East Harbor," A. J. Pieters.

S. LATIFOLIA, Willd. (S. VARIABILIS, Engelm.)

Common and variable.

S. RIGIDA, Pursh. (S. HETEROPHYLLA, Pursh.)

Sandusky Bay, Put-in-Bay, Harbors; frequent.
In deeper water than the last.

HYDROCHARIDACEÆ.

ELODEA, Michx. Water-Weed.

E. CANADENSIS, Michx.

Common. Kelley's Island, Put-in-Bay. Filling the cove east of Sandusky so as to make it difficult to row a boat there.

VALLISNERIA, L. Tape-Grass, Eel-Grass.

- V. SPIRALIS, L.
Common.

GRAMINEÆ.

AGROPYRON, Gaert.

- A. CANINUM, Beauv.*
Berlin Heights; rare.
- A. GLAUCUM, R. & S.*
L. S. & M. S. Ry., Sandusky; scarce.
- A. REPENS, Beauv. Couch-Grass, Quitch-Grass.
Infrequent. Kelley's Island.

AGROSTIS, L. Bent-Grass.

- A. ALBA, L.
Common, as is the variety *vulgaris*, Red Top.
- A. PERENNANS, Tuckerm, Thin-Grass.
Frequent.
- A. SCABRA, Willd. Hair-Grass.
Infrequent. Put-in-Bay, Middle Bass.

ALOPECURUS, L. Foxtail-Grass.

- A. GENICULATUS ARISTULATUS, Torr.
Islands, Peninsula and Milan; rare in Erie county.

AMMOPHILA, Host.

- A. ARUNDINACEA, Host. Sea Sand-Reed.
Cedar Point and Marblehead Sand Spit.

ANDROPOGON, L. Beard-Grass.

- A. PROVINCIALIS, Lam. (A. FURCATUS, Muhl.)
Frequent.
- A. SCOPARIUS, Michx.
Frequent. Not observed in Ottawa county.

ARISTIDA, L. Triple-awned Grass.A. **GRACILIS**, Ell.*

Unplowed prairie, Perkins.

A. **PURPURASCENS**, Poir.*

Roadside, Joseph Smith's, Perkins.

ASPERELLA, Humb. Bottle-brush Grass.A. **HYSTRIX**, Humb.

Common.

BOUTELOUA, Lag. Muskit-Grass.B. **RACEMOSA**, Lag.

Castalia cemetery and southwest, Marblehead ;
dry ground ; scarce.

Our forms approach the variety *aristosa*.

BRACHYELYTRUM, Beauv.B. **ERECTUM**, Beauv. (*B. ARISTATUM* R. & S.)

Frequent.

BROMUS, L. Brome-Grass.B. **CILIATUS**, L.

Common. Kelley's Island., Rattlesnake Island.
The variety *purgans* also common, but not on
the Islands.

B. **KALMI**, Gray. Wild Chess.

Margaretta Ridge ; rare.

B. *racemosus*, L. Upright Chess.

Common.

B. *secalinus*, L. Cheat or Chess.

Not so common as the last.

B. *tectorum*, L.

Along Big Four Ry., Sandusky and Castalia ;
elsewhere also, but scarce.

CENCHRUS, L. Hedgehog or Bur-Grass.C. **TRIBULOIDES**, L.

Common in sand.

CHRYSOPOGON, Trin.

- C. NUTANS, Benth, Indian Grass, Wood Grass.
Frequent.

CINNA, L. Wood Reed-Grass.

- C. ARUNDINACEA, L.
Frequent.

DACTYLIS, L. Orchard-Grass.

- D. *glomerata*, L.
Frequent.

DANTHONIA, D C. Wild Oat-Grass.

- D. SPICATA, A. & S.
Common. Not on Islands, except Put-in-Bay.

DEYEUXIA, Raf.

- D. CANADENSIS, Beauv. Blue-Joint Grass.
Frequent. Middle Bass, North Bass.

EATONIA, Raf.

- E. OBTUSATA, Gray.*
Infrequent. Margaretta ridge, Marblehead,
North Bass, etc.
- E. PENNSYLVANICA, Gray.
Frequent. Islands.
- E. PURPURASCENS Raf. (E. DUDLEYI, Vasey. E. NITIDA
Nash.)
Florence, and Furnace woods, Vermillion.

ELEUSINE, Gaertn.

- E. *indica*, Gaertn. Dog's-tail or Wire Grass.
Formerly seldom seen, but now common along
many sandy lanes.

ELYMUS, L. Lyme-Grass, Wild Rye.

- E. CANADENSIS, L.
Frequent, especially on sand beaches. Islands.
The so called variety *glaucifolius* occurs in a
number of places but does not appear at all dis-
tinct.

- E. *STRIATUS*, Willd.
 Infrequent. Kelley's Island. The so called variety *villosus* was found in Perkins.
- E. *VIRGINICUS*, L
 Frequent along streams and shores of the Islands.

ERAGROSTIS, Host.

- E. *CAPILLARIS*, Nees.
 Willow Point, Margaretta and different parts of the Peninsula.
- E. *FRANKII*, Steud.
 Perkins, Castalia, Lockwood's woods, Catawba.
- E. *major*, Host.
 Abundant.
- E. *PURSHII*, Schrader.
 Common in Erie Co., especially along railroads. Kelley's Island.
- E. *REPTANS*, Nees.
 Infrequent.
- E. *SPECTABILIS*, Steud.* (E. *PECTINACEA* *SPECTABILIS*, Gray) Lake sands of Cedar Point, Marble-head Spit, and Port Clinton; local.

FESTUCA, L. Fescue-Grass.

- F. *elatior*, L. Meadow Fescue.
 Common. The variety *pratensis* common in Sandusky and along some country roads.
- F. *NUTANS*, Spreng.
 Common. Not noticed on Kelley's Island.
- F. *TENELLA*, Willd.
 Marblehead, Cedar Point and east of Milan.

GLYCERIA, R. Br. Manna Grass.

- G. *FLUITANS*, R. Br.
 Infrequent. Islands.
- G. *NERVATA*, Trin.
 Common.

- G. *PALLIDA*, Trin.
Port Clinton; rare.

HIEROCHLOE, S. G. Gmel.

- H. *BOREALIS*, R. & S.
"Perkins" Elon House.

HORDEUM, L.

- H. *JUBATUM*, L. Squirrel-tail Grass.
Common along L. S. & M. S. Ry. in Ottawa Co.
Blue Hole, Castalia. Kelley's Island, where
probably introduced in baled hay. Marblehead.

KOELERIA, Pers.

- K. *CRISTATA*, Pers.*
Catawba, where first found by A. D. Selby.
Margaretta Ridge, Oxford; also ten miles west of
Toledo.

LEERSIA, Swartz.

- L. *ORYZOIDES*, Swartz. Rice Cut-grass.
Common. —
L. *VIRGINICA*, Willd. White Grass.
Common but not noticed on any island except
Kelley's.

LOLIUM, L.

- L. *perenne*, L. Common Darnel, Ray or Rye-Grass.
Sandusky, Soldier's Home, Kelley's Island, Put-in-
Bay; infrequent. Not noticed until 1897.

MELICA, L. Melic-Grass.

- M. *DIFFUSA*, Pursh.*
Castalia; rare.

MUHLENBERGIA, Schreb. Drop-seed Grass.

- M. *GLOMERATA*, Trin.*
West of Castalia; rare; also ten miles west of
Toledo.

M. MEXICANA, Trin.

Common.

M. SCHREBERI, J. F. Gmel. (M. DIFFUSA, Schreb.)

Common.

M. SOBOLIFERA, Trin.*

Florence, Catawba; rare.

M. SYLVATICA, Torr. & Gray.

Perkins, Florence, Middle Bass; infrequent.

M. WILLDENOWII, Trin.

Vermillion River, Huron, Milan, Perkins, Margaretta Ridge; infrequent.

ORYZOPSIS, Michx. Mountain Rice.

O. MELANOCARPA, Muhl.

Margaretta Ridge, Vermillion River, Put-in-Bay; rare.

PANICUM, L. Panic-Grass.

P. AGROSTOIDES, Muhl.

Huron, Milan, Oxford, Perkins, North Bass; local.

P. BARBULATUM, Michx.

Berlin; rare.

P. CAPILLARE, L. Old-witch Grass.

Common.

P. CLANDESTINUM, L.

Cedar Point, Perkins, and common along river channels.

P. COLUMBIANUM, Scribn.

Castalia, Cedar Point. Formerly called *P. dichotomum*.

P. *crus-galli*, L. Barnyard-Grass.

Abundant.

P. CRUS-GALLI HISPIDUM, Muhl.

Frequent on wet ground about Sandusky Bay and East Harbor.

P. DEPAUPERATUM, Muhl.

Catawba and high banks of Vermillion River and Old Woman Creek.

P. DICHOTOMUM, L.

Common and variable, the so called variety *gracile*, found only at Berlin Heights, seeming most distinct from other forms.

P. FLEXILE, Scribn.

Castalia prairie; common. Oxford.

P. *glabrum*, Gaudin. Small Crab-Grass.

Common. North Bass the only island.

P. LATIFOLIUM, L.

Common in Erie County.

P. MILIACEUM, L. Millet.

Adventive. "Cedar Point," E. Claassen.

Sandusky near the Bay, one specimen growing on rubbish.

P. PROLIFERUM, Lam.

Sandusky, Oxford; rare.

P. PUBESCENS, Lam.

Common in Erie County.

P. *sanguinale*, L. Large Crab-Grass.

Abundant.

P. SCOPARIUM, Lam.

Oxford, Margaretta, Cedar Point, Port Clinton; common.

P. VIRGATUM, L.

Frequent. Kelley's Island. Abundant on sandy shores of Lake Erie.

PASPALUM, L.**P. SETACEUM, Michx.**

Dell Lindsley's orchard, Perkins, where it has probably been for many years.

PHALARIS, L.**P. ARUNDINACEA, L.**

Cedar Point, Huron, western Margaretta, Middle Bass; infrequent. The variety *picta* Ribbon-Grass, has become established along some roadside ditches.

P. *canariensis*, L. Canary-Grass.

Adventive in Sandusky.

PHLEUM, L.

- P. pratense*, L. Timothy.
Abundant.

PHRAGMITES, Trin. Reed.

- P. COMMUNIS*, Trin.
Frequent on wet ground. Huron, Castalia, Port Clinton, Harbors.

POA, L. Meadow-Grass.

- P. ALSODES*, Gray.
Florence; scarce.
- P. annual*, L. Low Spear-Grass.
Frequent.
- P. compressa*, L. Wire-Grass.
Abundant.
- P. DEBILIS*, Torr.
Furnace woods, Vermillion; rare.
- P. PRATENSIS*, L. June Grass. Kentucky Blue-Grass.
Abundant. One specimen has a panicle eleven inches long.
- P. SEROTINA*, Ehrhart.
Huron; rare.
- P. SYLVESTRIS*, Gray.
Parker's Creek, Florence; rare.
- P. trivialis*, L.
Shinrock; rare.

SETARIA, Beauv.

- S. glauca*, Beauv. Foxtail. Pigeon-Grass.
Abundant. The worst weed we have.
- S. italica*, Beauv. Italian Millet, Hungarian Grass.
Rarely escaped. Middle Bass, North Bass.
- S. verticillata*, Beauv.
Sandusky near Big Four dock, 1898.
- S. viridis*, Beauv. Green Foxtail.
Less abundant than *S. glauca*.

SPARTINA, Schreb. Marsh Grass.

- S. SCHREBERI, J. F. Gmel. (S. CYNOSUROIDES Willd.)
 Fresh-water Cord-Grass.
 Frequent. Middle Bass.

SPOROBOLUS, R. Br. Rush-Grass.

- S. ASPER, Kunth.
 L. S. & M. S. Ry, east of Sandusky; rare.
- S. CRYPTANDRUS, Gray.
 Frequent on Cedar Point and several places on
 the Peninsula.
- S. NEGLECTUS, Nash.
 Sandusky, Castalia, Plaster Beds.
- S. VAGINÆFLORUS, Vasey.
 Common. Kelley's and Put-in-Bay the only
 Islands.

STIPA, L.

- S. SPARTEA, Trin.* Porcupine Grass.
 In sand; Cedar Point, Perkins, Bloomingville
 cemetery; rare.

TRIODIA, R. Br.

- T. CUPREA, Jacq.* Tall Red-Top.
 In sand near the road through the woods be-
 tween Port Clinton and Catawba; rare.

TRIPLASIS, Beauv.

- T. PURPUREA, Chapm. Sand-Grass.
 Frequent on all sandy shores of Lake Erie; in
 places abundant. Kelley's Island.

ZIZANIA, L.

- Z. AQUATICA, L. Indian Rice. Water Oats.
 Abundant in shallow parts of Sandusky Bay, the
 Harbors, etc. Middle Bass.

CYPERACEÆ.

CAREX, L., Sedge.

- C. ALBICANS, Willd.*
Put-in-Bay; rare.
- C. ALBURSINA, Sheldon, (C. LAXIFLORA LATIFOLIA Boott.)
Frequent. Kelley's Island.
- C. AQUATILIS, Wahl.
Huron, Cedar Point, Put-in-Bay; scarce.
- C. ARCTATA, Boott.
Florence, Berlin, Oxford; rare.
- C. AUREA, Nutt.*
One vigorous plant growing on a stump that stands in a stream near the Blue Hole, Castalia.
- C. BICKNELLII, Britton (C. STRAMINEA CRAWEI, Boott.)
Berlin Heights; rare.
- C. BROMOIDES, Schkuhr.
Florence, Berlin Heights, Milan; local.
- C. CAREYANA, Torr.
Beecher's flats, Vermillion River; rare.
- C. CEPHALOIDEA, Dewey.
Frequent.
- C. CEPHALOPHORA, Muhl.
More frequent than the last. Bass Islands.
- C. COMMUNIS, Bailey.
Florence, Margaretta Ridge; scarce.
- C. COMMUNIS WHEELERI, Bailey.*
Vermillion River, Florence; rare.
- C. CONJUNCTA, Boott.
Florence, Berlin, Perkins; scarce.
- C. CRAWEI, Dewey.*
Castalia prairie, Marblehead; local.
- C. CRINITA, Lam.
Frequent from the Huron River east, especially in Berlin.

- C. *DAVISII*, Schwein & Torr.
Shinrock, Perkins, Port Clinton, Kelley's Island;
infrequent.
- C. *DIGITALIS*, Willd.
Common in Florence; frequent in Vermillion,
Berlin and Milan.
- C. *DIGITALIS COPULATA*, Bailey.
Florence, Berlin, Milan; frequent.
- C. *EBURNEA*, Boott.*
Kelley's Island. Put-in-Bay; rare.
- C. *FILIFORMIS*, L.
Frequent?
- C. *FCENEAE PERPLEXA*, Bailey.*
Furnace woods, Vermillion; rare.
- C. *FUSCA*, All.
Throughout Erie Co; infrequent.
- C. *GLAUCODEA*, Tuckerm.
Vermillion, Berlin, Milan; infrequent.
- C. *GRACILLIMA*, Schwein.
Frequent in Erie Co.
- C. *GRANULARIS*, Muhl.
Frequent. Kelley's Island.
- C. *GRANULARIS HALEANA*, Porter.* (*C. HALEANA*, Olney)
Florence, Castalia, Groton; infrequent.
The Groton specimens have very broad leaves.
- C. *GRAYII*, Carey.
Huron, Milan and east; infrequent.
- C. *GRISEA*, Wahl.
Rather frequent.
- C. *HITCHCOCKIANA*, Dewey.
Florence; scarce.
- C. *HYSTERICINA*, Muhl.
Common. Put-in-Bay and Middle Bass the only
islands.
- C. *INTERIOR*, Bailey.*
Castalia; rare.
- C. *INTUMESCENS*, Rudge.
Berlin, Vermillion, Florence; infrequent.

- C. JAMESII, Schwein.
Berlin; rare. Florence; infrequent.
- C. LANUGINOSA, Michx. (C. FILIFORMIS LATIFOLIA,
Boeckl.)
Frequent. Put-in-Bay.
- C. LAXICULMIS, Schwein.
Florence, Vermillion, Milan; infrequent.
- C. LAXIFLORA, Lam.
Frequent. Kelleys Island.
- C. LAXIFLORA PATULIFOLIA, Carey.
Florence, Berlin, Huron; infrequent.
- C. LAXIFLORA STRIATULA, Carey.
Common.
- C. LAXIFLORA VARIANS, Bailey.
Common. Kelley's the only island.
- C. LUPULINA, Muhl.
Common. The so-called variety *hedunculata*
occurs in Florence.
- C. LURIDA, Wahl.
Frequent. Hybrids of this and the last occur in
Florence and Berlin.
- C. MONILE, Tuckerm.
Vermillion, Berlin, Kimball; scarce.
- C. MUHLENBERGII, Schkuhr.*
Cedar Point; frequent.
- C. MUHLENBERGII ENERVIS, Boott.
Catawba; rare.
- C. *muricata*, L.
Furnace woods, Vermillion; rare.
- C. MUSKINGUMENSIS, Schwein.*
Catawba; rare.
- C. OLIGOCARPA, Schkuhr.
Prout's, Shinrock, Vermillion, Florence: in-
frequent.
- C. PALLESCENS.
Berlin Heights and Florence; rare.
- C. PEDUNCULATA, Muhl.
Steep banks of Vermillion River, Florence; rare.

- C. PENNSYLVANICA, Lam.
Abundant. Put-in-Bay the only island.
- C. PLANTAGINEA, Lam.
Steep banks of Vermillion River and tributaries
in southern Florence; infrequent.
- C. PLATYPHYLLA, Carey.
High banks, Vermillion River, Florence; rare.
- C. PRASINA, Wahl.
Infrequent.
- C. PSEUDO-CYPERUS AMERICANA, Hochst. (C. COMOSA,
Boott.)
Islands, Cedar Point, Castalia, South Florence;
local.
- C. PUBESCENS, Muhl.
Frequent, especially in Florence.
- C. RICHARDSONII, R. Br.*
Castalia cemetery; rare.
- C. RIPARIA, Curtis.
Infrequent.
- C. ROSEA, Schkuhr.
Common. Middle Bass the only island.
- C. ROSEA RADIATA, Dewey.
Florence; rare.
- C. SARTWELLIANA, Olney.* (C. SARTWELLII, Dewey.)
Castalia; scarce. Huron, Cedar Point; rare.
- C. SCABRATA, Schwein.
Springy banks of Vermillion River; rare.
- C. SCOPARIA, Schkuhr.
Common. Not on the Islands.
- C. SETACEA, Dewey.
Oxford; rare or else taken for *C. vulpinoidea*.
- C. SHORTIANA, Dewey.
Perkins, Castalia, Berlin and common in Milan.
- C. SICCATA, Dewey.*
Perrin's, Milan; Margaretta Ridge; rare.
- C. SPARGANIOIDES, Muhl.
Frequent. Kelley's Island. Rattlesnake.

- C. SQUARROSA, L.
Frequent.
- C. STENOLEPIS, Torr.
Common, especially near Sandusky. Middle Bass the only island.
- C. STERILIS, Schkuhr.
Castalia; rare.
- C. STERILIS CEPHALANTHA, Bailey.
Tisdell's, Vermillion; rare.
- C. STIPATA, Muhl.
Common.
- C. STRAMINEA, Willd.
Infrequent.
- C. STRAMINEA BREVIOR, Dewey.* (C. FESTUCACEA, Schkuhr.)
Marblehead, Johnson's Island, Kelley's, Green.
- C. STRAMINEA MIRABILIS, Tuckerm.
Huron, Milan and east; rare.
- C. STRICTA, Lam.
Scarce.
- C. STRICTA DECORA, Bailey.* (C. HAYDENII, Dewey.)
Kimball; rare.
- C. TENELLA, Schkuhr.
Vermillion River flat, Florence; one place.
- C. TEREIUSCULA, Gooden.
Castalia; scarce.
- C. TETANICA, Schkuhr.
Castalia prairie; frequent.
- C. TETANICA MEADII, Bailey.*
Castalia prairie.
- C. TETANICA WOODII, Bailey.
Huron and southern Florence in woods. Differs from the species in habitat and appearance.
- C. TORTA, Boott.
Infrequent. One specimen considered a hybrid of this and *C. crinita*.

- C. **TRIBULOIDES**, Wahl.
Frequent, especially the variety *turbata*. North Bass.
- C. **TRIBULOIDES CRISTATA**, Bailey.
Common. North Bass the only island.
- C. **TRIBULOIDES REDUCTA**, Bailey.*
Florence and Huron ; rare.
- C. **TRICEPS HIRSUTA**, Bailey.
Frequent.
- C. **TRICHOCARPA**, Muhl.
Huron River, Milan. The variety *imberbis* grows in Florence. Both scarce.
- C. **TRICHOCARPA ARISTATA**, Bailey.*
Huron, Castalia ; infrequent.
- C. **TYPHINOIDES**, Schwein.
East Berlin ; local.
- C. **TUCKERMANNI**, Boott.
Infrequent.
- C. **UTRICULATA**, Boott.
Blair Creek, Florence ; rare. The so-called variety *minor* at Tisdell's, Vermillion ; rare.
- C. **VARIA**, Muhl.
Frequent.
- C. **VIRESCENS**, Muhl.
Oxford, Huron and east ; common.
- C. **VIRESCENS COSTATA**, Dewey.
Berlin Heights and east ; infrequent.
- C. **VIRIDULA**, Michx.* (C. **FLAVA VIRIDULA**, Bailey.)
Castalia prairie ; local.
- C. **VULPINOIDEA**, Michx.
Common.
- C. **WILDENOWII**, Schkuhr.
Florence ; rare.
- CLADIUM**, P. Br. Twig-Rush.
- C. **TRIGLOMERATUM**, Nees. (C. **MARISCOIDES**, Torr.)
Perkins, "Castalia," E. Claassen.

CYPERUS, L. Galingale.

- C. DIANDRUS, Torr.
Frequent. Islands. The so-called variety *castaneus* on Cedar Point.
- C. ESCULENTUS, L.
Frequent in cultivated ground.
- C. FILICULMIS, Vahl, (MARISCUS GLOMERATUS, Barton.)
Rather frequent in sand.
- C. FLAVESCENS, L.*
Frankinberg's pasture, south-eastern Florence.
- C. MICHAUXIANUS, Schult, (C. SPECIOSUS, Vahl.)
About Sandusky Bay; scarce.
- C. REFRACTUS, Engelm.*
East branch, Vermillion River; one specimen.
- C. SCHWEINITZII, Torr.
Cedar Point; common. Port Clinton.
- C. STRIGOSUS, L.
Common and variable. Abundant in many pastures. One specimen over three feet tall has primary rays 8 inches long, secondary rays 2½ inches, spikelets nearly 1 inch.

DULICHIMUM, Pers.

- D. SPATHACEUM, Pers.
Perkins, Milan, Cedar Point; local.

ELEOCHARIS, R. Br. Spike-Rush.

- E. ACICULARIS, R. Br.
Castalia and borders of marshes connected with Lake Erie; frequent. Bass Islands.
- E. ACUMINATA, Nees.* (E. COMPRESSA, Sullivant.)
Sandusky, Cedar Point, Huron, Marblehead; scarce.
- E. ENGELMANNI, Steud.*
North of Tisdell's, Vermillion; rare.
- E. INTERMEDIA, Schult.
Cedar Point, Johnson's Island, Marblehead, Bass Islands; frequent.

- E. OVATA, R. Br.
Frequent. Kelley's Island. North Bass.
- E. PALUSTRIS, R. Br.
Frequent.
- E. PALUSTRIS GLAUDESCENS, Gray.
Frequent. Put-in-Bay.
- E. PALUSTRIS VIGENS, Bailey.*
Sandusky Bay; in water several feet deep.
- E. TENUIS, Schult.
Infrequent.

ERIOPHORUM, L. Cotton-Grass:

- E. POLYSTACHYON, L.
"Huron River" Henry Schoepfle:

FIMBRISTYLIS, Vahl.

- F. AUTUMNALIS, R. & S.
A little bog near the Cedar Point light house.
- F. CAPILLARIS, Gray.*
In sand, south Perkins and east of Milan; local.

RYNCHOSPORA, Vahl. Beak-Rush.

- R. CAPILLACEA, Torr.
Prairie along L. E. & W. Ry., west of Castalia;
local.
- R. CYMOSA, Nutt.*
East of Milan; local.
- R. GLOMERATA, Vahl.*
East of Milan; local. Also ten miles west of
Toledo.

SCIRPUS, L. Bulrush.

- S. ATROVIRENS.
Common.
- S. ERECTUS, Poir.* (S. DEBILIS, Pursh.)
Along shore of East Harbor west of Lakeside.

- S. ERIOPHORUM, Michx. (ERIOPHORUM CYPERINUM, L.)
Frequent. The variety *laxum* occurs in Florence, Milan, and, probably, elsewhere.
- S. LACUSTRIS, L. Great Bulrush.
Common. Extensively used in the vineyards for tying up the vines.
- S. LINEATUS, Michx. (ERIOPHORUM LINEATUM, Benth & Hook.)
Frequent. Kelley's Island. North Bass.
- S. MARITIMUS, L. (S. FLUVIATILIS, Gray.) River Club-Rush.
Common in the marshes east of Sandusky and in the East Harbor; elsewhere infrequent. Put-in-Bay.
- S. POLYPHYLLUS, Vahl.
Frequent. Middle Bass.
- S. PUNGENS, Vahl.
Common, especially about Sandusky Bay and Lake Erie.
- S. SYLVATICUS, L.*
"Pond near U. S. Fish Hatchery, Put-in-Bay."
A. J. Pieters.
- S. TORREYI, Olney.*
North side of East Harbor; rare.

SCLERIA, Berg. Nut-Rush.

- S. PAUCIFLORA, Muhl.*
East of Milan; local. Also ten miles west of Toledo.
- S. TRIGLOMERATA, Michx.*
East of Milan; local. Also ten miles west of Toledo.

ARACEÆ.

ACORUS, L. Sweet Flag.

- A. CALAMUS, L.
Frequent. Abundant near Port Clinton. Put-in-Bay. "Kelley's Island."

ARISÆMA, Mart.

- A. **DRACONTIUM**, Schott. Green Dragon, Dragon-root.
Scarce.
- A. **TRIPHYLLUM**, Schott. Indian Turnip.
Common.

SYMPLOCARPUS, Salisb. Skunk Cabbage.

- S. **FOETIDUS**, Nutt.
Infrequent.

LEMNACEÆ.**LEMNA, L.** Duck-weed, Duck's-meat.

- L. **MINOR**, L.
Common at Castalia and on still water connected
with Lake Erie. Islands.
- L. **POLYRRHIZA**, L. (**SPIRODELA POLYRRHIZA**, Schleid.)
Common on still water connected with the Lake.
Florence.
- L. **TRISULCA**, L.
Castalia and still waters connected with the
Lake; infrequent- Put-in-Bay.

WOLFFIA, Workel.

- W. **COLUMBIANA**, Karsten.
Mouth of Old Woman Creek, Pipe Creek, Put-in-
Bay; local.

COMMELINACEÆ.**TRADESCANTIA, L.** Spiderwort.

- T. **VIRGINIANA**, L.
Frequent, especially on Cedar Point.
- T. **VIRGINIANA OCCIDENTALIS**, Britton.
B. & O. Ry. seven miles south of depot; rare.

PONTERIACEÆ.

HETERANTHERA, Ruiz & Pav. Mud-Plantain.

- H. GRAMINEA, Vahl.
Common in still water connected with Lake Erie.

PONTERIA, L. Pickerel-weed.

- P. CORDATA, L.
Frequent in shallow water connected with Lake Erie.

JUNCACEÆ.

JUNCUS, L. Rush. Bog-Rush.

- J. ACUMINATUS, Michx.
Florence; rare.
- J. ALPINUS INSIGNIS, Fries.
Castalia, Oxford, shores of Lake Erie; frequent.
Kelley's Island.
- J. BALTICUS LITTORALIS, Engelm.
Castalia, Cedar Point, Marblehead sand spit;
locally abundant.
- J. BUFONIUS, L.
Sandusky near B. & O. and L. S. & M. S. Ry's;
rare.
- J. CANADENSIS.
Shinrock and Sandusky where the so-called variety *longicaudatus* grows.
- J. CANADENSIS BRACHYCEPHALUS, Engelm.
Castalia, Willow Point, Sandy Beach.
- J. EFFUSUS, L. Common or Soft Rush.
Frequent. North Bass.
- J. MARGINATUS, Rostk.
Berlin, Vermillion, east of Milan; infrequent.
- J. NODOSUS, L.
Frequent.

- J. NODOSUS MEGACEPHALUS, Torr.
Frequent. Islands.
- J. SCIRPOIDES, Lam.*
Oxford, southern Perkins, Vermillion; infrequent.
- J. TENVIS, Willd.
Common.

LUZULA, D C. Wood-Rush.

- L. CAMPESTRIS, D C.
Frequent, especially in Milan.
- L. VERNALIS, D C.
Vermillion River, Chapelle Creek; scarce.

LILIACEÆ.

ALETRIS, L.

- A. FARINOSA, L.*
Perrin's, Milan and Joseph Smith's, Perkins; rare

ALLIUM, L.

- A. CANADENSE, L. Wild Garlic.
Infrequent. Kelley's Island.
- A. CERNUUM, Roth. Wild Onion.
Common on the Islands, Peninsula, and at
Castalia.
- A. TRICOCCUM, Ait. Wild Leek.
Islands, Peninsula, Florence; infrequent.

ASPARAGUS, L.

- A. *officinalis*, L. Garden Asparagus.
Escaped in many places. Islands.

CAMASSIA, Lindl.

- C. FRASERI, Torr. Wild Hyacinth.
Infrequent, but occurs on eight islands and in
eight townships.

CHAMAELIRIUM, Willd.

- C. CAROLINIANUM, Willd. Blazing-Star.
Southern Perkins, Margaretta Ridge, east of
Milan, Berlin Heights; rare.

DISPORUM, Salisb.

- D. LANUGINOSUM, Nichols.
Florence, Berlin; scarce.

ERYTHRONIUM, L.

- E. ALBIDUM, Nutt. White Dog's-tooth Violet.
A weed in vineyards west of Sandusky.
Common on Huron River bottoms, Infrequent
or rare in other parts of the county.
Johnson's Island, Kelley's, Rattlesnake, Port
Clinton.
- E. AMERICANUM, Ker. Yellow Adder's-tongue.
Common.

HEMEROCALLIS, L.

- H. *fulva*, L.
Roadsides; infrequent. North Bass.

LILIUM, L.

- L. CANADENSE, L. Wild Yellow Lily.
Infrequent. Kelley's, Island.
- L. PHILADELPHICUM, L. Wild Orangered Lily. Wood
Lily.
Scarce.
- L. SUPERBUM, L. Turk's-cap Lily.
Milan, Florence, Vermillion; rare. Mr. Haise of
Florence found "several years ago a lily with
forty or fifty flowers."

MAIANTHEMUM, Wigg.

- M. CONVALLARIA, Wigg. (M. CANADENSE, Desf.) False
Lily-of-the-valley.
Cedar Point and high banks of Old Woman
Creek, Chapelle Creek and Vermillion River;
infrequent.

MEDEOLA, L. Indian Cucumber-root.

M. VIRGINICA, L.

Florence, Berlin, Milan, Perkins; scarce.

OAKESIA, Watson.

O. SESSILIFOLIA, Watson.

Florence; rare.

ORNITHOGALUM, L. Star-of-Bethlehem.O. *umbellatum* L.

Perkins, Sandusky, Put-in-Bay; rare.

POLYGONATUM, Adans.

P. BIFLORUM, Ell. Smaller Solomon's Seal.

Common.

P. GIGANTEUM, Dietrich. Great Solomon's Seal.

Common.

SMILACINA, Desf. False Solomon's Seal.

S. RACEMOSA, Desf. False Spikenard.

Common.

S. STELLATA, Desf.

Common; less so on the mainland than the preceding.

SMILAX, L. Greenbrier.

S. ECIRRHATA, Watson.

Perkins, Groton, Catawba, Kelley's Island; scarce.

S. HERBACEA, L. Carrion-Flower.

Common.

S. HISPIDA, Muhl.

Frequent. Islands.

S. ROTUNDIFOLIA, L. Horse-brier.

Infrequent. Put-in-Bay.

The "variety" *crenulata* S. & H. found at Chapelle Creek.**TRILLIUM, L.** Wake Robin.

T. ERECTUM, L.

Common.

T. GRANDIFLORUM, Salisb.

Common.

T. SESSILE, L.

Vermillion River flats; frequent.

UVULARIA, L. Bellwort.

U. GRANDIFLORA.

Infrequent. Islands.

ZYGADENUS, Michx.

Z. ELEGANS, Pursh.*

Marblehead; rare.

AMARYLLIDACEÆ.

HYPOXIS, L. Star-Grass.

H. ERECTA, L.

Infrequent.

DIOSCOREACEÆ.

DIOSCOREA, L. Yam.

D. VILLOSA, L. Wild Yam-root.

Frequent. Kelley's Island, Put-in-Bay.

IRIDACEÆ.

IRIS, L. Flower-de-Luce.

[I. CRISTATA, Ait. Crested Dwarf Iris.

Our specimens of this rare plant were collected along the Vermillion River in what was said to be Erie County, but the spot proves to be a few yards south of the line. Eli Beecher, who owns the adjacent flats in Erie County, says he has seen it there.]

- I. VERSICOLOR, L. Larger Blue Flag.
Frequent. Islands.

SISYRINCHIUM, L. Blue-eyed Grass.

- S. ANGUSTIFOLIUM, Mill.
Infrequent.
- S. GRAMINOIDES, Bicknell
Infrequent.

ORCHIDACEÆ.

APLECTRUM, Torr. Putty-Root. Adam-and-Eye.

- A. HYEMALE, Torr.

Rare. Puckrin's woods, Perkins.

"Smith's, Perkins," Ross Ransom. "Cedar Point,"
Cláassen and Krebs. "Marblehead," Gertrude
Johnson. "Vermillion," Otto Todd. "Formerly
considerable near the quarry on west branch of
Vermillion River," Eli Beecher.

CALOPOGON, R. Br.

- C. PULCHELLUS, R. Br.

South-west of Castalia; rare. Seen only in 1895.

CORALLORHIZA, Haller. Coral-root.

- C. MULTIFLORA, Nutt.

Florence, Huron, Catawba; rare.

- C. ODONTORHIZA, Nutt.

Blair Creek, Florence; Graham's woods, Huron;
Smith's woods, Perkins; rare.

CYPRIPEDIUM, L. Lady's Slipper. Moccason-flower.

- C. CANDIDUM, Muhl.* Small White Lady's Slipper.

Along a railroad near Castalia; locally common.

- C. PUBESCENS, Willd. Larger yellow Lady's Slipper.

In seven townships, but rare.

- C. SPECTABILE, Salisb. Showy Lady's Slipper.

One spot on high, wet, shale bank of east branch,
Vermillion River. An orchid found by Job Fish
"about 1859, the most beautiful wild flower" he
"ever found" was probably of this species.

GOODYERA, R. Br. Rattlesnake-Plantain.

G. PUBESCENS, R. Br.

Florence, Berlin, Milan, Oxford, Perkins; scarce.

HABENARIA, Willd. Rein-Orchis.

H. BRACTEATA, R. Br.

In five townships; rare.

H. HERBIOLA, R. Br. (H. VIRESCENS, Spreng.)

In five townships; rare.

H. HOOKERIANA, Torr.

"Margaretta Ridge," Henry Schoepfle; one plant.

H. LACERA R. Br. Ragged Fringed-Orchis.

Perkins, Milan, Vermillion; rare.

H. PSYCODES, Gray. Purple Fringed-Orchis.

Florence, Milan, "Cedar Point," Leslie Stair: rare.

H. TRIDENTATA, Hook.

East of Milan; one plant.

LIPARIS, Richard. Twayblade.

L. LÆSELII, Richard.

Bog near Cedar Point Light House,

ORCHIS, L.

O. SPECTABILIS, L. Showy Orchis.

Rather frequent in Florence, infrequent in four townships.

POGONIA, Juss.

P. PENDULA, Lindl.

"Florence," Josephine Fish, also Otto Todd; East Berlin; "Perkins," Ransom; local.

SPIRANTHES, Richard. Ladies' Tresses.

S. CERNUA, Richard.

Local. This and *Orchis spectabilis* are less rare than our other orchids.

S. GRACILIS, Beck.

"Bloomingville," W. A. Kellerman. Perkins; rare.

DICOTYLEDONES.

SAURURACEÆ.

SAURURUS, L. Lizard's-tail.

S. CERNUUS, L.

Frequent in eastern part of the county; infrequent in Huron, Milan and Perkins.

JUGLANDACEÆ.

CARYA, Nutt. Hickory.

C. ALBA, Nutt. Shell-bark or Shag-bark Hickory.

Abundant. Hickory is used in Sandusky by two wheel works and two whip-stalk factories; also by the Sandusky Tool Company for chisel handles, for tin-smith's mallets, and for ladder-rounds that are sent to Northern Michigan for use in the copper mines.

C. AMARA, Nutt. Bitter-nut or Swamp Hickory.

Frequent. One in the German Settlement has a circumference of 9 feet, 8 inches.

C. MICROCARPA, Nutt.

Frequent, at least in Perkins.

C. SULCATA, Nutt. Big Shell-bark. King-nut.

Frequent.

- C. TOMENTOSA, Nutt. Mocker-nut. White-heart Hickory.
Frequent. Put-in-Bay.
- C. PORCINA, Nutt. Pig-nut or Broom Hickory.
Frequent. Islands.

JUGLANS, L.

- J. CINEREA, L. Butternut. White Walnut.
Infrequent.
- J. NIGRA, L. Black Walnut.
Frequent. Said to have grown formerly on Kelley's Island, and Middle Bass. The number and size of the walnut stumps along the border of the Huron marsh east of Sandusky and of the prostrate trunks in the marsh is remarkable. See page 14.

SALICACEÆ.

PÖPULUS, L.

- P. *alba*, L. White Poplar. Abele.
Frequent in the vicinity of planted trees. Kelley's Island. Put-in-Bay.
- P. GRANDIDENTATA, Michx. Large-toothed Aspen.
Rather frequent. Put-in-Bay. Plentiful along the lake shore drive east of Huron.
- P. HETEROPHYLLA, L. Downy Poplar.
Florence, Huron; rare.
- P. MONILIFERA, Ait. Cotton-wood. Necklace Poplar.
Common.
- P. TREMULOIDES, Michx. American Aspen.
Frequent, especially on the Islands.

SALIX, L. Willow. Osier.

- S. *alba cærulea*, Koch. Blue Willow.
Cedar Point and Sandusky near the Bay; rare.

- S. *alba vitellina*, Koch. Golden Osier.
Frequent. Islands.
- S. *AMYGDALOIDES*, Anders.
Frequent.
- S. *CANDIDA*, Willd.* Sage Willow. Hoary Willow.
Castalia prairie; rare.
- S. *CORDATA*, Muhl. Heart-leaved Willow.
Common, but not noticed on Kelley's Island.
- S. *CORDATA ANGUSTATA*, Anders.
Infrequent. Put-in-Bay.
- S. *DISCOLOR*, Muhl. Glaucaous Willow.
Frequent, as is also the "variety" *eriocephala*.
- S. *GLAUCOPHYLLA*, Bebb.
Cedar Point, Castalia; infrequent.
- S. *HUMILIS*, Marsh. Prairie Willow.
Oxford; scarce.
- S. *LONGIFOLIA*, Muhl.
Common, especially along the lake.
- S. *LUCIDA*, Muhl.
Florence, Marblehead, Put-in-Bay; infrequent.
- S. *NIGRA*, Marsh. Black Willow.
Frequent. Islands.
- S. *NIGRA FALCATA*, Torr.
Frequent.
- S. *PETIOLARIS*, Smith.
House's swamp, southern Perkins.
- S. *purpurea*, L. Purple Willow.
Infrequent. Kelley's Island. Put-in-Bay.
- S. *ROSTRATA*, Richardson.
Infrequent. Islands.
- S. *SERICEA*, Marsh. Silky Willow.
House's swamp, Perkins. Milan?
- S. *fragilis* \times *alba*.
Castalia, etc.

BETULACEÆ.**CARPINUS, L.** Iron-wood.

- C. AMERICANA, Michx. American Hornbeam. Blue or Water Beech.
Frequent. "Formerly many on Kelley's Island."
Lester Carpenter.

CORYLUS, L.

- C. AMERICANA, Walt. Hazel-nut.
Common. Not on the Islands.

OSTRYA, L. Iron-wood.

- O. VIRGINICA, Willd. American Hop-Hornbeam. Lever-wood.
Common, especially on rocky shores of the Islands.

FAGACEÆ.**CASTANEA, L.**

- C. SATIVA AMERICANA, Watson. Chestnut.
Common in Erie County in sandy soil.
Chestnut fence posts sometimes put forth leafy shoots.

FAGUS, L.

- F. FERRUGINEA, Ait. American Beech.
Not on Islands or Peninsula, nor within five miles of Sandusky. A few in Kromer's woods and farther south along Pipe Creek. Infrequent along Huron River in Milan, frequent in Berlin, common in Vermillion, abundant in Florence. "Two trees on Put-in-Bay thirty years ago," Vroman. "Formerly a few on Middle Bass." Wood found in the submerged forest, Huron Marsh. Most Sandusky children do not know beech nuts. Wood used by Sandusky Tool Company for planes.

QUERCUS, L. Oak.

- Q. ALBA, L. White Oak.
Common.
- Q. BICOLOR, Willd. Willd. Swamp White Oak.
Frequent. Kelley's Island.
- Q. COCCINEA, Wang. Scarlet Oak.
East of Milan; frequent. Marblehead, Port Clinton, Catawba and probably elsewhere.
- Q. IMBRICARIA, Michx. Laurel or Shingle Oak.
Common in middle and western parts of Erie County. Abundant in Oxford and on Cedar Point.
- Q. MACROCARPA, Michx. Bur Oak, Over-cup or Mossy-cup Oak.
Frequent. Islands. Under the large Bur Oak at the corner of Wayne and Jefferson Sts., the Indians used to hold their councils. It is said to have grown very little since the early settlers came to Sandusky.
- Q. MUHLENBERGII, Engelm. Yellow Oak. Chestnut Oak.
Common on the Peninsula and Islands. Less frequent in Erie County.
- Q. PALUSTRIS, Du Roi. Swamp Spanish or Pin Oak.
Common. Not noticed on the Islands.
- Q. PRINUS, L. Rock Chestnut Oak.
Sandusky. Marblehead, Islands and elsewhere? The oak in Judge Mackey's yard on Columbus Ave. south of the fair grounds is of this species.
- Q. RUBRA, L. Red Oak.
Common.
- Q. VELUTINA, Lam. (Q. TINCTORIA,) Bartram. Black Oak. Quercitron.
Common. Kelley's and Put-in-Bay the only islands. On Cedar Point, where this species abounds, is a tree which I should call *Q. marylandica*, Muench., were I not advised differently, and other trees of the same sort or else hybrids between it and *Q. velutina*. None of these were noticed until September, 1898.

ULMACEÆ.

CELTIS, L.

- C. OCCIDENTALIS, L. Hackberry. Sugar-berry.
Frequent. Common on the Islands and Cedar Point.

ULMUS, L.

- U. AMERICANA, L. American or White Elm.
Common. Wood used for the handles and bands of baskets and for lime barrels.
- U. FULVA, Michx. Slippery or Red Elm:
Frequent. All the Islands.

MORACEÆ.

CANNABIS, L.

- C. *sativa*, L. Hemp.
Roadside, Margaretta or Groton; very rare.

HUMULUS, L.

- H. LUPULUS, L. Hop.
Castalia, Milan; infrequent.

MACLURA, Nutt.

- M. AURANTIACA, Nutt. Osage Orange.
Found only near where it has been planted; scarcely naturalized. The row of trees on the Ransom place, Castalia road, probably surpasses any farther north in America.

MORUS, L.

- M. *alba*, L.* White Mulberry.
Rare in woods, where the seeds have probably been dropped by birds.
- M. RUBRA, L. Red Mulberry.
Throughout, but infrequent. "Formerly common at Port Clinton." Islands.

URTICACEÆ.**BEHMERIA, Jacq.**

- B. CYLINDRICA, Sw. False Nettle.
Common.

LAPORTEA, Gaudichaud.

- L. CANADENSIS, Gaudichaud. Wood-Nettle.
Common.

PARIETARIA, L.

- P. PENNSYLVANICA, Muhl. Pellitory.
Abundant.

PILEA, Lindl.

- P. PUMILA, Gray. Richweed. Clearweed.
Common. Kelley's the only island.

URTICA, L. Nettle.

- U. GRACILIS, Ait.
Common.

SANTALACEÆ.**COMANDRA, Nutt. Bastard Toad-flax.**

- C. UMBELLATA, Nutt.
Frequent.

ARISTOLOCHICEÆ.**ARISTOLOCHIA, L.**

- A. SERPENTARIA, L. Virginia Snakeroot.
Florence, Berlin, Perkins, Margareta; scarce.

ASARUM, L. Wild Ginger.

- A. ACUMINATUM, Bicknell.
Florence and probably elsewhere.

A. REFLEXUM, Bicknell.

Huron River, Milan, and probably elsewhere.
The variety *ambiguum* also occurs.

POLYGONACEÆ.

FAGOPYRUM, Gaertn.

F. ESCULENTUM, Moench. Buckwheat.

Infrequent, except in fields where it has sometime
been sown.

POLYGONUM, L. Knotweed.

P. ACRE, H. B. K. Water Smartweed.

Common.

P. AMPHIBIUM, L.*

Marblehead; rare.

P. ARIFOLIUM, L. Halberd-leaved Tear-thumb.

Bristol's woods, Florence.

P. AVICULARE, L. Knot-grass. Door-weed.

Abundant.

P. CAREYI, Olney.*

Southern Perkins.

P. *convolvulus*, L. Black Bindweed.

Common.

P. DUMETORUM, L. Copse or Hedge Buckwheat.

Milan, Marblehead. This or P. SCANDENS is
common and grows on the Islands.

P. ERECTUM, L. Erect Knotweed.

Common.

P. HARTWRIGHTII Gray.*

A few plants near L. S. & M. S. freight house.
Doubtless introduced.

P. HYDROPIPER. Smart-weed. Water Pepper.

Common.

P. HYDROPIPEROIDES, Michx. Mild Water Pepper.

Infrequent. Kelley's Island.

P. INCARNATUM Ell.

Frequent in wet places near Lake Erie and Sandusky Bay, also at Castalia.

P. LAPATHIFOLIUM, L.

Cedar Point, Lockwood's; infrequent.

P. LITTORALE, Link.*

Sandusky; frequent. Kelley's Island, and probably many other places near Lake Erie. We failed to distinguish it, till recently, from *P. aviculare*.

P. MUHLENBERGII, Watson.

Frequent. Islands.

P. orientale, L.

Barely naturalized in two or three places.

P. PENNSYLVANICUM, L.

Abundant. Kelley's and Middle Bass the only islands where it has been noticed.

P. persicaria, L. Lady's Thumb.

Abundant.

P. RAMOSISSIMUM, Michx.*

Hill's woods, southern Perkins; one plant.

P. SAGITTATUM, L. Arrow-leaved Tear-thumb.

Frequent.

P. SCANDENS, L. Climbing False Buckwheat.

Margaretta, Cedar Point and probably elsewhere. See *P. dumetorum*.

P. TENUE, Michx.*

Marblehead; frequent. Margaretta, between quarry and Castalia road. Only in thin soil overlying the lime stone.

P. VIRGINIANUM, L.

Common. Not on the Islands.

RUMEX, L.**R. acetosella**, L. Field or Sheep Sorrel.

Abundant. Put-in-Bay; rare. "Kelley's Island." Not on other islands.

- R. *ALTISSIMUS*, Wood. Pale Dock.
Sandusky by Big Four track, Put-in-Bay; rare;
also Oak Harbor, Ottawa County.
- R. *BRITANNICA*, L. Great Water-Dock.
Marshes connected with Sandusky Bay; frequent.
- R. *crispus*, L. Curled Dock.
Abundant.
- R. *obtusifolius*, L. Bitter Dock.
Common.
- R. *VERTICILLATUS*.
Common in marshes.

CHENOPODIACEÆ.

ATRIPLEX, L. Orache.

- A. *ARGENTEA*, Nutt.
Near Big Four R. R., Sandusky and Castalia;
rare.
- A. *HASTATA*, L.
Common near Lake and Bay. In many places in
Sandusky the most common weed.
- A. *LITTORALIS*, L.*
Sandusky; frequent. Huron.

CHENOPODIUM, L. Pigweed.

- C. *album*, L. Lamb's Quarters. Pigweed.
Common.
- C. *album viride*, Moq.
Common.
- C. *ambrosioides*, L. Mexican Tea.
L. S. & M. S. R. R. yards, Sandusky; rare.
- C. *BOSCIANUM*, Moq.
Cedar Point, Perkins, Kelley's Island, and,
doubtless, elsewhere.

- C. botrys*, L. Jerusalem Oak. Feather Geranium.
Western part of Erie Co., mostly along railways
(C. S. & H. and L. E. & W). Marblehead.
Kelley's Island. Infrequent except on Marble-
head.
- C. glaucum*, L. Oak-leaved Goosefoot.
Castalia prairie and along L. E. & W. Ry. at
Castalia and Sandusky; rare.
- C. HYBRIDUM*, L. Maple-leaved Goosefoot.
Islands, Peninsula, Cedar Point, Perkins,
Margaretta; frequent.
- C. LEPTOPHYLLUM*, Nutt.*
Cedar Point and probably elsewhere; infrequent.
- C. murale*, L.
Sandusky; infrequent.
- C. urbicum*, L.
Rather frequent on the Peninsula, and in the
western third of Erie Co. Kelley's Island.

AMARANTACEÆ.

ACNIDA, L.

- A- *TUBERCULATA*, Moq.
Wet ground near Lake and Bay and at Castalia;
infrequent. Kelley's Island. Middle Bass

AMARANTUS, L. Amaranth.

- A. *ALBUS*, L. Tumble Weed.
Common.
- A. *BLITOIDES*, Watson.
Common.
- A. *chlorostachys*, Willd.
Common.
- A. *hypochondriacus*, L.
Sandusky, Perkins; scarce.

A. paniculatus, L.

Roadsides, Sandusky and Islands; infrequent.

A. retroflexus, L.

Common.

PHYTOLACCACEÆ.

PHYTOLACCA, L.

P. DECANDRA, L. Poke. Scoke. Pigeon-berry. Garget. Common.

NYCTAGINACEÆ.

OXYBAPHUS, Vahl.

O. NYCTAGINEUS, Sweet.

L. S. & M. S. Ry. in eastern Sandusky.

AIZOACEÆ.

MOLLUGO, L.

M. VERTICILLATA, L. Carpet-weed.

Sandusky, southern Perkins, Milan; local.

PORTULACACEÆ.

CLAYTONIA, L.

C. VIRGINICA, L. Spring Beauty.

Abundant.

PORTULACA, L.

P. oleracea, L. Purslane.

Abundant.

CARYOPHYLLACEÆ.

ANYCHIA, Michx. Forked Chickweed.

A. CAPILLACEA, DC.

Infrequent. Put-in-Bay.

A. DICHOTOMA, Michx.

Marblehead, Catawba; infrequent. Plentiful in places on the shale in Oxford and Perkins.

ARENARIA, L. Sandwort.

A. LATERIFLORA, L.

Lake woods, Port Clinton and Big woods, Perkins; rare.

A. *serpyllifolia*, L. Thyme-leaved Sandwort.

Islands, Peninsula, Margaretta, western Perkins; frequent.

A. STRICTA, Michx.

Islands, Peninsula, Margaretta, western Perkins, Cedar Point; locally common.

CERASTIUM, L. Mouse-ear Chickweed.

C. NUTANS, Raf.

Frequent. Islands.

C. OBLONGIFOLIUM, Torrey.*

More frequent than the last on Islands and Peninsula and in the western half of Erie Co.

C. *vulgatum*, L.

Common.

LYCHNIS, L.

L. *dioica*, L. Red Lychnis.

Avery; probably adventive.

L. *githago*, Scop. Corn Cockle.

Common. Kelley's the only Island.

L. *vespertina*, Sibth.

Franz Otto's, Perkins.

SAPONARIA, L.

- S. officinalis*, L. Soapwort. Bouncing Bet.
Frequent. Islands.

SILENE, L.

- S. ANTIRRHINA*, L. Sleepy Catchfly.
Frequent. Kelley's Island.
- S. conica*, L.* Corn Catchfly.
"Sandy field west of B. & O. R. R., southern Perkins." Ross Ransom. The first recorded appearance of this plant in the United States was at Clyde, Sandusky County, where it was introduced in Crimson Clover seed, 1896.
- S. cucubalus*, Wibel.* Bladder Campion.
Well established and increasing in a field of James Hamilton, Kelley's Island.
- S. dichotoma*, Ehrh. Forked Catchfly.
Northeast of Port Clinton; probably adventive.
- S. noctiflora*, L. Night-flowering Catchfly.
Sandusky; scarce.
- S. VIRGINICA*, L. Fire Pink.
Put-in-Bay; frequent. Kelley's Island. Catawba, Hartshorn's, Johnson's Island. "Cedar Point," Alden Knight.

STELLARIA, L.

- S. LONGIFOLIA*, Muhl. Long-leaved Stitchwort.
Frequent.
- S. media*, Cyrill. Common Chickweed.
Abundant.

NYMPHÆACEÆ.**BRASENIA, Schreber.**

- B. PELTATA*, Pursh. Water-shield.
Cedar Point; one plant.

NELUMBIUM, Adans. Sacred Bean.

N. LUTEUM, Willd. American Nelumbo or Lotus.
Water Chinkapin or Wankapin.

In still, deep, water at several places about Sandusky Bay, in the East and West Harbors, at Port Clinton where a large amount of it grows in the Portage River, and west to Monroe, Michigan, but believed to grow nowhere along the American shore of Lake Erie east of the mouth of the Old Woman Creek. A hundred acres of it at the head of Sandusky Bay and along the river, more, probably, than the whole quantity in the United States farther east. The lotus has the largest flowers and largest leaves of any plant in the Sandusky flora. Petioles sometimes 9 feet long; "blades 26 inches broad."

NUPHAR, Smith. Spatter-Dock.

N. ADVENA, Ait. Yellow Pond-Lily.

Sandusky Bay, Middle Bass, Blair Creek; frequent.

NYMPHAEA, Tourn. Water-Lily.

N. TUBEROSA, Paine.

Common in still waters connected with the Bay and Lake.

CERATOPHYLLACEÆ.**CERATOPHYLLUM, L.** Hornwort.

C. DEMERSUM, L.

Sandusky Bay, East Harbor, Port Clinton, Put-in-Bay; common.

MAGNOLIACEÆ.**LIRIODENDRON, L.** Tulip-tree.**L. TULIPIFERA, L.**

Scarce in the western but frequent in the eastern part of the county, where many of the largest trees in the primeval forest were of this species. Lakeside. Commonly called White-wood and improperly, Yellow Poplar and White Poplar. The wood suitable for pumps, troughs and hollow ware.

MAGNOLIA, L.**M. ACUMINATA, L.** Cucumber-tree.

Two trees near the iron bridge across east branch of Vermillion River. "Big woods, Perkins."

AMONACEÆ.**ASIMINA, Adans.****A. TRILOBA, Dunal.** North American Papaw.

Not found near Sandusky, but near Milan and in many places east from there to the Vermillion River, especially along the Old Woman Creek and other streams. Also in the forest west of Castalia in Sandusky Co. "Formerly on Kelley's Island."

RANUNCULACEÆ.**ACTÆA, L.****A. ALBA, Mill.** White Baneberry.

Frequent.

A. SPICATA RUBRA, Ait. Red Baneberry.

Cedar Point, Perkins, Margaretta Ridge; scarce. "Berlin."

ANEMONE, L.

- A. ACUTILOBA, Laws. (*Hepatica acutiloba*, D. C.)
Liver-leaf.
Frequent. Islands.
- A. CYLINDRICA, Gray. Long-fruited Anemone.
Infrequent but observed in eight townships.
- A. DICHOTOMA, L. (*A pennsylvanica*, L.)
Common. All islands, except Kelley's.
- A. HEPATICA, L. (*Hepatica triloba*, Chaix) Liver-leaf.
Frequent. Not observed in Florence where *A. acutiloba* is rather common. Islands. Both species more frequent on the Peninsula than in Erie Co.
- A. NEMOROSA, L. Wind-flower. Wood Anemone.
Common.
- A. THALICTROIDES, L. Rue-Anemone.
Common. Sometimes double. In blossom as late as September.
- A. VIRGINIANA, L.
Frequent. Islands.

AQUILEGIA, L. Columbine.

- A. CANADENSIS, L.
Not noticed near Sandusky, except on Cedar Point, but common among rocks on the Peninsula and Islands and at Margaretta Ridge. Berlin, Vermillion, Florence. Adorns the rocky shores of the islands.

CALTHA, L. Marsh Marigold.

- C. PALUSTRIS, L.
Frequent.

CIMICIFUGA, L. Bugbane.

- C. RACEMOSA, Nutt. Black Snakeroot. Black Cohosh.
Common in woods in eastern part of Erie Co, and extending west to Perkins.

CLEMATIS, L. Virgin's Bower**C. VIRGINIANA, L.**

Frequent. North Bass.

DELPHINIUM, L. Larkspur.**D. ajacis, L.**

Spontaneous in gardens and near them.

D. AZUREUM, Michx.

One plant found by L. S. & M. S. Ry. between Venice and Bay Bridge, by Will Newberry. Probably adventive.

HYDRASTIS, Ellis. Orange-root.**H. CANADENSIS, L.** Golden Seal.

Frequent in rich woods long undisturbed. "Kelley's Island." "Catawba."

ISOPYRUM, L.**I. BITERNATUM, Torr & Gray.**

Vermillion River, southern Florence; scarce. "Huron River at Norwalk" Leslie D. Stair.

NIGELLA, L.**N. damascena, L.** Fennel-flower.

Spontaneous in gardens and rarely escaped.

RANUNCULUS, L. Crowfoot. Buttercup.**R. ABORTIVUS, L.** Small-flowered Crowfoot.

Common.

R. acris, L. Tall or Meadow Buttercup.

Florence, Berlin, Huron, Sandusky, Put-in-Bay; infrequent.

R. CIRGINATUS, Sibth. Stiff Water Crowfoot.

Sandusky Bay, Castalia, Mill's Creek; frequent.

R. FASCICULARIS, Muhl. Early Buttercup.

Margaretta, Huron, Peninsula, Johnson's Island, Kelley's Island; locally plentiful.

- R. **MULTIFIDUS**, Pursh.
House's swamp, Perkins; Castalia; Peninsula;
Islands; infrequent.
- R. **OBTUSIUSCULUS**, Raf. (*R. ambigens*, Watson.)
Water Plantain Spearwort.
Millan and Florence; rare.
- R. **PENNSYLVANICUS**, L. f. Bristly Buttercup.
Sandnsky and Willow Point near the Bay,
Catawba; rare.
- R. **RECURTATUS**, Poir. Hooked Crowfoot.
Frequent, especially along rivers.
- R. **SCELERATUS**, L. Cursed Crowfoot.
Frequent. Islands.
- R. **SEPTENTRIONALIS**, Poir. Swamp or Marsh Buttercup.
Common. Kelley's and "Put-in-Bay" the only
islands.
- THALICTRUM**, L. Meadow-Rue.
- T. **DIOICUM**, L. Early Meadow-Rue.
Common.—
- T. **POLYGAMUM**, Muhl. Tall Meadow-Rue.
Frequent.
- T. **PURPURASCENS**, L. Purplish Meadow-Rue.
Frequent, especially near Castalia.

BERBERIDACEÆ.

BERBERIS, L. Barberry.

- B. **VULGARIS**, L. Common Barberry.
Woods, Milan and Huron; rare. Seeds
probably dropped by birds.

CAULOPHYLLUM, Michx. Blue Cohosh.

- C. **THALICTROIDES**, Michx.
Florence, Vermillion, Berlin, Perkins, Johnson's
Island; infrequent.

JEFFERSONIA, Barton. Twin-leaf.**J. BINATA, Barton, (J. DIPHYLLA, Pers.)**

Johnson's Island, but nowhere else near Sandusky. Lockwood's woods, Peninsula. Several places along Vermillion River, Florence.

PODOPHYLLUM, L. Mandrake.**P. PELTATUM, L.** May-Apple.

Abundant. Fruit edible. "Leaves and roots poisonous." Gray.

MENISPERMACEÆ.**MENISPERMUM, L.** Moonseed.**M. CANADENSE, L.**

Frequent. Islands.

LAURACEÆ.**LINDERA, Thumb.****L. BENZOIN, Meisn.** Spice-bush. Benjamin-bush.

In rich woods in Erie County the most abundant shrub.

SASSAFRAS, Nees.**S. OFFICINALE, Nees.**

Frequent. "Formerly on the Islands." Submerged trunks found in Huron Marsh. See page 15. Some trees on the Peninsula measured by J. R. Kelly have trunks with circumferences as follows: 8 ft. 1 in.; 7½ft.; 6 ft. 10 in.; 6 ft. Formerly sassafras oil was made in Sandusky.

PAPAVERACEÆ.**CHELIDONIUM, L.** Celandine.**C. majus, L.**

Scarce.

PAPAYER, L. Poppy.

P. argemone, L. Rough-fruited Corn-Poppy.

"In a Crimson Clover field, Perkins." Ross
Ransom. Probably adventive.

P. somniferum, L. Opium Poppy.

Along a railroad, Sandusky; rare and
adventive.

SANGUINARIA, Dell. Blood-root.

S. CANADENSIS, L.

Frequent. Islands.

FUMARIACEÆ.**CORYDALIS, Vent.**

C. AUREA, Willd. Golden Corydalis.

"Port Clinton," Leslie D. Stair.

C. FLAVULA, D.C.

Peninsula and Islands including Johnson's.
"Cedar Point." Krebs.

DICENTRA, Borkh.

D. CANADENSIS, Walp. Squirrel Corn.

Berlin, Florence, Milan, Perkins; rare.
"Vermillion" Otto K. Todd.

D. CUCULLARIA, Bernh. Dutchman's Breeches.

Frequent. All the Islands.

FUMARIA, L. Fumitory.

F. officinalis, L.

Sandusky, Cedar Point, Kelley's Island; rare.

CRUCIFERÆ.**ALYSSUM, L.**

A. CALYGINUM, L.

"Catawba" Nettie Schnaitter.

ARABIS, L. Rock Cress.

- A. **CANADENSIS**, L. Sickle-pod.
Perkins, Margaretta, Peninsula, Johnson's
Island, Put-in-Bay. Middle Bass; infrequent.
- A. **DENTATA**, Torr & Gray.
Cedar Point, Florence, Johnson's Island, North
Bass, Green Island; infrequent.
- A. **DRUMMONDII**, Gray. (A. **CONFINIS**, Watson.)
Cedar Point and Islands; frequent.
- A. **HIRSUTA**, Scop.
Marblehead; common. Catawba, Mouse Island,
Margaretta, Huron River.
- A. **LÆVIGATA**, DC.
Frequent. Islands.
- A. **LYRATA**, L.
Cedar Point; common. Perkins, Marblehead.
- A. **PERFOLIATA**, Lam. Tower Mustard.
Johnson's Island; rare.

BARBAREA, R. Br. Winter Cress.

- B. **VULGARIS**, R. Br. Yellow Rocket.
Frequent, Green Island. Some of the specimens,
at least, belong to the "variety" *stricta*, which
may be distinct.

BRASSICA, L.

- B. *napus*, L. Rape.
Sandusky, Vermillion; adventive.
- B. *nigra*, Koch. Black Mustard.
Common.
- B. *sinapistrum*, Boiss. Charlock.
Abundant.

CAKILE, Tourn. Sea-Rocket.

- C. **MARITIMA**, Scop. (C. **AMERICANA**, Nutt.)
Shores of Lake and Bay; common.

CAMELINA, Crantz. False Flax.

- C. sativa*, Crantz.
Sandusky and Avery; rare.

CAPSELLA, Medic. Shepherd's Purse.

- C. bursa-pastoris*, Medic.
Abundant.

CARDAMINE, L. Bitter Cress.

- C. DIPHYLLA*, Wood. Two-leaved Toothwort.
Huron River near Millan; rare. Florence;
scarce. "Berlin Heights" Chas. Judson.
- C. LACINIATA*, Wood. Toothwort. Peppercroot.
Common.
- C. PENNSYLVANICA*, Muhl.
Frequent. Kelley's Island. North Bass.
- C. RHOMBOIDEA*, DC. Spring Cress.
Common.
- C. RHOMBOIDEA PURPUREA*, Torr.
Common.

COCHLEARIA, L.

- C. armoracia*, L. (*Nasturtium armoracia*, Fries.)
Horseradish.
Frequent. Islands.

CONRINGIA, Link.

- C. orientalis*, Dum.* Hare's-ear Mustard.
Four plants found along railroad near ice houses,
eastern Sandusky, 1897, by Geo. Gilbert.

DRABA, Dill. Whitlow-Grass.

- D. CAROLINIANA*, Walt.
Common on Marblehead and in some places in
Margaretta in thin soil overlying the limestone.
- D. verna*, L.
"Perkins," Lindsey House. rare.

ERYSIMUM, L. Treacle Mustard.**E. PARVIFLORUM, Nutt.***

One place along L. E. & W. Ry., west of Castalia;
rare.

LEPIDIUM, L. Pepperwort. Peppergrass.**L. APETALUM, Willd.** (**L. INTERMEDIUM, Gray.**)

Sandusky; infrequent.

L. campestre, R. Br.

Sandusky, Perkins, Margaretta, Peninsula,
Kelley's Island, Put-in-Bay. Common in places,
especially on the Peninsula.

L. VIRGINICUM, L. Wild Peppergrass.

Common.

NASTURTIUM, R. Br. Water-Cress.**N. LACUSTRE, Gray.** Lake Cress.

Shinrock; rare.

N. officinale, R. Br. True Water-Cress.

Castalia; frequent.

N. PALUSTRE, D C. Marsh Cress.

Common. On the Islands, and generally near
the Lake or Bay, the variety *hispidum* is more
common.

N. sylvestre, R. Br.* Yellow Cress.

Four places in Perkins, three of them near or not
far from Pipe Creek.

SISYMBRIUM, L.**S. alliaria, Scop.**

"Kelley's Island." Probably adventive.

S. CANESCENS, Nutt. Tansy Mustard.

Cedar Point, Marblehead, Islands; frequent.

S. officinale, Scop. Hedge Mustard.

Common.

THLASPI, L.**T. arvense, L.** Field Penny-cress.

Sandusky; rare and adventive.

CAPPARIDACEÆ.**CLEOME, L.**

- C. GRAVEOLENS, Raf. (POLANISIA GRAVEOLENS, Raf.)
Common on sandy beaches. Also in gravel along
L. E. & W. R. R.

RESEDACEÆ.**RESEDA, L.** Mignonette.

- R. *lutea*, L.
Sandusky, Kelley's Island; rare and adventive.

DROSERACEÆ.**DROSERA, L.** Sundew.

- D. ROTUNDIFOLIA, L.
East of Milan; very rare.

CRASSULACEÆ.**PENTHORUM, Gronov.** Ditch Stone-crop.

- P. SEDOIDES, L.
Frequent. Islands.

SEDUM, L. Stone-crop. Orpine.

- S. *acre*, L. Mossy Stone-crop.
Kelley's Island, roadside by the cemetery. Cedar
Point near the Light House. Escaped.
- S. *telephium*, L. Orpine. Live-for-ever.
Bogart, Castalia, and Sandhill cemeteries. Put-
in-Bay, North Bass, "Marblehead" U G. Sanger
- S. TERNATUM, Michx. Wild Stone-crop.
Frequent at the foot of steep shale banks of
streams. Put-in-Bay. Gibraltar.

SAXIFRAGACÆ.

CHRYSOSPLENIUM, L. Golden Saxifrage.

C. AMERICANUM, Schwein.
Vermillion River, Florence; two places.

HEUCHERA, L. Alum-root.

H. AMERICANA, L.
Common.

MITELLA, L. Bishop's-Cap. Mitrewort.

M. DIPHYLLA, L.
Infrequent.

PARNASSIA, L. Grass of Parnassus.

P. CAROLINIANA, Michx.
Castalia; frequent. Perkins, Milan, Florence;
rare.

PHILADELPHUS, L.

P. coronarius, L. Mock Orange. Syringa.
Springly escaped at Sandusky and Berlin
Heights.

SAXIFRAGA, L. Saxifrage.

S. PENNSYLVANICA, L. Swamp Saxifrage.
Milan and Florence; scarce.

TIARELLA, L. False Mitrewort.

T. CORDIFOLIA, L.
East fork, Vermillion River; rare.

GROSSULARIACÆ.

RIBES, L.

R. AUREUM, Pursh. Missouri or Buffalo Currant.
Well established on south side of Kelley's Island.
Roadside near a house in Margaretta.

R. CYNOSBATI, L. Gooseberry.
Common.

- R. FLORIDUM, L'Her. Wild Black Currant.
 Infrequent. Kelley's Island.
- R. LACUSTRE, Poir.
 "Cedar Point." Millie Carter.

HAMAMELIDACEÆ.

Hamamelis, L. Witch-Hazel.

- H. VIRGINIANA, L.
 Florence, Vermillion, Berlin, Milan; frequent.
 "Portage River."

PLATANACEÆ.

PLATANUS, L. Sycamore.

- P. OCCIDENTALIS, L. Buttonwood.
 Frequent. Islands. The largest tree in Erie county is probably the buttonwood six miles south of Sodusky, in the woods, but near the road and a little east of Pipe Creek.

ROSACEÆ.

AGRIMONIA, L. Agrimony.

- A. EUPATORIA, L.
 Common. Kelley's the only Island.
- A. MOLLIS, Torr. & Gray.
 Perkins and doubtless elsewhere.
- A. PARVIFLORA, Soland.
 Frequent. In places, abundant.
- A. STRIATA Michx.
 Margaretta Ridge. Probably elsewhere.

FRAGARIA, L. Strawberry.

- F. VESCA, L.
 Peninsula, Kelley's Island, Put-in-Bay, Cedar Point, Margaretta, Berlin; frequent in rocky places.

F. VIRGINIANA, Duchesne.

Common. Kelley's, Put-in-Bay and Mouse the only Islands. Many specimens answer to description of the "variety" *illinoense*.

GEUM, L. Avens.

G. ALBUM, Gmelin.

Common.

G. STRICTUM, Soland.

Southern Perkins; rare.

G; VERNUM, Torr. & Gray.

Johnson's Island, Marblehead, Berlin, Perkins, etc.; rather frequent.

G. VIRGINIANUM, L.

Frequent. Kelley's Island? Put-in-Bay.

NEILLIA, D. Don. Ninebark.

N. OPULIFOLIA, Benth. & Hook.

Common on rocky shores of Peninsula and Islands. Vermillion River; rare.

POTENTILLA, L. Cinquefoil.

P. ANSERINA, L. Silver-weed.

Common on sandy shores of Lake and Bay, back a few yards from the water. Middle Bass, North Bass, Rattlesnake Island.

P. ARGUTA, Pursh.

Marblehead, Port Clinton, Put-in-Bay, Margareta Ridge, Krieger's, Perkins; infrequent.

P. CANADENSIS, L. Five-finger.

Common. Not on the Islands.

P. FRUTICOSA, L. Shrubby Cinquefoil.

Castalia prairie; common. In blossom as late as October 10th.

P. NORVEGICA, L.

Frequent. In places abundant. Put-in-Bay.

P. SUPINA, L.

Huron and several places about Sandusky Bay.

ROSA, L. Rose.

- R. BLANDA, Ait.
Cedar Point, Oxford, Groton, Margaretta; local.
- R. CAROLINA, L.
Common.
- R. HUMILIS, Marsh.
Common. Kelley's and Put-in-Bay the only
Islands.
- R. *rubiginosa*, L. Sweetbrier. Eglantine.
Frequent. Islands.
- R. SETIGERA, Michx. Climbing or Prairie Rose.
Perkins, Groton, Cedar Point, Johnson's Island,
Peninsula, Mouse Island, Kelley's Island, Middle
Bass; common. Well worth cultivating.

RUBUS, L. Bramble.

- R. CANADENSIS, L. Low Blackberry, Dewberry.
Common.
- R. HISPIDUS, L. Running Swamp Blackberry.
East of Milan, Berlin, Vermillion, Joseph Smith's,
Perkins; local.
- R. OCCIDENTALIS, L. Black Raspberry. Thimbleberry.
Common.
- R. ODORATUS, L. Purple-flowering Raspberry.
"Near Vermillion River north of Birmingham"
Mrs. W. H. Olds. I have seen this handsome
species at Buffalo, Ashtabula, Cleveland and in
Lorain County within a few rods of Erie County,
but no farther west.
- R. SETOSUS, Bigel.* Bristly Blackberry.
Prairie, Oxford and Perkins; common.
- R. STRIGOSUS, Michx. Wild Red Raspberry.
Old huckleberry swamp near Axtell; rare.
"Other places"?
- R. TRIFLORUS, Richardson. Dwarf Raspberry.
German settlement, Perkins, and east fork of Ver-
million River; rare. Also in the forest west of
Castalia, in Sandusky County.

- R. *VILLOSUS*, Ait. High Blackberry.
Common.

SPIRÆA, L. Meadow-Sweet.

- S. *LOBATA*, Jacq.* Queen of the Prairie.
Southwest of Castalia; local.
A beautiful plant.
- S. *SALICIFOLIA*, L. Common Meadow-sweet.
Oxford, Perkins, Milan, Florence; infrequent.
- S. *TOMENTOSA*, L. Hardhack. Steeple-Bush.
Oxford prairie; very rare.

POMACEÆ.

AMELANCHIER, Medic. June-berry.

- A. *CANADENSIS*, Torr & Gray. Shad-bush. Service-
berry.
Frequent. Islands.
- A. *OBLONGIFOLIA*, Torr & Gray.
Cedar Point, Mouse Island, Kelley's Island;
scarce.

CRATÆGUS, L. Thorn.

- C. *COCCINEA*, L.
Common. Put-in-bay; scarce. North Bass. No
other islands.
- C. *CRUS-GALLI*, L. Cockspur Thorn.
Frequent.
- C. *oxyacantha*, L. English Hawthorn.
In a thicket, Vermillion and two places in Huron.
Seed probably dropped by birds.
- C. *PUNCTATA*, Jacq.
Perkins, Shinrock, Florence. Frequent in
Florence. "Marblehead" Gertrude Johnson.
- C. *SUBVILLOSA*, T. & G. (C. *COCCINEA MOLLIS*, T. & G.)
Common. Kelley's the only Island.
- C. *TOMENTOSA*, L.
Infrequent. Kelley's Island. Middle Bass.

PYRUS, L.

- P. AMERICANA, D C.* American Mountain-Ash.
In thickets, Rattlesnake Island, Put-in-Bay and several places in Erie County. Doubtless from seeds dropped by birds.
- P. ANGUSTIFOLIA, Ait.*
"Margaretta" Flossie Nolan. Perkins, scarce.
- P. ARBUTIFOLIA, L. f. Choke-berry.
Tisdell's, Vermillion; rare.
- P. ARBUTIFOLIA MELANOCARPA, Hook.
Milan, Berlin, Vermillion, Marblehead; infrequent
- P. *communis*, L. Pear.
In woods or by roadsides, Perkins, Grotón, Catawba, Put-in-Bay; rare. "Kelley's Island."
- P. CORONARIA, L. American Crab-Apple.
Frequent. Put-in-Bay.
- P. *malus*, L. Apple.
Frequent. Islands.

DRUPACEÆ.

PRUNUS, L.

- P. AMERICANA, Marshall. Wild Yellow or Red Plum.
Rather frequent. Kelley's Island. Put-in-Bay.
- P. *avium*, L. Sweet Cherry.
In several woods where, doubtless, it has started from pits dropped by birds. Kelley's Island.
- P. CUNEATA, Raf.*
Oxford prairie; rare.
- P. *persica*, Stokes. Peach.
Roadsides; infrequent. Islands. 300,000 bushels of peaches, raised on Catawba, were shipped from there in 1898, enough to have supplied more than a peck to every family in the western half of the United States.

P. SEROTINA, Ehrh. Wild Black Cherry.

Common. Timber found in the submerged forest, Huron marsh. Mr. W. H. Todd says that these cherries are more attractive to birds than grapes, and that it pays to plant the trees near vineyards for this reason. Are they not worth planting for the timber?

P. VIRGINIANA, L. Choke-Cherry.

Abundant on Cedar Point and Islands. Much less common elsewhere.

CÆSALPINACEÆ.

CASSIA, L. Senna.

B. CHAMÆCRISTA, L. Partridge Pea.

Common on the shale in Oxford, Perkins, and Huron near the "slate" cut. Infrequent along railroads in Sandusky. Catawba.

C. MARYLANDICA, L. Wild Senna.

Margaretta, Johnson's Island, Marblehead; infrequent. "Port Clinton."

CERCIS, L. Judas-tree.

C. CANADENSIS, L. Red-bud.

Peninsula; frequent. Margaretta; infrequent. Milan; scarce.

GLEDITSCHIA, L. Honey-Locust.

G. TRIACANTHOS, L. Three-thorned Acacia. Honey-Locust.

Common, especially near Sandusky and in Ottawa county. A tree of great expanse stands on Osborn St. near Hayes Ave.

GYMNOCLADUS, Lam. Kentucky Coffee-tree.

G. CANADENSIS, Lam.

Distribution peculiar and the tree not generally known. It grows on all of the eight islands on

which I have collected, yet on Put-in-Bay seems limited to one spot near the south point. Marblehead, one standing by the side of the principal street; Catawba; Port Clinton where Dr. Hitchcock said there were fifty on one acre, Margareta, several places; Perkins, Gurley's; Huron, one by the Sandusky road; Berlin, formerly on Sterling Hill's place and elsewhere; Vermillion, near Axtel; Florence, near Terryville.

PAPILIONACEÆ

AMPHICARPÆA, Ell. Hog Pea-nut.

A. **MONOICA, Ell.**

Common.

A. **PITCHERI, Torr & Gray.***

Perkins, Milan, Cedar Point, Catawba, Islands; frequent.

APIOS, Boerhaave. Ground-nut. Wild Bean.

A. **TUBEROSA, Moench.**

Rather frequent. "Tubers edible."

ASTRAGALUS, L. Milk-Vetch.

A. **CANADENSIS, L.**

Shores of the Islands and about Sandusky Bay; frequent.

BAPTISIA, Vent. False Indigo.

B. **LEUCANTHA, Torr & Gray.**

Oxford and southern Perkins; infrequent.

B. **TINCTORIA, R. Br.** Wild Indigo.

Oxford, Perkins, eastern Milan, Vermillion, Florence; infrequent.

DESMODIUM, Desv. Tick-Trefoil.

D. **ACUMINATUM, DC.**

Common. Not on the Islands. Some specimens show a reversion of loment to leaves. See sixth annual report, page 32.

- D. CANADENSE, DC.
Frequent.
- D. CANESCENS, DC.
Common.
- D. CILIARE, DC.
Margaretta Ridge, Berlin Heights, east of Milan
and Joseph Smith's woods, Perkins; infrequent.
- D. CUSPIDATUM, Hooker.
Infrequent.
- D. DILLENII, Darlingt.
Frequent. Put-in-Bay.
- D. ILLINOENSE, Gray.*
Marblehead, Margaretta, southern Perkins;
scarce.
- D. LINEATUM, DC.*
Joseph Smith's woods, Perkins; local.
- D. MARYLANDICUM, F. Boott.
Margaretta Ridge; rare.
- D. NUDIFLORUM, DC.
Frequent.
- D. PANICULATUM, DC.
Frequent. Put-in-Bay.
- D. RIGIDUM, DC.
Infrequent.
- D. ROTUNDIFOLIUM DC.
Rather frequent in sandy woods, occurring in, at
least, fourteen places in Erie County and on the
Peninsula.
- D. SESSILIFOLIUM, Torr. and Gray.*
Sandy fields on Margaretta Ridge; common.
Sandhill cemetery. Also ten miles west of Toledo.
- LATHYRUS, L.** Vetchling.
- L. MYRTIFOLIUS, Muhl.
Huron River near Enterprise. "L. S. & M. S. Ry.
Sandusky," Elmer Unchrich.
- L. OCHROLEUCUS, Hook.
Peninsula and Islands.

L. PALUSTRIS, L.

Common.

L. VENOSUS, Muhl.*

Margaretta Ridge; considerable.

LESPEDEZA, Michx. Bush-Clover.

L. CAPITATA, Michx.

Common, at least in sandy soil.

Not on the Islands.

L. NUTTALLII, Darl.*

Margaretta Ridge.

L. POLYSTACHYA, Michx.

Margaretta Ridge, East of Milan, Berlin Heights,
Vermillion, Florence; frequent.

L. PROCUMBENS, Michx.

Vermillion; rare.

L. RETICULATA, Pers.

Margaretta, Huron, Marblehead, Catawba.

L. STUVEI INTERMEDIA, Watson.

Frequent.

L. VIOLACEA, Pers.

Frequent.

LUPINUS, L. Lupine.

L. PERENNIS, L. Wild Lupine.

Margaretta Ridge; Joseph's Smith's, Perkins;
east of Milan; local. "Scott's cemetery"
Gertrude Taylor.

MEDICAGO, L. Medick.

M. *lupulina*, L. Black Medick. Nonesuch.

Frequent. Islands.

M. *sativa*, L. Lucerne. Alfalfa.

Sandusky, Perkins, Marblehead, Put-in-Bay;
roadsides, scarce. Can be raised in the dry soil of
the Peninsula and Islands.

MELILOTUS, Juss. Melilot. Sweet Clover.

M. *alba* Desv. White Melilot.

Abundant.

- M. *officinalis*, Lam. Yellow Melilot.
Sandusky, Johnson's Island, Put-in-Bay; infrequent.

PHASEOLUS, L.

- P. *DIVERSIFOLIUS*, Pers. (*STROPHOSTYLES ANGULOSA*, Ell.) Trailing Wild Bean.
Common on sandy shores. Islands.

PSORALEA, L.

- P. *MELILOTOIDES*, Michx.*
Bloomingville cemetery and southeast of Kimball; indigenous but rare.

ROBINIA, L. Locust-tree.

- R. *PSEUDACACIA*, L. Common Locust. False Acacia.
Infrequent. Islands. Naturalized on banks of Huron River and elsewhere.
The first tree of this species taken to Europe, 1638, was still standing in the *Jardin des Plantes*, Paris, in 1890.

TEPHROSIA, Pers. Hoary Pea.

- T. *VIRGINIANA*, Pers. Goat's Rue. Cat-gut.
Castalia cemetery.

TRIFOLIUM, L. Clover.

- T. *HYBRIDUM*, L. Alsike Clover.
Frequent. Put-in-Bay.
T. *pratense*, L. Red Clover.
Common.
T. *REFLEXUM*, L.* Buffalo Clover.
"Johnson's Island." Minnie Matern.
T. *REPENS*, L. White Clover.
Common.

VICIA, L. Vetch.

- V. *AMERICANA*, Muhl.
Sandusky, especially along L. S. & M. S. R. R. west of Hancock St., Margaretta Ridge, Catawba, Kelley's Island, North Bass; local.

V. CAROLINIANA, Walt.

Islands, Peninsula and western part of Erie county; common.

V. *sativa*, L.

Lakeside, North Bass, Rattlesnake Island; rare.

GERANIACEÆ.

ERODIUM, L'Her. Storksbill.

E. *cicutarium*, L'Her.

"East of Milan." Will Bittner.

GERANIUM, L. Cranesbill.

G. CAROLINIANUM, L.

Frequent in cultivated ground. Islands.

G. MACULATUM, L. Wild Cranesbill.

Common. Kelley's the only Island.

G. ROBERTIANUM, L. Herb Robert.

Common in rocky woods on the Peninsula and all the Islands. In sand, Cedar Point; frequent. Florence, but scarce so far from the Lake. Seldom if ever seen in the interior of Ohio or Michigan. I have seen it in Great Britain, where it is also native but not so common as on our Islands and Peninsula. Here it probably thrives better than anywhere farther south in America. It blooms from May till late in October and adds much to the beauty of woodland and rocky shores.

OXALIDACEÆ.

OXALIS, L. Wood-Sorrel.

O. CYMOSA, Small.

Common.

O. STRICTA, L.

Common.

O. VIOLACEA, L. Violet Wood-Sorrel.

Frequent along a stream in south-eastern Milan and in woods in southern Perkins. Infrequent in Berlin, Huron, near the Soldiers' Home and near the West Harbor. "Florence."

LINACEÆ.

LINUM, L. Flax.

L. SULCATUM.

Widder's woods and Castalia cemetery, Margaretta; Sandhill cemetery; Latham's, Catawba; rare.

L. *usitatissimum*, L. Common Flax.

Along railroads; infrequent. Kelley's Island.

L. VIRGINIANUM, L.

Dry unbroken ground, especially at the top of high steep banks, Oxford and east; scarce.

RUTACEÆ.

PTELEA, L. Hop-tree.

P. TRIFOLIATA, L. Shrubby Trefoil.

Common on the Islands and generally on sandy shores of the Lake. Occurs also in Florence and Margaretta. One on Cedar point has a circumference of thirty-four inches, one foot above the ground.

ZANTHOXYLUM, L. Prickly Ash:

Z. AMERICANUM, Mill. Prickly Ash. Toothache-tree.

Perkins, Groton, Cedar Point, Marblehead, Port Clinton, Kelley's Island, Middle Bass; frequent.

SIMARUBACEÆ.

AILANTHUS, Desf. Tree-of-Heaven.

A. glandulosa, Desf. Chinese Sumach.

Naturalized on Cedar Point and in many places in Sandusky, especially about lumber yards and near buildings where the shelter from wind, the reflected sunlight and the protection afforded by the Bay from untimely frosts enable it to thrive better than in most places so far north. Woods, Florence, and creek valleys, Berlin; rare.

POLYGALACEÆ.

POLYGALA, L. Milkwort.

P. SANGUINEA, L.

Abundant on the shale, Oxford and southern Perkins. Huron, south-east of Milan, Berlin, Vermillion; locally common.

P. SENEGA, L.

Margaretta Ridge, Marblehead, Perkins cemetery; scarce. The variety *latifolia* grows at Catawba.

P. VERTICILLATA, L.

Dry soil, especially at the top of steep banks; infrequent.

P. VERTICILLATA AMBIGUA, Wats & Coult.

South of Huron; rare.

EUPHORBIACEÆ.

ACALYPHA, L. Three-seeded Mercury.

A. VIRGINICA, L.

Abundant.

EUPHORBIA, L. Spurge.

- E. COMMUTATA, Engelm.
Marblehead, Johnson's Island, Cedar Point,
Willow Point; rare except near the railroad on
Marblehead.
- E. COROLLATA, L.
Frequent.
- E. *cyparissias*, L. Cypress Spurge.
Spreading in and from cemeteries and yards.
Islands.
- E. DENTATA, Michx.*
Islands, Peninsula and mainland near Sandusky
Bay; frequent.
- E. HIRSUTA, Wiegand.*
Common, but not on the Islands.
- E. MACULATA, L.
Abundant.
- E. MARGINATA, Pursh.
Naturalized in flower gardens, frequent; else-
where rare.
- E. *peplus*, L.*
Along fence, Jefferson St., near Fulton St., San-
dusky, where it has been for a number of years.
- E. POLYGONIFOLIA, L.
Abundant on sandy shores of Lake Erie. Islands.
- E. PRÉSILI, Guss.
Common.
- E. SERPENS, HBK.*
Johnson's Island; rare. A lot in Sandusky, va-
cant in 1896, but since used for a building site.

CALLITRICHACEÆ.

CALLITRICHE, L. Water-Starwort.

- C. HETEROPHYLLA, Pursh.
Berlin; rare.

C. VERNA, L.

Birmingham and Kimball; rare.

LIMNANTHACEÆ.

FLÆRKEA, Willd. False Mermaid.

F. PROSERPINACOIDES, Willd.

Common in alluvial soil.

ANACARDIACEÆ.

RHUS, L. Sumach.

R. AROMATICA, Ait. Fragrant Sumac.

Cedar Point and Marblehead; common. Other parts of the Peninsula, Islands, Margaretta, western Perkins; frequent.

R. COPALLINA, L. Dwarf Sumac.

Oxford and southern Perkins; common. Southeast of Milan.

R. GLABRA, L. Smooth Sumac.

Common.

R. RADICANS, L. (R. TOXICODENDRON,) Poison Ivy.

Everywhere except on Green Island. Common. Berries eaten and seeds distributed by birds.

R. TYPHINA, L. Staghorn Sumac.

Islands, Peninsula and Cedar Point; abundant. Lester Carpenter of Kelley's Island has bookshelves of this wood, and says that one tree was sixteen inches in diameter near the ground, and about fourteen inches, at a height of six feet. Where else does sumac attain such a size?

R. VENENATA, DC. Poison Sumac.

Vermillion; almost exterminated. "Formerly in old huckleberry swamp near Axtel" A. A. Blair and L. W. Washburn.

ILICACEÆ.**ILEX**, L. Holly.

- I. **VERTICILLATA**, Gray. Winterberry. Black Alder.
Rather frequent. Green Island.

CELASTRACEÆ.**CELASTRUS**, L. Shrubby Bitter sweet.

- C. **SCANDENS**, L. Wax-work, Climbing Bitter-sweet.
Common.

EUONYMUS, L. Spindle-tree.

- E. **ATROPURPUREUS**, Jacq. Burning-Bush. Wahoo.
Frequent. Kelley's Island.
- E. **OBOVATUS**, Nutt. Running Strawberry Bush.
Islands; Sugar Rock, Catawba; Hartshorn's;
frequent. Vermillion River, Florence.

STAPHYLEACEÆ.**STAPHYLEA**, L. Bladder-nut.

- S. **TRIFOLIA**, L. American Bladder-nut.
Frequent. Green Island.

ACERACEÆ.**ACER**, L. Maple.

- A. **DASYCARPUM**, Ehrh. White or Silver Maple.
Common. Planted for shade.
Wood used in Sandusky in making baskets.
- A. **RUBRUM**, L. Red or Swamp Maple.
River banks; infrequent.

A. SACCHARINUM, Wang. Sugar or Rock Maple.

Common in Florence, where there are many sugar bushes. Less common in other parts of the county, on the Peninsula and all the Islands. Wood used by the Sandusky Furniture Company for making bowling alleys, and by the Tool Company for the jaws of hand-screws.

A. SACCHARINUM NIGRUM, Torr & Gray. Black Sugar Maple.

Frequent. Kelley's Island. North Bass.

 NEGUNDO, Moench. Ash-leaved Maple. Box Elder.

N. ACEROIDES, Moench.

Vermillion River, Huron River, Pipe Creek, Shinnock, Bay Bridge, Port Clinton, Put-in-Bay; scarce except along rivers.

HIPPOCASTANACEÆ.

AESCULUS, L.

Æ. GLABRA, Willd. Fetid or Ohio Buckeye.

Frequent along streams and on Johnson's Island. Marblehead, Kelley's Island; scarce. Middle Bass, one. "North Bass, one." "Buckeye Island, formerly."

BALSAMINACEÆ.

IMPATIENS, L. Balsam. Jewel-weed.

I. AUREA, Muhl. (I. PALLIDA, Nutt.) Pale Touch-me-not.

Frequent in rich soil in damp woods. Rattlesnake Island.

I. BIFLORA, Walt. (I. FULVA, Nutt.) Spotted Touch-me-not.

Common, especially on Cedar Point and shores of the Islands.

RHAMNACEÆ.

CEANOTHUS, L. Red-root.

- C. AMERICANUS, L. New Jersey Tea.
 Peninsula, Margeretta Ridge, Perkins, Oxford,
 east of Milan; frequent.
- C. OVATUS, Desf.
 Peninsula; frequent.

VITACEÆ.

VITIS, L. Grape.

- V. BICOLOR, LeConte. Blue or Winter Grape.
 Infrequent. A vine in Peter Mainzer's woods,
 German Settlement, Perkins, is about 80 feet
 high and measures $28\frac{1}{4}$ inches in circumference.
- V. CORDIFOLIA, Michx. Frost or Chicken Grape.
 Milan, Berlin, Vermillion; rather frequent. John-
 son's Island.
- V. HEDERACEA, Ehrh. (AMPELOPSIS QUINQUEFOLIA,
 Michx.) Virginia Creeper.
 Common.
- V. LABRUSCA, L. Northern Fox Grape.
 Vermillion, Florence, Berlin, Milan, Oxford.
 Rather frequent in Florence.
- V. RIPARIA, Michx. Riverside or Sweet scented Grape.
 Common. Abundant on Cedar Point. Nearly all
 the wild grape vines near Sandusky and on the
 Islands and Peninsula are of this species. Wild
 grapes formerly abounded on the Islands. Vine-
 yards have for many years occupied half or more
 of the cultivated ground of the Islands,—more
 than half the entire area of Middle Bass and North
 Bass. Of late they have been to some extent sup-
 planted by peach orchards. The yield continues
 good,—between six and nine million pounds an-
 nually for Ottawa county, surpassed the last few
 years by Lake and Cuyahoga counties,—but the
 price has been low.

TILIACEÆ.

TILIA, L. Linden.

T. AMERICANA, L. Basswood.

Common. Wood used in Sandusky for making excelsior and small boxes. Crayon made in Sandusky is used in nearly every school-house in the United States and to some extent in Europe. For the crayon boxes, basswood logs four feet long, steamed and stripped of bark, are revolved in front of a knife that peels off long sheets of the required thickness. The cores of the logs, about six inches thick, are sent to Muncie, Indiana, for making paper pulp.

MALVACEÆ.

ABUTILON, Gaertn. Indian Mallow.

A. *avicennae*, Gaertn. Velvet-Leaf.

Common. Cultivated in western China for its fibre: here a garden weed.

ALTHÆA.

A. *rosea*, Cav. Hollyhock.

Escaped into streets and vacant lots in a hundred places, in Sandusky; also in many other places in Erie county and on the Islands and Peninsula.

HIBISCUS, L. Rose-Mallow.

H. MOSCHEUTOS, L. Swamp Rose-Mallow.

In marshes connected with Sandusky Bay and the Harbors; frequent. Port Clinton. North Bass. A showy plant.

- H. *trionum*, L. Bladder Ketmia. Flower-of-an-Hour.
 Venice Mallow. Black-eyed Susan.
 Frequent. Not yet well known, but occurring
 throughout Frie county, on the Peninsula and on
 Kelley's Island. Plentiful in some places.

MALVA, L. Mallow.

- M. *moschata*, L. Musk Mallow.
 Scarce. Kelley's Island.
 M. *rotundifolia*, L. Common Mallow.
 Abundant.
 M. *sylvestris*, L. High Mallow.
 Rare.

SIDA, L.

- S. *spinosa*, L.
 Sandusky, Perkins, Peninsula; local. Kelley's
 Island; frequent.

HYPERICACEÆ.

HYPERICUM, L. St John's-wort.

- H. *ASCYRON*, L. Great St. John's-wort.
 Vermillion River, Huron River, Shinrock;
 infrequent.
 H. *CANADENSE*, L.*
 South-east of Milan; rare.
 H. *CANADENSE MAJUS*, Gray.*
 Perkins, Groton; infrequent.
 H. *GYMNANTHUM*, Engelm & Gray.*
 Prairie, Oxford and Perkins; common.
 H. *KALMIANUM*, L.
 Prairie north and west of Castalia; common.
 Middle Bass; rare. "Put-in-Bay."
 H. *MACULATUM*, Walt.
 Frequent. Rattlesnake Island.

- H. **MUTILUM**, L.
Frequent. Common on Oxford prairie.
- H. *perforatum*, L. Common St. John's-wort.
Frequent. Common in parts of Berlin. Kelley's
Island. Middle Bass.
- H. **SAROTHA**, Michx. (H. **NUDICAULE** Walt.)
Orange-grass. Pine-weed.
Oxford; common on the shale. Huron, Ver-
million; local.
- H. **VIRGINICUM**, L. (**ELODES CAMPANULATA**, Pursh.)
Marsh St Johns-wort.
Infrequent.

CISTACEÆ.

HELIANTHEMUM, Pers. Frost-weed.

- H. **CANADENSE**, Michx.
Margaretta Ridge and Perkins; rare.
- H. **MAJUS**, (L) B. S. P.
East of Milan; infrequent. Cedar Point and
southern Perkins; local.

LECHEA, Kalm. Pinweed.

- L. **LEGGETII**, Britt & Holl.
Leonard's Hazel Patch, Perkins.
- L. **MAJOR**, Michx.
Wintergreen woods east of Milan, Bloomingville
cemetery, Castalia cemetery, Smith's, Perkins;
local. "Cedar Point" Claassen.
- L. **MINOR**, L. (L. **THYMIFOLIA** of Gray's Manual.)
Vermillion, southern Perkins and east of Milan;
local and scarcer than the last.

VIOLACEÆ.

IONIDIUM, Vent.

- I. **CONCOLOR**, Benth & Hook. Green Violet.
Vermillion River, Florence; rare.

VIOLA, L. Violet.

- V. BLANDA, Willd. Sweet White Violet.
One wet field in Margaretta, since plowed up.
"Perkins." "Berlin."
- V. BLANDA PALUSTRIFORMIS, Gray.*
Damp cool rocks, Vermillion River and tributary
ravines; scarce.
- V. CANINA MUHLENBERGII, Gray. Dog Violet.
Vermillion River near Birmingham; one specimen.
Also Rocky Ridge, Ottawa county.
- V. CUCULLATA, Ait. Common Blue Violet.
Abundant. In bloom October 8.
- V. LANCEOLATA, L. Lance-leaved Violet.
Oxford and Perkins prairie; rather frequent.
Vermillion southeast of the village; locally
plentiful.
- V. OVATA, Nutt.*
Castalia cemetery; rare.
- V. PALMATA, L.
Sandusky, Catawba; scarce.
- V. PEDATIFIDA, G. Don.*
Marblehead; scarce. Margaretta and Perkins
rare.
- V. PUBESCENS, Ait. Downy Yellow Violet.
Common.
- V. PUBESCENS SCABRIUSCULA, Torr & Gray.
Perkins, Milan. Apparently common: we have
confounded it with the species.
- V. ROSTRATA, Pursh. Long-spurred Violet.
Florence; frequent. Berlin Heights; but not
nearer Sandusky.
- V. SAGITTATA, Ait. Arrow-leaved Violet.
Prairie, Oxford and Perkins; common. East of
Milan. Vermillion. In bloom October 5.
- V. STRIATA, Ait. Pale Violet.
Common along rivers and, locally, elsewhere.

- V. TENELLA, Muhl. (*Viola tricolor arvensis* DC., perhaps.) Field Pansy. Cedar Point, Johnson's Island, Marblehead, Catawba. Put-in-Bay; infrequent but apparently indigenous. *V. tricolor* L., Pansy, persists where it has been cultivated. Three other species grow in Cuyahoga county. See page 30.

CACTACEÆ.

OPUNTIA, Mill. Prickly Pear.

- O. RAFINESQUII, Engelm.*
Cedar Point and one field in Margaretta; common. Marblehead; scarce.

THYMELÆACEÆ.

DIRCA, L. Leatherwood. Moosewood.

- D. PALUSTRIS, L.
One bush on Beecher's flats, Vermillion River, southern Florence. "Formerly plentiful" there.

ELÆAGNACEÆ.

SHEPHERDIA, Nutt.

- S. CANADENSIS, Nutt.
One spot on east fork Vermillion River; rare. "Cedar Point," W. A. Kellerman.

LYTHRACEÆ.

AMMANNIA, L.

- A. COCCINEA, Rottb.*
Presque Isle Point, Peninsula; local.

LYTHRUM, L. Loosestrife.**L. ALATUM, Pursh.**

Common, especially on wet prairies.

Put-in-Bay and Middle Bass the only Islands.

NESÆA, Comm, Juss.**N. VERTICILLATA, HBK.** (DECODON VERTICILLATUS.

Ell.) Swamp Loosestrife.

Marshes connected with Bay and Lake; common.
Islands.

ROOTALA, L.**R. RAMOSIOR, Koehne.**

Marblehead; rare. The only spot in northern
Ohio.

MELASTOMACEÆ.**RHEXIA, L.** Deer-Grass. Meadow-Beauty.**R. VIRGINICA, L.***

Southern Perkins and East of Milan; plentiful in
a few places; regarded rare until 1898.

ONAGRACEÆ.**CIRCÆA, L.** Enchanter's Nightshade.**C. ALPINA, L.**

Florence, mostly on old logs; scarce.

C. LUTETIANA, L.

Common. Put-in-bay the only Island.

EPILOBIUM, L. Willow-herb.**E. ADENOCAULON, Haussk.**

Castalia, Vermillion in old quarry, Marblehead,
Kelley's Island, North Bass; infrequent.

- E. *ANGUSTIFOLIUM*, L. Great Willow-herb. Fire-weed.
 Infrequent.
- E. *COLORATUM*, Muhl.
 Frequent. Kelley's Island. Middle Bass.
- E. *LINEARE*, Muhl.
 Castalia and Peninsula; infrequent.

GAURA, L.

- G. *BIENNIS*, L.
 Rather frequent.

LUDWIGIA, L. False Loosestrife.

- L. *ALTERNIFOLIA*, L. Seed-box.
 Common on the shale. Cedar Point.
- L. *PALUSTRIS*, Ell. Water Purslane.
 Frequent.
- L. *POLYCARPA*, Short & Peter.
 Oxford, Perkins, Vermillion; infrequent.

ŒNOTHERA, L. Evening Primrose.

- Œ. *BIENNIS*, L. Common Evening Primrose.
 Common.
- Œ. *FRUTICOSA*, L. Sundrops.
 Kimball; locally plentiful.
- Œ. *OAKESIANA*, Robbins.*
 Sandusky and probably Cedar Point and elsewhere about the Lake. Not distinguished from Œ. *bennis* until 1898, probably for the reason that it is not annual, as described. Several years ago August Guenther, at my suggestion, pulled up a large number of Œnotheras on Cedar Point and elsewhere, but failed to find one with an annual root. One or the other species is very common on the shores of the Islands.

Æ. PUMILA, L.

Oxford, southern Perkins, east of Milan, Vermillion; scarce. "Southern Margaretta," Elsie Johns.

Æ. RHOMBIPETALA, Nutt.*

Cedar Point.

HALORAGIDACEÆ.

MYRIOPHYLLUM, L. Water-Milfoil.

M. SPICATUM, L.

Sandusky Bay, East Harbor, Catawba, Put-in-Bay; common.

PROSERPINACA, L. Mermaid-weed.

P. PALUSTRIS, L.

Perkins, Castalia, Marblehead; in swamps.

ARALIACEÆ.

ARALIA, L.

A. NUDICAULIS, L. Wild Sarsaparilla.

Rather frequent. Green Island, Kelley's Island.

A. QUINQUEFOLIA Decsne & Planch. Ginseng.

A few years ago frequent; now nearly exterminated. The ginseng dug on Put-in-Bay, 1892 and 1893, sold for about \$800 at about \$3 a pound.

A. RACEMOSA, L. Spikenard.

Frequent on steep banks of streams, and occurs in several other places.

A. TRIFOLIA, Decsne & Planch. Dwarf Ginseng.
Ground-nut.

Two places in Florence.

UMBELLIFERÆ.

ARCHANGELIGA, Hoffm.

- A. ATROPURPUREA, Hoffm.
Castalia; frequent. Perkins.
- A. HIRSUTA, Torr & Gray.
Sandy soil; infrequent.

CARUM, L. Caraway.

- C. *carvi*, L.
Infrequent. Islands.

CHÆROPHYLLUM, L.

- C. PROCUMBENS, Crantz.
Infrequent. Kelley's Island.

CICUTA, L. Water Hemlock.

- C. BULBIFERA, L.
Frequent. Islands.
- C. MACULATA, L. Musquash Root.
Frequent. Kelley's Island.

CONIUM, L. Poison Hemlock.

- C. *maculatum*, L.
Roadside, Groton; local.

CRYPTOTÆNIA, DC. Honewort.

- C. CANADENSIS, DC.
Frequent.

DAUCUS, L. Carrot.

- D. *carota*, L.
A weed in some places in the eastern part of Erie county. Infrequent or scarce in Sandusky and elsewhere, but, perhaps, spreading from the east.

ERIGENIA, Nutt. Harbinger-of-Spring.**E. BULBOSA, Nutt.**

Rather frequent near streams.
Kelley's Island.

ERYNGIUM, L.**E. YUCCÆFOLIUM, Michx.***

Rattlesnake-Master. Button Snake-root.
Southeast of Kimball; plentiful. Roadside west
of Union Corners, and roadside at Joseph Smith's,
Perkins; rare.

FÆNICULUM, Adans. Fennel.**F. vulgare, Mill.** (*F. officinale, All.*)

Sandusky and Groton; rare.

HERACLEUM, L. Cow-Parship.**H. LANATUM, Michx.**

Perkins, Florence, Port Clinton; infrequent.

HYDROCOTYLE, L. Water Pennywort.**H. AMERICANA, L.**

Florence; rare.

OSMORRHIZA, Raf. Sweet Cicely.**O. BREVISTYLIS, DC.**

Common.

O. LONGISTYLIS, DC.

Common.

PEUCEDANUM, L.**P. sativum, Benth & Hook.** Parsnip.

Common. Kelley's the only island.

P. TERNATUM, Nutt. (*TIEDEMANNIA RIGIDA, Coult & Rose.*) Cowbane.

Infrequent.

PIMPINELLA, L.**P. INTEGERRIMA, Benth & Hook.**

Frequent, especially on rocky hillsides. Kelley's Island, Put-in-Bay.

SANICULA, L. Sanicle. Black Snakeroot.

S. CANADENSIS, L.

Frequent or common. Put-in-Bay group.

S. MARYLANDICA, L.

Frequent or common. Kelley's Island.

The two species of sanicle are so much alike that I have not always attempted to distinguish between them. The U. S. National Museum has a specimen of *S. trifoliata* from Lorain county, and the same might probably be found in Erie county by diligent searching.

SIUM, L. Water Parsnip.

S. CUCUTÆFOLIUM, Schrank.

Frequent. Kelley's Island.

THASPIUM, Nutt. Meadow-Parsnip.

T. AUREUM, Nutt.

Sandusky, Margaretta, Marblehead: infrequent. The so-called variety *atropurpureum* in Florence.

T. AUREUM TRIFOLIATUM, Coult & Rose.

Frequent on the Peninsula and in the western part of Erie county. Put-in-Bay.

T. BARBINODE, Nutt.

Margaretta, Peninsula, Islands; frequent. "Cedar Point."

T. BARBINODE, ANGUSTIFOLIUM, Coult & Rose.

Cedar Point, Johnson's Island, Marblehead, Mouse Island; frequent.

ZIZIA, Koch.

Z. AUREA, Koch.

Frequent. Kelley's Island.

CORNACEÆ.

CORNUS, L. Cornel. Dogwood.

- C. ALTERNIFOLIA, L. f.**
Florence, Catawba; scarce.
- C. AMOMUM, Mill.** (**C. SERICEA, L.**)
Silky Cornel. Kinnikinnik.
Common.
- C. ASPERIFOLIA, Michx.**
Common.
- C. CANDIDISSIMA, Mill.** (**C. PANICULATA, L'Her.**)
Frequent.
- C. CIRCINATA, L'Her.** Round-leaved Cornel or Dogwood.
Frequent, especially on the Peninsula and along the Vermillion River. Kelley's Island.
- C. FLORIDA, L.** Flowering Dogwood.
Common. Kelley's the only Island.
- C. STOLONIFERA, Michx.** Red-osier Dogwood.
Castalia; rare. Shore of Lake Erie east of Huron.

NYSSA, L. Tupelo.

- N. MULTIFLORA, Wang.** (**N. SYLVATICA, Marsh.**)
Pepperidge. Sour Gum.
Rich soil; infrequent.

PYROLACEÆ.

CHIMAPHILA, Pursh. Pipsissewa.

- C. MACULATA, Pursh.** Spotted Wintergreen.
Furnace woods, Vermillion.
- C. UMBELLATA, Nutt.** Prince's Pine.
Cedar Point; east of Milan; Vermillion River,
Florence; rare.

PYROLA, L. Wintergreen.

- P. ELLIPTICA, Nutt.** Shin-leaf.
Florence, Milan, Perkins, Cedar Point, Marblehead; infrequent.
- P. RÖTUNDIFOLIA, L.**
Florence, Berlin Heights, Milan, Perkins, Margaretta Ridge; infrequent.

MONOTROPACEÆ.**MONOTROPA, L.** Indian Pipe.

- M. UNIFLORA, L.** Corpse-Plant.
Infrequent.

ERICACEÆ.**ARCTOSTAPHYLOS, Adans.** Bearberry.

- A. UVA-URSI, Spreng.***
Cedar Point; frequent. Vermillion River, Vermillion; rare.

EPIGÆA, L. Ground Laurel.

- E. REPENS, L.** Trailing Arbutus.
Berlin Heights; rare.

GAULTHERIA, L. Aromatic Wintergreen.

- G. PROCUMBENS, L.** Creeping Wintergreen.
One woods east of Milan; frequent. Berlin Heights and Vermillion River; rare. Formerly so plentiful on the banks of the Vermillion River north of Birmingham that they were known locally as the "Wintergreen Banks."

VACCINIACEÆ.

GAYLUSSACIA, H. B. K. Huckleberry.

- H. RESINOSA, Torr & Gray. Black Huckleberry.
Oxford and east; frequent.

OXYCOCCUS, Hill. Cranberry.

- O. MACROCARPUS, Pers. Large or American Cranberry.
Milan; nearly exterminated. "Formerly east of
Berlin Heights and plentiful near Axtel."

VACCINIUM, L. Blueberry.

- V. CORYMBOSUM, L. High-bush or Swamp Blueberry.
A few bushes on and near Tisdale's Vermillion,
and in the old swamp near Axtel where years
ago, "grew a thousand bushels of berries." See
page 31.
- V. PENNSYLVANICUM, Lam. Dwarf Blueberry.
Vermillion River, Vermillion; rare.
- V. VACILLANS, Solander. Low Blueberry.
Frequent from the Huron River east. This and
the Black Huckleberry are the only *Ericaceæ* often
met with in Erie county and these not often west
of the Huron River. I know of none of this order
on the Islands and, excepting the Shin-leaf and
"Indian Pipe," none on the Peninsula.

PRIMULACEÆ.

ANAGALLIS, L. Pimpernel.

- A. *arvensis*, L. Common Pimpernel.
"Sandusky." Victor Hommel.

DODECATHEON, L. American Cowslip.

- D. MEADIA, L.* Shooting-Star.
Castalia; rare. Called also Pride-of-Ohio, but
probably not one in a thousand of the people now
living in Ohio ever saw it growing wild.

LYSIMACHIA, L. Loosestrife.

- L. nummularia, L.** Moneywort.
Frequent in damp places along roads and occasional elsewhere. Middle Bass.
- L. QUADRIFOLIA, L.**
Rather frequent.
- L. STRICTA, Ait.**
Infrequent. Bass Islands.
- L. THYRSIFLORA, L.** Tufted Loosestrife.
Perkins, Huron, Cedar Point, Catawba; infrequent.

SAMOLUS, L. Water Pimpernel. Brook-weed.

- S. VALERANDI AMERICANUS, Gray.**
Florence, Shinrock, Huron, Milan, Groton; infrequent.

STEIRONEMA, Raf.

- S. CILIATUM, Raf.**
Common.
- S. LONGIFOLIUM, Gray.**
Sandusky, Oxford, Margareta, Peninsula, Put-in Bay, Middle Bass, Rattlesnake Island; frequent.

OLEACEÆ.**FRAXINUS, L.** Ash.

- F. AMERICANA, L.** White Ash.
Common. Wood used by the Sandusky Tool Company for hoe handles.
- F. PUBESCENS, Lam.** Red Ash.
Frequent. Islands. On Kelley's Island fruit $2\frac{1}{4}$ inches long and 5-12 inch wide.
- F. QUADRANGULATA, Michx.** Blue Ash.
Islands and Peninsula; frequent. Margareta Ridge.

- F. *SAMBUCIFOLIA*, Lam. Black Ash.
 Infrequent. Islands.
 F. *VIRIDIS*, Michx. f. Green Ash.
 Cedar Point and Vermillion River.

LIGUSTRUM, L.

- L. *vulgare*, L. Privet. Prim.
 Cedar Point; Milan, etc; rare.

SYRINGA, L.

- S. *vulgaris*, L. Lilac.
 Kelley's Island; well established. Sandusky.

GENTIANACEÆ.

BARTONIA, Muhl.

- B. *TENELLA*, Muhl.
 East of Milan; rare.

FRASERA, Walt. American Columbo.

- F. *CAROLINENSIS*, Walt.
 Margaretta Ridge, Perkins, Huron, Berlin; scarce.

GENTIANA, L. Gentian.

- G. *ANDREWSII*, Griseb. Closed Gentian.
 Frequent along ditches.
 G. *CRINITA*, Froel. Fringed Gentian.
 Castalia, southern Perkins, eastern Milan, Oxford
 near Huron River; infrequent. "Marblehead."
 G. *DETONSA* Rottb. (*G. SERRATA*, Gunner.)
 Vermillion River, Florence; one young plant found
 on wet shale cliff.
 G. *PUBERULA*, Michx.*
 Southern Perkins; beautiful but very rare.

G. QUINQUEFLORA, Lam.

Vermillion River; frequent on the east fork. Margaretta Ridge; rare. The variety *occidentalis* in southern Perkins.

SABBATIA, Adans.

S. ANGULARIS, Pursh.

"Florence, 1888." Josephine Fish.
Eastern Milan and Vermillion River, Florence; scarce.

APOCYNACEÆ.

APOCYNUM, L.

A. ANDROSÆMIFOLIUM, L. Spreading Dogbane.

Frequent. Put-in-Bay. Middle Bass.

A. CANNABINUM, L. Indian Hemp.

Frequent but on lower ground. Islands.

VINCA, L.

V. *minor* L. Periwinkle, Myrtle.

Spreading in and from yards and cemeteries.
Kelley's Island. Middle Bass.

ASCLEPIADACEÆ.

ACERATES, Ell. Green Milkweed.

A. LONGIFOLIA, Ell.*

Prairie; Oxford, Perkins, Huron; frequent.

A. VIRIDIFLORA, Ell.

Oxford, Margaretta, Cedar Point, Marblehead, Catawba. Infrequent, except on Marblehead, where the "variety" *lanceolata* also occurs.

ASCLEPIAS, L. Milkweed.

- A. INCARNATA, L. Swamp Milkweed.
Common.
- A. INCARNATA PULCHRA, Pers.
Castalia; rare.
- A. OBTUSIFOLIA, Michx.*
In sand, Margaretta Ridge, Castalia cemetery,
southern Perkins; rare.
- A. PHYTOLACCOIDES, Pursh. Poke Milkweed.
In nine places, but scarce. Put-in-Bay.
- A. PURPURASCENS, L. Purple Milkweed.
Perkins, Margaretta, Groton, Marblehead,
Catawba; infrequent.
- A. QUADRIFOLIA, Jacq.
Huron River and Perkins; rare.
- A. SULLIVANTII, Engelm.*
Oxford and Sandusky; scarce.
- A. SYRIACA, L. Common Milkweed or Silkweed.
Common.
- A. TUBEROSA, L. Butterfly-weed. Pleurisy-root.
Frequent. Put-in-Bay. North Bass.
- A. VERTICILLATA, L.
Southern Margaretta, Groton, Marblehead,
Catawba; scarce.

CONVOLVULACEÆ.

CONVOLVULUS, L. Bindweed.

- C. *arvensis*, L. Small Bindweed.
Sandusky and Islands; local.
- C. SEPIUM, L. (CALYSTEGIA SEPIUM, R. Br.)
Hedge Bindweed.
Common. A rank weed in corn fields in Perkins.
On portions of the bay shore of Cedar Point so
thick as to make walking difficult.

C. SEPIUM REPENS, Gray.*

Oxford; frequent? Catawba. "Marblehead,"
U. G. Sanger.

IPOMŒA, L. Morning Glory.

I. PANDURATA, Meyer. (I. FASTIGIATA. Sweet.) Wild
Potato-vine. Man-of-the-earth.

Frequent.

I. *purpurea*, Roth. Morning-glory.

Escaped into roads and waste places, Sandusky,
Peninsula, Put-in-Bay, North Bass; infrequent.

CUSCUTACEÆ.

CUSCUTA, L. Dodder.

C. ARVENSIS, Beyrich.*

Oxford, Florence, Port Clinton; rare.

C. CHLOROCARPA, Engelm.*

Catawba; frequent. East Harbor, Castalia,
Willow Point, Sandusky, Oxford; infrequent.

C. DECORA, Engelm.*

Marblehead; rare.

C. GRONOVII, Willd.

Common.

C. INFLEXA, Engelm.*

Oxford and Margaretta Ridge; scarce.

G. TENUIFLORA, Engelm.

Perkins, Oxford, Port Clinton, Put-in-Bay;
Infrequent.

POLEMONIACEÆ.

PHLOX, L.

P. DIVARICATA, L.

Common. A specimen from Johnson's Island has
narrow, acuminate, corolla lobes.

P. PANICULATA, L.

Spreading from gardens to roadsides in several places.

P. PILOSA, L.

Margaretta Ridge, Oxford, southern Perkins, Huron, Catawba; locally common.

P. SUBULATA, L. Ground or Moss Pink.

Catawba; frequent. Vermillion or Florence; rare. "Berlin" Sterling Hill.

POLEMONIUM, L. Greek Valerian.**P. REPTANS, L.**

Near the Huron and Vermillion rivers; infrequent, "Hartshorn's, Peninsula." Pearl Green.

HYDROPHYLLACEÆ.**HYDROPHYLLUM, L. Waterleaf.****H. APPENDICULATUM, Michx.**

Frequent, especially on the Islands and Peninsula.

H. CANADENSE, L.

Florence and Vermillion; rare.

H. MACROPHYLLUM, Nutt.

One spot on west bank of west fork of Vermillion River; a dozen or more plants growing with a few of the preceding species. Unknown elsewhere so far north.

H. VIRGINICUM, L.

Common. Islands, except Kelley's and Put-in-Bay.

PHACELIA, Juss.**P. PURSHII, Buckley.**

Johnson's Island; common. Milan, Vermillion, Peninsula, Kelley's Island; scarce.

BORAGINACEÆ.**BORAGO, L.**

- B. officinalis*, L. Borage.
Spontaneous near the Soldiers' Home.

CYNOGLOSSUM, L.

- C. officinale*, L. Hound's-tongue.
Common.

ECHINOSPERMUM, Lehm. Stickseed.

- E. lappula*, Lehm.
Peninsula, Kelley's Island, Middle Bass, Perkins,
Sandusky; rather frequent.
- E. VIRGINICUM*, Lehm. Beggar's Lice.
Frequent. Kelley's Island. Put-in-Bay.

ECHIUM, L. Viper's Bugloss.

- E. vulgare*, L. Blue-weed.
Well established in the L. E. & W. freight yard,
Sandusky.

LITHOSPERMUM, L.

- L. arvense*, L. Corn Gromwell.
Abundant One of the worst weeds on Kelley's
Island and elsewhere.
- L. CANESCENS*, Lehm. Hoary Puccoon:
Peninsula, Margaretta, southern Perkins;
infrequent.
- L. HIRTUM*, Lehm.* Hairy Puccoon.
Cedar Point; common.

MERTENSIA, Roth. Lungwort.

- M. VIRGINICA*, DC. Virginia Cowslip. Blue-bells.
Johnson's Island, Huron River; frequent.
Marblehead, Kelley's Island, North Bass, Berlin,
Vermillion River; infrequent or scarce.

MYOSOTIS, L. Scorpion-grass.**M. VERNA**, Nutt.

Rather frequent. Put-in-Bay.

ONOSMODIUM, Michx.**O. CAROLINIANUM**, DC.

Margaretta, western Perkins, Peninsula, Johnson's Island; infrequent.

VERBENACEÆ.**LIPPIA, L.****L. LANCEOLATA**, Michx. Fog-fruit.

Sandusky, Margaretta, Groton, Johnson's Island, Peninsula, Put-in-Bay; infrequent.

VERBENA, L. Vervain.**V. ANGUSTIFOLIA**, Michx.

Common in dry calcareous soil. Kelley's the only island.

V. BRACTEATA, Lag & Rodr.*

Near the L. E. & W. freight house; rare.

V. HASTATA, L. Blue Vervain.

Common.

V. URTICAEFOLIA, L. White Vervain.

Frequent. Islands. Hybrids between this and the preceding occur.

LABIATÆ.**BLEPHILIA, Raf.****B. CILIATA**, Raf.

Johnson's Island, Marblehead, Catawba, Kelley's Island, Put-in-Bay, Margaretta, western Perkins; locally plentiful.

B. *HIRSUTA*, Benth.

In woods, Erie county and Catawba; infrequent.

CALAMINTHA, Lam.

C. *CLINOPODIUM*, Benth. Basil.

Islands, Peninsula, Cedar Point; common.
Smith's woods, Perkins.

C. *NUTTALLII*, Benth.

Prairies, Castalia and Marblehead; common.

COLLINSONIA, L. Horse Balm.

C. *CANADENSIS*, L. Rich-weed.

Frequent.

HEDEOMA, Pers.

H. *PULEGIODES*, Pers. American Pennyroyal.

Common.

ISANTHUS, Michx.

I. *CAERULEUS*, Michx. False Pennyroyal.

Dry calcareous soil; frequent, especially about
quarries. Kelley's Island. Common on Marble-
head.

LAMIUM, L. Dead-Nettle.

I. *amplexicaule*, L.

Throughout but scarce. Islands.

L. *purpureum*, L.

"Soldiers' Home." Carl Anderson.

LEONURUS, L.

L. *cardiaca*, L. Motherwort.

Common.

LOPHANTHUS, Benth. Giant Hyssop.

L. *NEPETOIDES*, Benth.

Peninsula; frequent. Kelley's Island, Cedar
Point, Johnson's Island, Groton, Perkins, Bloom-
ingville, Florence; infrequent.

L. SCROPHULARIAEFOLIUS, Benth.

East of Milan; rare. Also at Oak Harbor,
Ottawa county.

LYCOPUS, L. Water Hoarhound.

L. RUBELLUS, Moench.

Infrequent. Islands.

L. SINUATUS, Ell.

Frequent. Islands.

L. VIRGINICUS, L. Bugle-weed.

Common.

MARRUBIUM, L. Hoarhound.

M. *vulgare*, L. Common Hoarhound.

Islands and Peninsula; common. Margaretta
Sandusky, Milan; local.

MELISSA, L. Balm.

M. *officinalis*, L. Common Balm.

Woods, Put-in-Bay and Vermillion; rare.

MENTHA, L. Mint.

M. CANADENSIS, L. Wild Mint.

Common.

M. *piperata*, L. Peppermint.

Frequent, especially about Castalia. "The
continuous inhalation of the oil for several days
will cure catarrh."

M. *viridis*, L. Spearmint.

Common. Put-in-Bay the only island.

M. CLINOPODIA, L. **MONARDA, L. Horie-mint.**

Milan; rare.

M. FISTULOSA, L. Wild Bergamot.

Common. The variety *mollis* seems to be the
more common form.

NEPETA, L. Cat-Mint,

N. cataria, L. Catnip.

Common.

N. glechoma, Benth. Ground Ivy. Gill.

Common. Not noticed on the Islands, except Rattlesnake, where it appeared about 1892, and Put-in-Bay. Along rivers it has become super-abundant.

PHYSOSTEGIA, Benth. False Dragon-head.

P. VIRGINIANA, Benth.

Marblehead, Put-in-Bay, Middle Bass, Groton, eastern Sandusky; scarce.

PRUNELLA, L. Self-heal.

P. VULGARIS, L. Heal-all.

Common.

PYCNANTHEMUM, Michx. Mountain Mint.

P. LANCEOLATUM, Pursh.

Castalia; common. Oxford, Milan, Peninsula; frequent. Put-in-Bay.

P. LINIFOLIUM, Pursh.

Oxford prairie and Vermillion River flats; rare.

P. MUTICUM PILOSUM, Gray.

East of Port Clinton; rare.

SATUREIA, L. Savory.

S. hortensis, L. Summer Savory.

Well established in and near the village of Marblehead.

SCUTELLARIA, L. Skullcap.

S. GALERICULATA, L.

Common. Put-in-Bay and Middle Bass the only islands.

- S. *LATERIFLORA*, L. Mad-dog Skullcap.
Common.
- S. *NERVOSA*, Pursh.
Vermillion, woods east of the river and Florence
along west fork; rare.
- S. *PARVULA*, Michx.
Mostly in calcareous soil, Margaretta, Peninsula,
Kelley's Island; frequent.
- S. *VERSICOLOR*, Nutt.
Marblehead; frequent. Cedar Point, Johnson's
Island, Put-in-Bay, Catawba, Margaretta, Per-
kins; infrequent.

STACHYS, L. Hedge-Nettle.

- S. *ASPERA*, Michx.
Sandusky, Cedar Point, Peninsula; common.
Middle Bass, North Bass.
- S. *TENUIFOLIA*, Willd. (S. *ASPERA GLABRA*, Gray.)
Old Woman Creek, Berlin Heights; rare.

TEUCRIUM, L. Germander.

- T. *CANADENSE*, L. Wood Sage.
Common especially on the shores of the Islands.

SOLANACEÆ.

DATURA, L. Jamestown or Jimson-weed.

- D. *stramonium*, L.
Margaretta; frequent; elsewhere scarce.
- D. *tatula*, L.
Frequent. Kelley's Island.

LYCIUM, L. Matrimony Vine.

- L. *vulgare*, Dunal.
Escaped from gardens in some places. Kelley's
Island.

LYCOPERSICUM, Hill.

- L. esculentum*, Mill. Tomato.
Sandusky; well established near the Bay. Kelley's Island. Put-in-Bay.

NICANDRA, Adans. Apple of Peru.

- N. physaloides*, Gaertn.,
Perkins; scarce.

PHYSALIS, L. Ground Cherry.

- P. HETEROPHYLLA*, Nees. (*P. VIRGINIANA*, Gray.)
Common.
- P. HETEROPHYLLA AMBIGUA*, Gray.
Marblehead.
- P. HETEROPHYLLA NYCTAGINEA*, Dunal.
Huron, Milan, Perkins, Danbury.
- P. LANCEOLATA*, Michx.
Sandusky, Perkins, Port Clinton, Kelley's Island,
"Marblehead."
- P. PHILADELPHICA*, Lam.
Perkins, Groton.
- P. PRUINOSA*, L.
Kelley's Island.

SOLANUM, L. Nightshade.

- S. CAROLINENSE*, L. Horse-Nettle.
Several places near railroads; scarce.
- S. dulcamara*, L. Bittersweet.
Frequent, especially on the Peninsula and Islands.
Abundant in Lake woods east of Port Clinton. Appearing to be indigenous.
- S. NIGRUM*, L. Common Nightshade.
Common.
- S. ROSTRATUM*, Dunal.
Marblehead, about the quarry, where the dry soil seems adapted to this western weed, but we hope Mr. Harsh has succeeded in exterminating it. Put-in-Bay and "west of Sandusky," 1895.

SCROPHULARIACEÆ.

CASTILLEJA, L. Painted-Cup.

- C. COCCINEA, Spreng. Scarlet Painted-Cup.
Hartshorn's, Peninsula and Catawba; rare.

CHELONE, L. Turtle-head.

- C. GLABRA, L. Snake-head.
Throughout Erie county; infrequent.

CONOBEA, Aublet.

- C. MULTIFIDA, Benth.*
Prairies, Castalia, Marblehead, Kelley's Island;
scarce.

GERARDIA, L.

- G. AURICULATA, Michx.*
Marblehead; rare.
- G. FLAVA, L. Downy False Foxglove.
"Huron River?" Henry Schoepfle.
- G. PURPUREA, L. Purple Gerardia.
Castalia, where it adorns the grounds of the
Trout Club, Oxford, southern Perkins, Perrin's,
Milan, Cedar Point, Peninsula; infrequent.
- G. PURPUREA PAUPERCULA, Gray.*
Oxford and southern Perkins; rare.
- G. QUERCIFOLIA, Pursh. Smooth False Foxglove.
Infrequent;
- G. TENUIFOLIA, Vahl. Slender Gerardia.
Frequent. Kelley's Island.

GRATIOLA, L. Hedge-Hyssop.

- G. SPHAEROCARPA, Ell.*
DeLamater's, Kimball; rare.
- G. VIRGINIANA, L.
Rather frequent.

ILYSANTHES, Raf.

- I. RIPARIA, Raf.** False Pimpernel.
Sandusky. Huron River, Peninsula; infrequent.

LINARIA, Juss. Toad Flax.

- L. vulgaris, Mill.** Butter and Eggs.
Common.

MIMULUS, L. Monkey-flower.

- M. ALATUS, Solander.**
Frequent in the eastern part of Erie county.
Milan and Perkins; infrequent.

- M. RINGENS, L.**
Frequent. Bass Islands.

PEDICULARIS, L. Lousewort.

- P. CANADENSIS, L.** Wood Betony.
Infrequent. Kelley's Island. Put-in-Bay.
- P. LANCEOLATA, Michx.**
Milan, Margaretta, Perkins; infrequent.

PENTSTEMON, Mitchell. Beard-tongue.

- P. PUBESCENS, Solander.**
Frequent, especially on the Islands and Peninsula.

SCROPHULARIA, L. Figwort.

- S. NODOSA MARYLANDICA, Gray.**
Frequent. Islands,

SEYMERIA, Pursh.

- S. MACROPHYLLA, Nutt.** Mullein-Foxglove.
Cedar Point, Port Clinton, Vermillion River;
scarce.

VERBASCUM, L. Mullein.

- V. blattaria, L.** Moth Mullein.
Frequent. Kelley's Island. Middle Bass.

V. thapsus, L. Common Mullein.
Common.

VERONICA, L. Speedwell.

V. ANAGALLIS, L. Water Speedwell.
Margaretta, Huron, Berlin, Kelley's Island;
infrequent.

V. arvensis, L. Corn Speedwell.
Common.

V. hederæfolia, L.* Ivy-leaved Speedwell.
"Yard on east Market St., Sandusky." Ione
Pratt.

V. OFFICINALIS, L. Common Speedwell.
Margaretta Ridge and east of Port Clinton;
rare. "Florence." Josephine Fish.

V. PEREGRINA, L. Neckweed. Purslane Speedwell.
Frequent. Put-in-Bay, North Bass, Rattlesnake
Island.

V. SCUTELLATA, L. Marsh Speedwell.
Infrequent.

V. SERPYLLIFOLIA, L. Thyme-leaved Speedwell.
Frequent. Put-in-Bay.

V. VIRGINICA, L. Culver's-root. Culver's Physic.
Infrequent.

LENTIBULARIACEÆ.

UTRICULARIA, L. Bladderwort.

U. GIBBA, L.*
Cedar Point; local.

U. VULGARIS, L. Greater Bladderwort.
Sandusky Bay and East Harbor; frequent. Cas-
talia; infrequent.

OROBANCHACEÆ.**APHYLLON, Mitchell.**

- A. UNIFLORUM, Gray. One-flowered Cancer-root.
Sandusky, three places; "Bogart" James D. Parker, Jr.; Florence; "Catawba" Earl Covell: scarce.

CONOPHOLIS, Wallroth. Squaw-root. Cancer-root.

- C. AMERICANA, Wallroth.
Local. Put-in-Bay, northwest woods; plentiful. Perkins, big woods. Florence; two places.

EPIFAGUS, Nutt. Beech-drops. Cancer-root.

- E. AMERICANUS, Nutt. (EPIPHEGUS VIRGINIANA, Bart).
Florence, Vermillion, Berlin; frequent.

BIGNONIACEÆ.**TECOMA, Juss. Trumpet-flower.**

- T. RADICANS, Juss. Trumpet Creeper.
Frequent in woods and probably indigenous. Abundant on Cedar Point. Islands.

ACANTHACEÆ.**DIANTHERA, Gronov. Water-Willow.**

- D. AMERICANA, L.
Marblehead, Put-in-Bay, Middle Bass; rare. "Mills Creek; plentiful" Hommel.

PHRYMACEÆ.**PHRYMA, L. Lopseed.**

- P. LEPTOSTACHYA, L.
Frequent. Kelley's Island. Put-in-Bay.

PLANTAGINACEÆ.

PLANTAGO, L. Plantain.

- P. ARISTATA, Michx.
Sandy field on Margaretta Ridge and near L. E.
& W. freight house, Sandusky; rare.
- P. CORDATA, Lam.
Huron and Florence; rare.
- P. lanceolata, L. Ribgrass. Ribwort. English
Plantain.
Frequent but not common in most parts. Kelly's
Island, Put-in-Bay.
- P. MAJOR, L. Common Plantain.
Common.
- P. RUGELII, Decaisne.
More common than the preceding.
- P. VIRGINICA, L.
Sandy field on Margaretta Ridge; rare.

RUBIACEÆ.

CEPHALANTHUS, L. Button-bush.

- C. OCCIDENTALIS, L.
Common.

GALIUM, L. Bedstraw. Cleavers.

- G. APARINE, L. Cleavers. Goose-Grass.
Abundant.
- G. ASPRELLUM, Michx. Rough Bedstraw.
Infrequent. Islands.
- G. BOREALE, L. Northern Bedstraw.
Perkins, Margaretta, Marblehead, Catawba,
Kelley's Island; scarce.
- G. CIRCÆZANS, Michx. Wild Liquorice.
Rather common. Put-in-Bay, Middle Bass,
Rattlesnake Island.

- G. CONCINNUM, Torr & Gray.
Common. Not on the Islands.
- G. LANCEOLATUM, Torr. Wild Liquorice.
Florence, Vermillion, Berlin Heights; rare.
- G. PILOSUM, Ait.
Frequent. One specimen shows a reversion of
flowers to leaves.
- G. TRIFIDUM, L. Small Bedstraw.
Frequent. Put-in-Bay. Middle Bass. The
variety *pusillum* occurs at Castalia and "Cedar
Point."
- G. TRIFIDUM LATIFOLIUM, Torr.
Infrequent.
- G. TRIFLORUM, Michx. Sweet-scented Bedstraw.
Frequent. Rattlesnake Island.

HOUSTONIA, L.

- H. CÆRULEA, L. Bluets. Innocence.
Not found near Sandusky but in many places
from southern Perkins south and east. East of
Milan I have seen several million blossoms on
three or four acres of ground, appearing at a
distance as if a light snow had fallen, not com-
pletely covering the grass.
- H. CILIOLATA, Torr.
Marblehead; common. Margaretta. Soldier's
Home.
- H. LONGIFOLIA, Gaertn.
Rocky shores of Rattlesnake Island and Put-in-
Bay; frequent. Marblehead.

MITCHELLA, L. Partridge-berry.

- M. REPENS, L.
Banks of Vermillion River and tributaries;
common. Old Woman Creek at Berlin Heights;
frequent. Milan, Perkins, Groton; scarce.

CAPRIFOLIACEÆ.**LONICERA, L.** Honeysuckle.

L. GLAUCA, Hill.

Margaretta Ridge; rare.

L. GLAUDESCENS, Rydb.

Infrequent. Islands.

L. SEMPERVIRENS, L. Trumpet or Coral Honeysuckle.

Woods near Huron, where the seed was doubtless dropped by birds; rare.

SAMBUCUS, L. Elder.

S. CANADENSIS, L. Common Elder.

Common.

S. RACEMOSA, L. Red-berried Elder.

Eastern Sandusky; east of Milan; Vermillion River, Florence; scarce.

SYMPHORICARPOS, Juss. Snowberry.

S. ORBICULATUS, Moench. (**S. VULGARIS, Michx.**)

Indian Currant. Coral-berry.

Sandusky and Milan; escaped.

S. RACEMOSUS, Michx. Snowberry.

Marblehead; common, Elsewhere scarce.

S. RACEMOSUS PAUCIFLORUS, Robbins.

Cedar Point; common.

TRIOSTEUM, L. Horse-Gentian.

T. PERFOLIATUM, L. Fever-wort.

Frequent.

VIBURNUM, L. Arrow-wood.

V. ACERIFOLIUM, L. Dockmackie.

Frequent from the Huron River east. Put-in-Bay.

V. DENTATUM, L.

Florence and eastern Berlin; infrequent.

- V. LENTAGO, L. Sweet Viburnum. Sheep-berry.
Infrequent. Kelley's Island, Middle Bass.
- V. OPULUS, L. Cranberry-tree.
"Groton" and big woods, Perkins; rare.
- V. PUBESCENS, Pursh.
Marblehead, Catawba, Kelley's Island, Put-in-Bay; frequent.

VALERIANACEÆ.

VALERIANA, L. Valerian.

- V. PAUCIFLORA, Michx.
Lake woods east of Port Clinton, Florence, Milan; rare.

VALERIANELLA, Poll. Corn-Salad. Lamb-Lettuce.

- V. *olitoria*, Poll.
Shinrock; rare.
- V. RADIATA, Dufur.
Perkins, Milan, Shinrock; scarce.
- V. WOODSIANA, Walp.*
Woodbury's woods, Berlin; local.

DIPSACACEÆ.

DIPSACUS, L. Teasel.

- D. *sylvestris*, Mill.
Common. Kelley's the only island.

CUCURBITACEÆ.

ECHINO CYSTIS, Torr & Gray. Wild Balsam-apple.

- E. LOBATA, Torr & Gray.
Lake woods east of Port Clinton; abundant. Elsewhere infrequent.

SICYOS, L.

- S. ANGULATUS, L.** One-seeded Bur-Cucumber.
Green Island; common. Rattlesnake Island, Put-in-Bay, Catawba, Port Clinton, Cedar Point, Sandusky; infrequent.

CAMPANULACEÆ.**CAMPANULA, L.** Bellflower.

- C. AMERICANA, L.** Tall Bellflower.
Common.
- C. APARINOIDES, Pursh.** Marsh Bellflower.
Cedar Point, Venice, Peninsula; locally common.
- C. ROTUNDIFOLIA.** Harebell.
Common on rocky shores but apparently absent from Kelley's Island.

LOBELIA, L.

- L. CARDINALIS, L.** Cardinal-flower.
Infrequent. Islands.
- L. INFLATA, L.** Indian Tobacco.
Rather frequent. Put-in-Bay.
- L. KALMII, L.**
Common on rocky shores. Florence; rare.
- L. SPICATA, Lam.**
Common on the prairies.
- L. SYPHILITICA, L.** Great Lobelia.
Common. Kelley's, Middle Bass and North Bass the only islands.

SPECULARIA, Heister. Venus's Looking-glass.

- S. PERFOLIATA, A. DC.**
Infrequent. Kelley's Island, Put-in-Bay.

CICHORIACEÆ.

CICHORIUM, L. Chicory. Succory.

C. *intybus*, L.

Roadsides in a number of places; local. Common at Port Clinton and Catawba. Kelley's Island, Middle Bass.

HIERACIUM, L. Hawkweed.

H. CANADENSE, Michx.*

Huron, Milan, Oxford, Marblehead, Catawba; infrequent.

H. GRONOVII, L. Hairy Hawkweed.

Infrequent. The "variety" *subnudum* in the Bloomingville cemetery.

H. PANICULATUM, L.

Vermillion River and Berlin Heights; infrequent.

H. SCABRUM, Michx.

Frequent.

KRIGIA, Schreb. Dwarf Dandelion.

K. AMPLEXICAULIS, Nutt.

Frequent in Milan Township. Elsewhere infrequent. Kelley's Island.

LACTUCA, L. Lettuce.

L. ACUMINATA, Spreng.

Perkin's, Margaretta, Port Clinton; infrequent.

L. ALPINA, Benth & Hook, (L. LEUCOPHÆA, Gray.)

Frequent. Kelley's Island, Put-in-Bay.

L. CANADENSIS, L. Wild Lettuce.

Common.

L. FLORIDANA, Gaertn.

Margaretta Ridge, Cedar Point, Peninsula, Put-in-Bay, Green Island; frequent.

L. *scariola*, L. Prickly Lettuce.

Abundant. One of the worst weeds.

PRENANTHES, L. Rattlesnake-root.

- P. ALBA, L.** White-lettuce.
Common.
- P. ALTISSIMA, L.**
Infrequent. Put-in-Bay.
- P. ASPERA, Michx.***
Prairie east of Kimball; rare.
- P. CREPIDINEA, Michx.**
Near Pipe Creek in German Settlement woods;
rare.
- P. RACEMOSA, Michx.**
Prairies. West of Castalia; frequent. Oxford,
Gröton, "Perkins," "Gypsum"; infrequent or
scarce.

SONCHUS, L. Sow-Thistle.

- S. asper, Vill.** Spiny-leaved Sow-thistle.
Infrequent. Islands.
- S. oleraceus, L.** Common Sow-Thistle.
Frequent. Islands.

TARAXICUM, L. Dandelion.

- T. officinale, Weber.** Common Dandelion.
Abundant. "In blossom when the boys were
skating" Freyensee.

TRAGOPOGON, L. Goats-beard.

- T. porrifolius, L.** Salsify. Oyster-plant.
Roadsides; infrequent. Islands.
- T. pratensis, L.** Goats-beard.
Sandusky, in vacant lots near Central Avenue
and elsewhere; spreading.

COMPOSITAE.**ACHILLEA, L.** Yarrow.

- A. MILLEFOLIUM, L.** Common Yarrow or Milfoil.
Abundant.

ACTINELLA, Nutt.**A. ACAULIS GLABRA, Gray.***

Marblehead prairie; infrequent but occurring at places widely separated and, apparently, indigenous.

ACTINOMERIS, Nutt.**A. SQUARROSA, Nutt.**

Frequent on flood grounds of streams.

AMBROSIA, L. Ragweed.**A. ARTEMISIFOLIA, L. Ragweed. Roman Wormwood.**

Abundant. After *Setaria glauca* probably the worst weed.

A. TRIFIDA, L. Great Ragweed.

Common. The so-called variety *integrifolia* is infrequent.

ANTENNARIA, Gaertn. Everlasting.**A. PLANTAGINEA, R. Br. Plantain-leaved Everlasting.**

Common. Kelley's and Put-in-Bay the only islands. A specimen collected on Marblehead by Ralph H. McKelvey is what Greene would call *A. neglecta* and one in Perkins by Will Sprow *A. neodioica*.

ANTHEMIS, L. Chamomile.**A. cotula, L. May-weed.**

Common.

ARCTIUM, L. Burdock.**A. lappa majus, Gray.**

"Bogart" H. D. Banks.

A. lappa minus, Gray.

Common.

ARTEMISIA, L. Wormwood.

A. annua, L.

Sandusky, well established near the Big Four docks.

A. BIENNIS, Willd.

Sandusky, Castalia, Johnson's Island, Marblehead, Middle Bass, North Bass; frequent only near railroads or docks.

A. CAUDATA, Michx.*

Cedar Point and Marblehead sand spit; common.

A. LUDOVICIANA, Nutt.* Western Mugwort.

Established in one spot on embankment of L. S. & M. S. Ry., eastern Sandusky.

A. vulgaris, L. Common Mugwort.

Escaped in cemeteries and from gardens to roads; scarce.

ASTER, L.

A. AZUREUS, Lindl.

Sandy soil from Margaretta Ridge to Berlinville; infrequent. Catawba.

A. CORDIFOLIUS, L.

Frequent.

A. CORYMBOSUS, Ait.

Florence and Milan; scarce.

A. DIFFUSUS, Ait.

Frequent and variable.

A. DUMOSUS, L.*

Sandy soil, Milan, southern Perkins; infrequent. Oxford; frequent? Flowers white.

A. ERICOIDES, L.

Common on rocky shores.

A. ERICOIDES PLATYPHYLLUS, Torr & Gray.*

Castalia; rare.

- A. JUNCEUS, Ait.*
Castalia and east of Milan; scarce.
- A. LAEVIS, L.
Milan, Huron, Oxford, Margaretta, Florence, Catawba; rather frequent.
- A. MACROPHYLLUS, L.
Frequent but not observed near Sandusky. Put-in-Bay.
- A. MULTIFLORUS, Ait.
Dry soil in the limestone region; frequent. Put-in-Bay.
- A. NOVÆ-ANGLIÆ, L.
Along roads near Sandusky and south next to the most common Aster. Not so common in the eastern part of the county and on the Peninsula. Kelley's Island, Put-in-Bay; scarce.
- A. PANICULATUS, Lam.
Our most common Aster.
- A. POLYPHYLLUS, Willd.
Marblehead, Put-in-Bay, Gibraltar, and probably other islands.
- A. PRENANTHOIDES, Muhl.
Perkins, Bloomingville, Milan, Berlin, Florence; infrequent.
- A. PTARMICOIDES, Torr & Gray.*
Marblehead; local.
- A. PUNICEUS, L.
Castalia, Bloomingville, Milan, Florence; infrequent.
- A. PUNICEUS LUCIDULUS, Gray.*
Castalia, along the mill race.
- A. SAGITTIFOLIUS, Willd.
Common.
- A. SALICIFOLIUS, Ait.
Oxford, Milan, Groton, Margaretta, Sandusky, Catawba; infrequent. Many specimens of *A. paniculatus* approach this species.

A. *SHORTII*, Hook.

Peninsula and Islands; common. Huron and Vermillion Rivers; frequent.

A. *TRADESCANTI*, L.

Frequent, at least in Perkins and Oxford. Kelley's Island.

A. *UMBELLATUS*, Mill.

Infrequent.

A. *VIMINEUS*, Lam.*

Perkins and probably elsewhere.

BIDENS, L. Bur-Marigold.B. *BECKII*, Torr.* Water Marigold.

Black Channel, Biemiller's Cove, East Harbor; scarce.

B. *BIPINNATA*, L. Spanish Needles.

Sandusky, Cedar Point, Catawba, North Bass; rare.

B. *CERNUA*, L. Smaller Bur-Marigold.

Perkins and Margaretta; scarce.

B. *CHRYSANTHEMOIDES*, Michx. Larger Bur-Marigold.

Frequent. Islands.

B. *CONNATA*, Muhl. Swamp Beggar-ticks.

Common. One specimen seven feet tall. Some specimens have the awns upwardly barbed.

B. *CONNATA COMOSA*, Gray.

Frequent.

B. *FRONDOSA*, L. Common Beggar-ticks. Stick-tight.

Common. A troublesome weed.

BOLTONIA, L'Her.B. *ASTEROIDES*, L'Her.

Sheltered beaches of Lake Erie and Sandusky Bay especially Johnson's Island and the beach stretching from Port Clinton towards Catawba. Not on rocks nor pure sand. Put-in-Bay the only island in the lake.

CALENDULA, L. Marigold.

- C. officinalis*, L. Garden Marigold.
Sandusky and Put-in-Bay; spreading and escaping, but seldom far from gardens. Hardly naturalized.

CENTAUREA, L.

- C. cyanus*, L. Blue-bottle. Corn-flower.
Kelley's Island and elsewhere; sparingly escaped.

CHRYSANTHEMUM, L.

- C. balsamita*, L. Costmary.
Escaped from gardens in several places.
- C. leucanthemum*, L. Ox-eye or White Daisy. White-weed.
Common in several places but not generally distributed. Put-in-Bay.
- C. parthenium*, Bernh. Feverfew.
Escaped to waste places in Sandusky and well established in woods on Put-in-Bay.

CNICUS, L.

- C. altissimus*, Willd.
Infrequent. Kelley's Island.
- C. arvensis*, Hoffm. Canada Thistle.
Frequent, especially near the Lake and Bay Islands.
- C. discolor*, Muhl.
Frequent.
- C. lanceolatus*, Willd. Common Thistle.
Common.
- C. muticus*, Ell. Swamp Thistle.
Infrequent.

COREOPSIS, L. Tickseed.

- C. aristosa*, Michx.
Castalia and Venice marshes; common. Cedar Point, Catawba, Vermillion; frequent.

C. DISCOIDEA, Torr & Gray.

Sandusky, Cedar Point, Oxford; locally plentiful.

C. TRICHOSPERMA, Michx. Tickseed Sunflower.

Infrequent.

C. TRICHOSPERMA TENUILOBA, Gray.

Frequent, especially on wet prairies. Kelley's Island. Hundreds of acres of marsh near Bay Bridge glow in autumn with the yellow blossoms, a sight worth going far to see.

C. TRIPTERIS, L. Tall Coreopsis.

Frequent from Milan and Cedar Point west Peninsula.

ECLIPTA, L.

E. ERÉCTA, L. (E. ALBA Hassk.)

Sandusky, East Harbor, Lockwood's; scarce.

ERECHTITES, Raf. Fireweed.

E. PRÆALTA, Raf. (E. HIERACIFOLIA, Raf.)

Common.

ERIGERON, L. Fleabane.

E. ANNUUS, Pers. Daisy Fleabane. Sweet Scabious.

Common.

F. BELLIDIFOLIUS, Muhl. Robin's Plantain.

Milan, Perkins, Margaretta Ridge; infrequent.

E. CANADENSIS, L. Horse-weed. Butter-weed.

Common.

E. PHILADELPHICUS, L. Common Fleabane.

Common.

E. STRIGOSUS, Muhl. Daisy Fleabane.

Frequent or common. Islands. Abundant on Marblehead.

EUPATORIUM, L. Thoroughwort.

E. AGERATOIDES, L. White Snakeroot.

Common. Rattlesnake the only island. This plant H. H. Lockwood says is the "Trembleweed" and the cause of milk sickness.

- E. ALTISSIMUM, L.
Northwestern Margareta; infrequent. Johnson's, Marblehead; rare.
- E. PERFOLIATUM, L. Thoroughwort. Boneset.
Common.
- F. PURPUREUM, L. Joe-Pye Weed. Trumpet-Weed.
Common. Not on the Islands.
- E. SESSILIFOLIUM, L. Upland Boneset.
Milan, Huron, Catawba; rare.

GNAPHALIUM, L. Cudweed.

- G. DECURRENS, Ives. Everlasting.
Catawba and Florence; very rare.
- G. OBTUSIFOLIUM, L. (G. POLYCEPHALUM, Michx.)
Common Everlasting.
Common.
- G. PURPUREUM, L. Purplish Cudweed.
Infrequent.
- G. ULIGINOSUM, L. Low Cudweed.
Infrequent.

HELENIUM, L. Sneeze-weed.

- H. AUTUMNALE, L.
Common at Sandusky and vicinity. Florence.
Catawba.

HELIANTHUS, L. Sunflower.

- H. ANNUUS, L.
Frequently escaped. "Cedar Point, far from any house" Ralph H. McKelvey.
- H. DECAPETALUS, L.
Frequent.
- H. DIVARICATUS, L.
Frequent, especially on Marblehead and the Islands.

- H. GIGANTEUS, L.
Sandusky to Milan and west; common. The so-called variety, *ambiguus*, occurs in Perkins and Oxford, and near Port Clinton.
- H. GROSSE-SERRATUS, Martens.
Oxford, Groton, Margaretta; frequent.
- H. HIRSUTUS, Raf.
Cedar Point, Peninsula, Oxford, Margaretta, Groton; rather common.
- H. MOLLIS, Lam.*
Prairie, Oxford and Huron; enough to supply the botanists of the world.
- H. OCCIDENTALIS, Riddell.
Castalia cemetery and Kimball; scarce.
- H. PARVIFLORUS, Bernh.
Frequent.
- H. STRUMOSUS MOLLIS, Torr & Gray.*
Oxford, Groton, Castalia, Cedar Point, Port Clinton; infrequent. Apparently all our specimens of *H. strumosus* are of this variety.
- H. TRACHELIIFOLIUS, Willd.
Florence, Port Clinton; scarce?
- H. TUBEROSUS, L. Jerusalem Artichoke.
Frequent. Kelley's Island. Put-in-Bay.

HELIOPSIS, Pers. Ox-eye.

- H. LÆVIS, Pers.
Common.
- H. SCABRA, Dunal.
Rather frequent.

INULA, L. Elecampane.

- I. *helenium*, L.
Infrequent. Florence; frequent.

KUHNTIA, L.

K. EUPATORIOIDES, L.

Dry soil near Castalia; locally common. Sandusky and Perkins; scarce.

LEPACHYS, Raf.

L. PINNATIFIDA, Raf.

Common on prairies.

LIATRIS, Schreb. Button Snakeroot.

L. SCARIOSA, Willd.

Catawba, Cedar Point, Margaretta Ridge, southern Perkins, Kimball; plentiful in some places.

L. SPICATA, Willd.

Castalia prairie; abundant and showy. Marblehead, Cedar Point, Oxford, southern Perkins, Groton, east of Milan; frequent on undisturbed damp ground.

L. SQUARROSA INTERMEDIA, DC.* Blazing-Star.

Castalia and Sandhill cemeteries.

POLYMNIA, L. Leaf-Cup.

P. CANADENSIS, L.

Cedar Point, Peninsula, Islands; infrequent.

RUDBECKIA, L. Cone-flower.

R. HIRTA, L.

Common. Not on the Islands.

R. LACINIATA, L.

Frequent.

R. TRILOBA, L.

"Port Clinton" Wm. Krebs.

SENECIO, L. Groundsel.

S. ATRIPLICIFOLIUS, Hook. (CACALIA ATRIPLICIFOLIA,

L.) Pale Indian Plantain.

Vermillion River, Florence; frequent. Elsewhere infrequent.

- S. AUREUS**, L. Golden Ragwort.
Frequent.
- S. AUREUS OBOVATUS**, Torr & Gray. Squaw-weed.
Common. Kelley's the only island.
- S. AUREUS BALSAMITÆ**, Torr & Gray.
Castalia, Perkins, Marblehead, Catawba; frequent. Put-in-Bay.

SILPHIUM, L. Rosin-weed.

- S. PERFOLIATUM**, L. Cup-Plant.
Huron and Vermillion rivers; infrequent. Castalia; local.
- S. TEREBINTHENACEUM**, Jacq. Prairie Dock.
Common on the prairies.
- S. TRIFOLIATUM**, L.
Frequent.

SOLIDAGO, L. Golden-rod.

- S. BICOLOR**, L.
Frequent.
- S. BICOLOR CONCOLOR**, Torr & Gray.
Rocky shores of the Put-in-Bay Islands; infrequent.
- S. CAESIA**, L.
Common in rich woods. Islands.
- S. CANADENSIS**, L.
Abundant.
- S. JUNCEA**, Ait.
Frequent.
- S. LANCEOLATA**, L.
Common.
- S. LATIFOLIA**, L.
Florence; frequent. Vermillion, Berlin Heights, Milan, Perkins, Catawba, Kelley's Island, Green Island, Rattlesnake; scarce.

- S. NEMORALIS, Ait.
Frequent. Islands.
- S. OHIOENSIS, Riddell.
Castalia prairie; infrequent.
- S. PATULA, Muhl.
Florence, Milan, Castalia, Kelley's Island;
infrequent.
- S. RIDDELLII, Frank.
Castalia; frequent. Marblehead, Groton, House's
swamp, Perkins; infrequent.
- S. RIGIDA, L.
Marblehead and Oxford; frequent. Huron, San-
dusky, Margaretta, Groton, Middle Bass; local.
- S. RUGOSA, Mill.
East of Milan; local.
- S. SEROTINA, Ait.
Frequent.
- S. SEROTINA GIGANTEA, Gray.
Milan, Oxford, southern Perkins; scarce.
- S. SPECIOSA, Nutt.
Huron River and Peninsula; infrequent. South-
ern Perkins; scarce.
- S. SPECIOSA ANGUSTATA, Torr & Gray.*
Leonard's Hazel Patch, Perkins; rare.
- S. TENUIFOLIA, Pursh.
Oxford prairie; abundant.
- S. ULMIFOLIA, Muhl.
Marblehead; frequent. Elsewhere infrequent.
Islands.

TANACETUM, L. Tansy.

- T. *vulgare*, L.
Roadsides; frequent. Islands. The ordinary
form is the variety *crispum*, but the other occurs
in "Perkins" and on "Kelley's Island."

VERNONIA, Schreb. Iron-weed.V. **ALTISSIMA, Nutt.**

Common. Kelley's the only island.

V. **ALTISSIMA GRANDIFLORA, Nutt.**

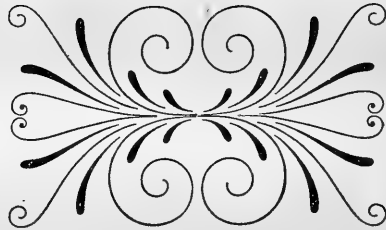
Huron, Willow Point, Kelley's Island; infrequent.

V. **FASCICULATA, Michx.**

Prairies; frequent.

XANTHIUM, L. Cocklebur.X. **CANADENSE, Mill.**

Common. The so-called variety *echinatum* is the common form near the Bay and Lake.



CORRECTIONS.

- Page 7. For *Hypericum kalmianum* read *Potentilla fruticosa*. The two grow together on the prairie but the latter is more abundant and to it belong the small petrified leaves collected.
- Page 28. The four names at the top of first column should be at the bottom.
- Page 50. For *P. annual* read *P. annua*.
- Page 54. For *hedunculata* read *pedunculata*.
- Page 63. For *J. TENVIS* read *J. TENUIS*.
- Page 76. Place a mark of doubt —?— after occurs, at end of third line.
- Page 84. For **AMONACEÆ** read **ANONACEÆ**.
- Page 94. For **SAXIFRAGACÆ** read **SAXIFRAGACEÆ**.
- Page 150. For *T. pratensis* read *T. pratensis*.

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* * The names of families are in capitals. In the catalogue the genera of each family and the species of each genus are arranged alphabetically.

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SPECIAL PAPERS NO. 2.

THE
ODONATA OF OHIO

A DESCRIPTIVE CATALOGUE OF THE DRAGONFLIES
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A POSTHUMOUS PAPER

BY

DAVID S. KELLICOTT, PH. D.,

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PREFATORY NOTE

The paper on the *Odonata* of Ohio, by Prof. D. S. Kellicott herewith presented to the public, was in such an advanced stage of progress at the time of his death that there can be no possible question as to the desirability of publishing it in the form which he had given to it. It was necessary, however, in order to give it the completeness that would make it most serviceable in the line intended by the author that the species not covered in the manuscript he left should be given a similar treatment. This duty has been performed by Mr. J. S. Hine, whose long association with Prof. Kellicott, and participation with him in the collection and preparation of material on which the paper is based gave him exceptional advantages for the work. Of the original manuscript by Prof. Kellicott, which covers everything up to and including *Gomphus externus* nothing has been changed, except to make such verbal changes as he himself would have made on a final revision for the press. For the remainder the effort has been to complete as nearly as possible on the plan followed by Prof. Kellicott, in the portion he had finished and, wherever possible, use has been made of his published descriptions.

The sketch of Prof. Kellicott's life, and the bibliography have also been prepared by Mr. Hine, the drawings for the plates by Mr. W. E. Kellicott.

HERBERT OSBORN.

Dept. Zool. and Ent. O. S. U., Columbus, Ohio.

Feb. 10, 1899.

BIOGRAPHICAL SKETCH.

David S. Kellicott, Ph. D., late Professor of Zoology and Entomology at the Ohio State University, was born at Hasting's Center, Oswego County, New York, January 28, 1842. His boyhood days were spent on a farm, where early in life he acquired an intense love for nature.

He availed himself of the opportunities for preliminary education offered by the district school, and prepared for College at Mexico Academy, Mexico, New York. He entered Genesee College, now Syracuse University, and completed the science course. Later he received the degrees of Bachelor of Philosophy, and Doctor of Philosophy from the same Institution. His life work was teaching; he taught village schools at first, but was soon called to college work, and from 1870-'72 was teacher of Mathematics in the Keystone State Normal School. At this time an opportunity presented, and he accepted a position in his chosen field, becoming Professor of Natural History in the Buffalo State Normal School, which position he held until he resigned in 1888, to accept the position at the Ohio State University. Here his quiet enthusiasm, indomitable energy and enlightened judgment developed his department to a high degree of efficiency.

The scientific attainments of Professor Kellicott have been gratefully recognized by an appreciative public. At the time of his death he was president of the American Microscopical Society, General Secretary of the American Association for the Advancement of Science, and Treasurer of the Ohio State Academy of

Science. Formerly he was president of the Buffalo Academy of Science, and the Ohio State Academy of Science. He was among the first in this country to become a fellow of the Royal Microscopical Society of London.

His death was caused by pneumonia. After an illness of only a few days he died April 13th 1898.

Professor Kellicott has contributed articles to various American periodicals, most of which are included in the following list.

PROCEEDINGS OF THE AMERICAN SOCIETY OF MICROSCOPISTS.

1879. On Certain Crustaceous Parasites of Fishes from the Great Lakes. I, 53.
Observations on *Lerneocera cruciata*. I, 64.
1880. *Lerneocera tortura*, n. s. II, 41.
1882. On Certain Crustaceous Parasites of Fresh-Water Fishes. IV, 75.
Polyzoa—Observations on Species Detected near Buffalo, N. Y. IV, 217.
1883. On some Infusoria found on the Cray-Fish. V, 105.
Cothurnia lata, n. s. V, 113.
Note on two Parasites of the Cray-Fish. V, 115.
1884. Observations on Infusoria with Description of New Species. VI, 110.
Notes: Infusoria, Rotatoria, Etc. VI, 126.
1885. Observations on some Fresh-water Infusoria—with Descriptions of a few Species regarded as new. 38.
A new Floscule. 48.
1886. A note on *Argulus catostomi*. 144.
1887. Additional note on a Certain Species of Rotifera. 181.
Some new and rare Infusoria. 187.
1888. President's Address: The Nature of Protozoa, and Lessons of these Simplest Animals. 5.
Partial List of Rotifera of Shiawassee River, at Corunna, Michigan. 84.
Observations of Fresh-water Infusoria. 97.
1889. A New Rotiferon. 32.
1892. Crustaceous Parasite of the "Miller's Thumb." 76.
1895. Formalin in the Zoological and Histological Laboratory. 331.
1896. The Rotifera of Sandusky Bay—First Paper. 155.
1897. The Rotifera of Sandusky Bay—Second Paper. 43.

ANNUAL REPORT OF THE OHIO STATE ACADEMY OF SCIENCE.

1893. On Certain Marine Infusoria observed at Woods Hall, Mass. II, 10.
Preliminary Report of the Dragonflies of Ohio. II, 11.
1895. Third Report on the Odonata of Ohio. IV, 33.
1896. Additions to the Catalogue of the Odonata of Ohio. V, 47.
Preliminary Report on the Fresh-Water Sponges of Ohio. V, 50.
1897. Additions to the Catalogue of Dragonflies of Ohio. VI, 27.

INSECT LIFE.

1891. The Preparatory Stages of *Eustrotia caduca*. III, 321.
1892. Note on the Horn Fly in Ohio. IV, 35.
1893. *Hypoderas columbæ*—A Note. V, 77.
Notes on the *Aegeriidæ* of Central Ohio—II. V, 81.

JOURNAL OF THE CINCINNATI SOCIETY OF NATURAL HISTORY.

1893. Remarkable Malformation in a Cat. XV, 54.
1895. Catalogue of Ohio Odonota—Part I. XVII, 195.
1896. Catalogue of Ohio Odonota—Part II. XVIII, 105.
1897. Catalogue of Ohio Odonota—Part III. XIX, 66.
An Odonate Nymph from a Thermal Spring. XIX, 63.

ENTOMOLOGICA AMERICANA.

1885. On the Larval Stages of *Harmonia pini*, and a Parasite of the same. I, 171.
On the Preparatory Stages of an Undetermined *Cossus*. I, 173.
1886. Notes on Two Larvæ of the Genus *Catocala*. II, 45.
1888. Note on *Hepialis argenteomaculatus*. IV, 153.

ENTOMOLOGICAL NEWS.

1890. Dragonflies Congregating at Night. I, 146.
1891. *Retinia comstockiana*, Fernald. II, 33.
Platyserura furcilla, Packard. II, 33.
Psyche confederata, G. & R. II, 122.
There are exceptions. II, 123.
1892. *Perophora melsheimerii*. III, 18.
Cossid or Hepialid? III, 123.
1892. The White Ant Again. V, 314.
Distribution of Odonata: V, 314.
1895. Odonata—A Note and a Description. VI, 239.

TRANSACTIONS OF THE OHIO STATE MEDICAL SOCIETY.

Certain Entozoa of the Dog and Sheep. 1894.
The State University and Medical Education.

JOURNAL OF THE COLUMBUS HORTICULTURAL SOCIETY.

1890. Our Injurious Ægerians. V, 11.
Blackberry Borer, (*Bembicia marginata*). V, 27.
1891. Entomology. VI, 60.
Report of the Committee on Entomology. VI, 100.
1892. Observations on Forest Insects. VII, 92.
Report of the Committee on Entomology. VII, 96.
Report of the Committee on Entomology, VII, 111.
1894. Some Museum and Granary Pests. IX, 11.
The White Ant. IX, 81.
Report of the Committee on Entomology. IX, 179.
1895. Report of the Committee on Entomology. X, 58.
Report of the Committee on Entomology. X, 144.
1896. Remarkable Extension in the Northward Range of the Bag or
Basket Worm. XI, 4.
Report of the Committee on Entomology. XI, 48.

AMERICAN MONTHLY MICROSCOPICAL JOURNAL.

1885. Opercularia constricta, n. s.
1888. Nature of Protozoa.

NATURALISTS BULLETIN.

1883. The Larvæ of the Catocalæ.

51ST ANNUAL REPORT OF BUFFALO LIBRARY.

Address at the Opening of the Buffalo Public Library.

BULLETIN OF THE BUFFALO NATURALIST'S AND FIELD CLUB.

1883. Notes on Protozoa. No. I.
Notes on Protozoa. No. II.
Entomological Notes. 41.
Entomological Notes. 68.
Entomological Notes. 88.

BULLETIN OF THE BUFFALO SOCIETY OF NATURAL SCIENCE.

1877. Description of a New Species of Argulus. III, 214.
1882. Observations and Notes. IV, 29.
Notes on the Larvæ of some Local Pterophoridaæ. IV, 47.
Observations and Notes. IV, 61.

THE MICROSCOPE.

1887. Notes on Fresh Water Infusoria, with Remarks on Collecting and Preserving these Delicate Animals.
1889. Intestinal Parasitic Infusoria of the Frog.

CANADIAN ENTOMOLOGIST.

1878. A New Gall Moth, and Notes on Larvæ of Other Gall Moths. X, 201.
1879. Observations on *Nephoterix zimmermani*. XI, 114.
1880. Correspondence. XII, 59.
Larval Habits of the Golden-rod Boring Plume. XII, 105.
1881. Observations on Several Species of *Ægeriadae* inhabiting the Vicinity of Buffalo, N. Y. XIII, 3.
The Larvæ of *Catocala unijuncta*. XIII, 38.
Notes on *Ægeria pini*. XIII, 157.
1882. Is *Poedisca Scudderiana* a Gall-maker? XIV, 161.
1883. *Psephenus Lecontei*—On the External Anatomy of the Larva. XV, 191.
1884. A Note—Ovipositing Apparatus of *Nonagria Subcarnea*. XVI, 170.
1884. Occurrence of the Basket-worm in Ontario. XVI, 180.
1885. *Eumacaria brumearia*, Packard. XVII, 32.
1889. *Arzama obliquata*. XXI, 39.
1891. Notes on Two Borers Injurious to the Mountain Ash. XXIII, 250.
1892. Notes on the *Ægeriadae* of Central Ohio. XXIV, 42.
Notes on the *Ægeriadae* of Central Ohio—II. XXIV, 209.
Preparatory Stages of *Calothysanis amaturlaria*, XXIV, 242.
1894. List of the Dragon-flies of Corunna, Michigan. XXVI, 345.
1895. Correction. XXVII, 15.

AGRICULTURAL STUDENT.

1895. The Hessian Fly. II, 31.
1896. Notes on the Occurrence of Dragonflies in Ohio. III, 141.
1897. Rare Ohio Dragonflies. IV, 45.

REPORT OF THE ENTOMOLOGICAL SOCIETY OF ONTARIO.

1891. Note on the Horn Fly in Ohio. XXII, 59.

PROCEEDINGS OF INDIANA ACADEMY OF SCIENCE.

1895. Rotifera. 242.
Odonata. 251.

MISCELLANEOUS.

1897. Dissection of an Ophidian—Published by the Author.
1881. Address of the Retiring President of the Buffalo Microscopical Club.
1899. The Odonata of Ohio. Published as Special Papers 2. Ohio State Academy of Science.



Yours truly,
D. J. Kellicott.

TO MY ASSOCIATES AND STUDENTS
IN THE
DEPARTMENT OF ZOOLOGY
OF THE
OHIO STATE UNIVERSITY, THIS BOOKLET IS DEDICATED,
IN MEMORY OF
HAPPY HOURS SPENT TOGETHER
AS NATURALISTS IN FIELDS AND WOODS.



INTRODUCTION.

This brochure has been prepared in answer to the often repeated query of students and young naturalists, "What book can I get to help me in identifying the dragonflies." If it does not prove helpful to these inquiring ones, the purpose of its making has been missed. The effort has been to prepare a helpful and suggestive guide, clear and scientifically accurate; and to record without too painful dryness, the present state of our knowledge of a delightful group of insects. Should the attempt prove in a measure successful, as a means of increasing interest in these lively creatures and in helping some earnest minded young people to enjoy more thoroughly the pleasures of studying nature afield, the writer will feel richly repaid for his pains.

The writings of Dr. Herman Hagen, Baron de Selys-Longchamps, W. F. Kirby, Benjamin D. Walsh Philip P. Calvert, Nathan Banks, Rene' Martin and other students of the odonata have been freely consulted and deep obligations to each are acknowledged. Much assistance has been given in collecting by Professor J. S. Hine, Professor E. E. Bogue, by my son, W. E. Kellicott and by many students of the Ohio State University.

It does not seem necessary to give here an account of the anatomy and metamorphosis of the dragonflies; this has been done quite recently in papers by Nathan Banks,¹ Philip P. Calvert,² and by Professor J. H. Comstock,³ nor will the bibliography be repeated, as it

(1.) A Synopsis Catalogue and Bibliography of the Neuropteroid Insects of Temperate North America. *Transaction of the Am. Ent. Soc.*, of Philadelphia, Vol. XIX.

(2.) Catalogue of the Odonata of the vicinity of Philadelphia, with an Introduction to the Study of this Group of Insects. *Ib.* Vol. XX.

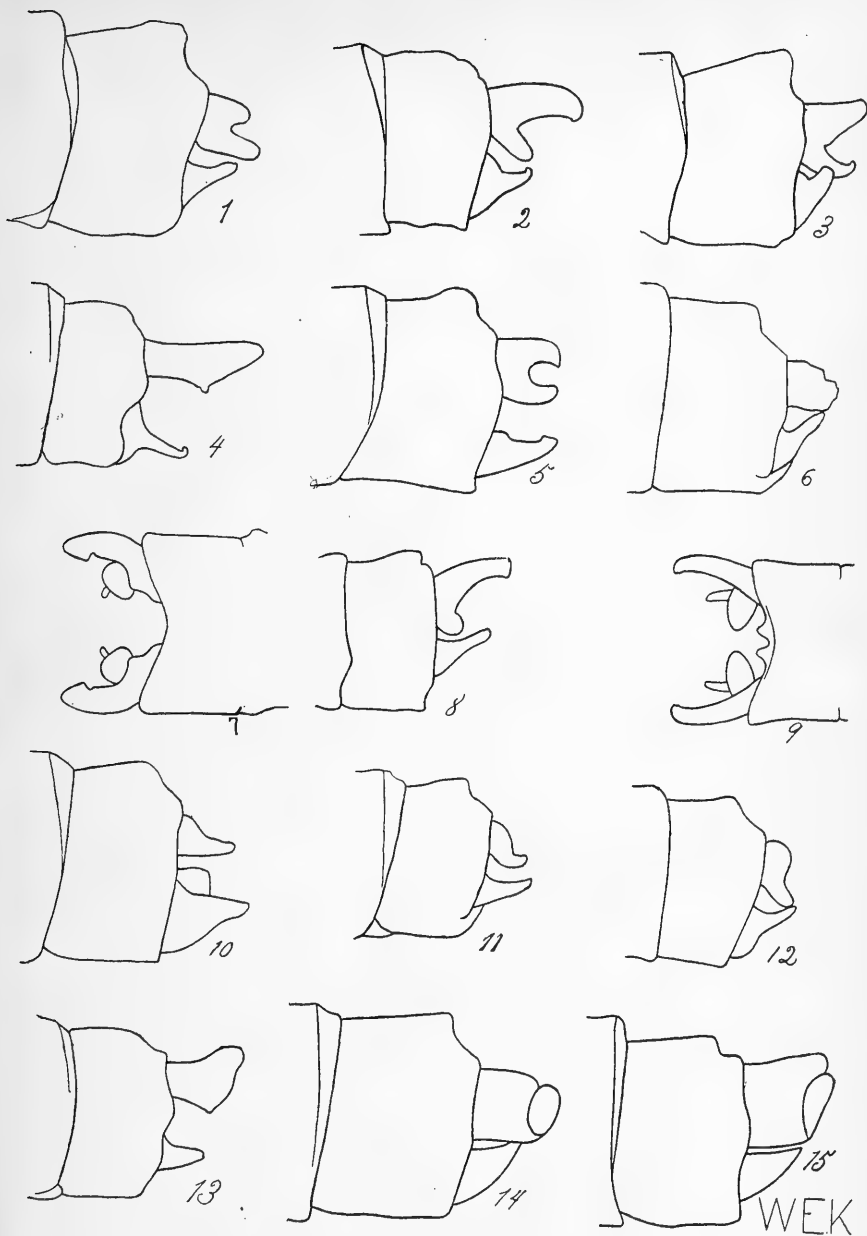
(3.) Manual for the study of Insects, Ithaca. N. Y., 1895.

is accessible to most students in the papers cited and in the Synoptic Catalogue of W. F. Kirby. References will be made, by foot notes, to descriptions made since the papers cited were published.

Dragonflies occur in most parts of the earth. Representatives of this ancient race fly beyond the Arctic Circle and at an elevation of 10,000 feet. However, they are heat-loving insects and of course are more numerous in tropical and sub-tropical countries than elsewhere. The number of known species in the whole world exceeds 2000; in North America about 300; and in Ohio 100.

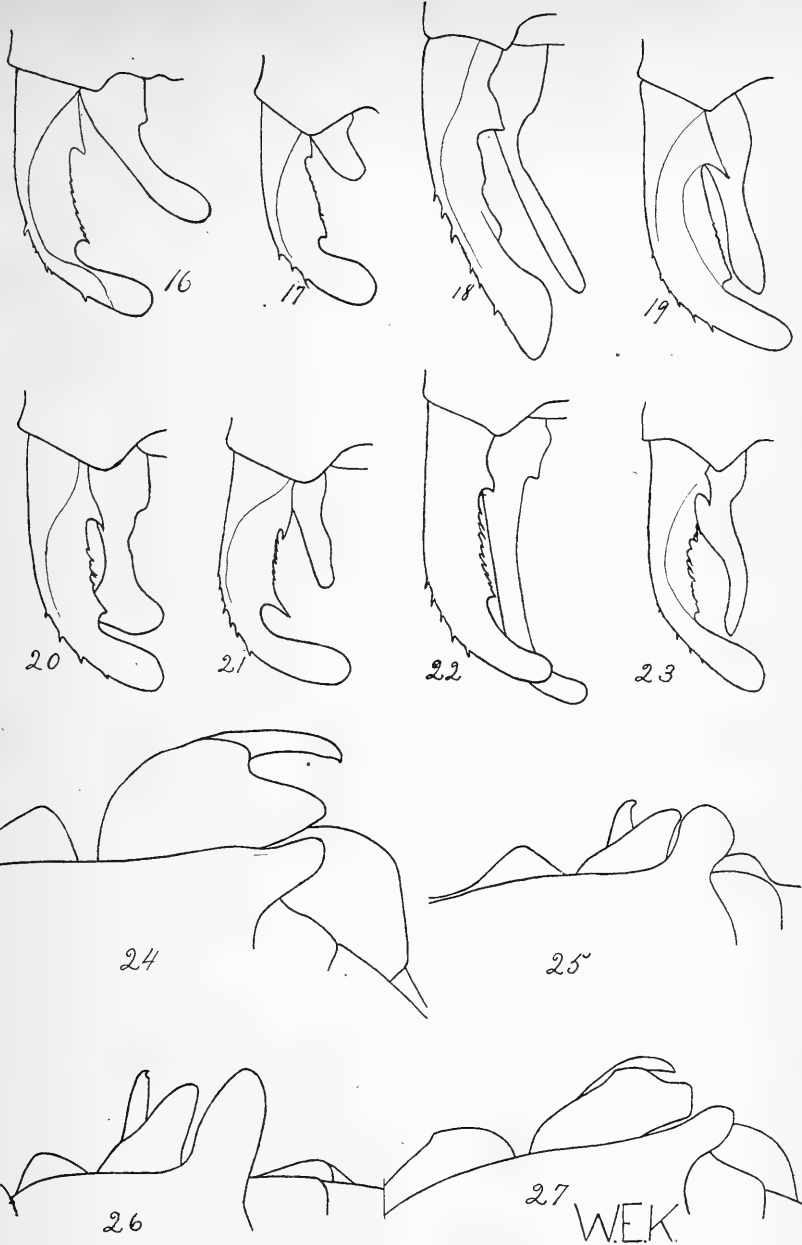
The Odonate fauna of Ohio is essentially rich in species and in the number of individuals. The great lake system on the north, and the Ohio River on the south afford favorable conditions for their life, and avenues for their approach from south-west and north-west; while our diversified area with its numerous rivers and morasses is not an unfavorable habitat. The number of living species listed for Great Britain is forty-five, for France seventy, and for all Europe one hundred and twenty. Still our Century of Odonates, it is supposed, represents a waning race; once, when the climate was more nearly tropical, the number was probably much greater. A question of equal interest is whether the results of the changes incident to civilization have produced a diminution of our resident species. There is an impression abroad that we have lost species in, for example, the present century; that some species cannot withstand the consequences of stream pollution, drainage of morasses, and the more inconstant character of the streams and ponds. There are no data for determining the question. It is the opinion of the writer that some few forms once residents are no longer within our limits, but that others have taken up their homes here at the same time; in fact it appears probable that the number has increased rather than diminished up to the present time.

The pronounced individuality of the Dragonflies has attracted the attention of people to them quite universally and strongly. This is shown by the awakened imagination shown in the many and often strikingly significant popular names. The Germans call them "*Wassernymphe*," the Dutch "*Scherpstekendevlieg*," the French "*Demoiselle*," the Portugese "*Mosca que da grandes picacas*," the Italians "*Saetta*," the English Dragonflies or Horsestingers, while in our own country we may have not only the English names but others quite as forcible; for example, "Spindles," "Mosquito-hawks," "Snake-feeders," "Snake-doctors," "Darning-needles," or to be more profane "Devil's darning-needles." These names most happily express the characteristics of these veritable dragons of the air and water. It has been said that "some of these names testify to the wide spread, but quite unfounded, belief in the harmfulness of these creatures to man." The writer recalls at least one grown person who truly believed they were harmful. This was a school teacher, who impressed upon him, and others of her charge, that the devil's darning-needles about the "old swimmin' hole" were dangerous, and that they were quite determined to sew up the ears of truants who sought the limpid waters and grass-covered banks of the millrace, rather than the hard and strict ways of the prosy school-room. This is the one "fact" of Natural History he remembers to have been taught him in the "district" school.



EXPLANATION OF FIGURES.

- | | |
|--|--|
| 1. Lateral view of ♂ abdominal appendages of <i>Enallagma exsulans</i> . | 8. Lateral view ♂ abdominal appendages <i>E. traviatum</i> . |
| 2. Same <i>E. aspersum</i> . | 9. Dorsal view ♂ abdominal appendages <i>E. traviatum</i> . |
| 3. Same <i>E. fischeri</i> . | 10. Lateral view ♂ abdominal appendages <i>E. hageni</i> . |
| 4. Same <i>E. signatum</i> . | 11. Same <i>E. geminatum</i> . |
| 5. Same <i>E. ebrium</i> . | 12. Same <i>E. divagans</i> . |
| 6. Same <i>E. doubledayi</i> . | 13. Same <i>E. pollutum</i> . |
| 7. Dorsal view ♂ abdominal appendages <i>E. aspersum</i> . | 14. Same <i>E. carrunculatum</i> . |

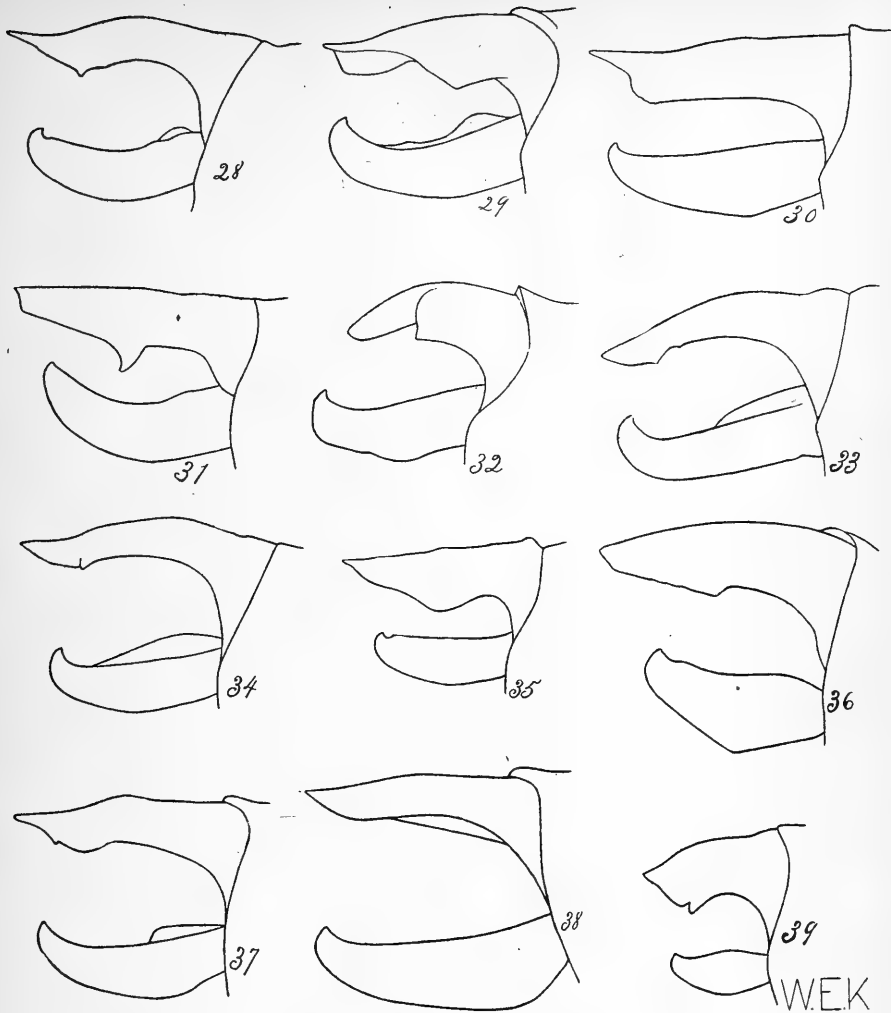


EXPLANATION OF FIGURES.

16. Dorsal view left ♂ abdominal appendages *Lestes disjuncta*.
 17. Same *L. congener*.
 18. Same *L. vigilax*.
 19. Same *L. forcipata*.
 20. Same *L. uncata*.
 21. Same *L. rectangularis*.
 22. Same *L. inaequalis*.
 23. Same *L. unguiculata*.

24. Lateral view external ♂ genital organs of second abdominal segment of *Diplax rubicundula*, as seen when the insect is turned upside down.
 25. Same *D. semicineta*.
 25. Same *D. vicina*.
 27. Same *D. obtusa*.

W.E.K.



W.E.K

EXPLANATION OF FIGURES.

- | | |
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| 28. Lateral view ♂ abdominal appendages <i>Gomphus fraternus</i> . | 34. Same <i>G. vastus</i> . |
| 29. Same <i>G. graslinellis</i> . | 35. Same <i>G. exilis</i> . |
| 30. Same <i>G. villosipes</i> . | 36. Same <i>G. plagiatus</i> . |
| 31. Same <i>G. spicatus</i> . | 37. Same <i>G. lividus</i> . |
| 32. Same <i>G. furcifer</i> . | 38. Same <i>G. spiniceps</i> . |
| 33. Same <i>G. externus</i> . | 39. Same <i>G. quadricolor</i> . |

The Systematic Place of the Odonata.

The orders of insects fall naturally into two groups: those having incomplete metamorphosis, *Heterometabola*, and those in which the metamorphosis is complete, *Metabola*. In the latter group of orders there are four sharply separated stages,—egg, larva, pupa and imago; in the former the changes incident to the period of adolescence are gradual, so that the larval and pupal stages are not sharply defined. The young continue active and feed from birth until the final change to imago. Such growing insects are called nymphs.

They are arranged by Professor J. H. Comstock, as follows:

Heterometabola.

Thysanura.
Ephemera.
Odonata.
Plecoptera.
Isoptera.
Corrodentia.
Mallophaga.
Euplexoptera.
Orthoptera.
Physopoda.
Hemiptera.

Metabola.

Neuroptera.
Mecoptera.
Trichoptera.
Lepidoptera.
Diptera.
Siphonaptera.
Coleoptera.
Hymenoptera.

Thus the Odonata or Dragonflies rank among least specialized insects; those most nearly related to the

primitive stock; to those orders having representatives at lower geological horizons than *Metabola*. They present, however, some contrasts and exceptions to those of related orders. In these the head thorax and abdomen are sharply separated as in *Metabola*. They are active, powerful and boldly predaceous. Their nymphs, as well as the adults, exhibit the malignant side of life that lived and sported about the marshes of the remote Tertiary Period.

LESSER GROUPS OF THE ORDER.

The Order *Odonata* is divided into two sub-orders :

I. *Zygoptera* in which both pairs of wings are similar and which in repose are held vertically; the males have two inferior abdominal appendages and the nymphs have three caudal gill-plates; and II. *Anisoptera* in which the two pairs of wings are dissimilar, in repose they are held horizontally; the males have one terminal inferior abdominal appendage, and the nymphs have no terminal gill-plates.

Our representatives of the Order may be arranged in the following lesser groups :

ORDER ODONATA.

I. SUB-ORDER ZYGOPTERA.

1. FAMILY AGRIONIDÆ.

- (1) Sub-family Calopteryginæ.
- (2) Sub-family Agrioninæ.

II. SUB-ORDER ANISOPTERA.

2. FAMILY ÆSCHNIDÆ.

- (3) Sub-family Gomphinæ.
- (4) Sub-family Corduligasterinæ.
- (5) Sub-family Æschninæ.

3. FAMILY LIBELLULIDÆ.

(6) Sub-family Cordulinæ.

(7) Sub-family Libellulinæ.

Key to the Foregoing Sub-families.

1. Wings alike, closed vertically in repose, eyes far separated.....2
Not as above.....3
2. More than two antecubitals.....(1) *Calopteryginæ*.
Only two antecubitals.....(2) *Agrioninæ*.
3. Antecubitals of the first and second series, not corresponding
throughout4.
Corresponding throughout.....5.
4. Eyes separated by a wedge-shaped occiput.....(3) *Gomphinæ*.
Eyes barely touching.....(4) *Corduligasterinæ*.
Eyes touching for a short distance.....(5) *Aeschninæ*.
5. Eyes tuberculated behind.....(6) *Cordulinæ*.
Eyes not tubercled.....(7) *Libellulinæ*.

THE FIRST SUB-FAMILY.

CALOPTERYGINÆ.

The species of this sub-family are among the most beautiful of dragonflies. Their bright metallic colors, their clouded and reticulated wings, their slender and graceful bodies at once attract attention. Their flight is not strong and they seldom wander far from the grassy borders of native pond or stream, where in turn they are to deposit their eggs and where their young are to be matured. While our species are few, most of them are common and occur everywhere; they belong to genera determined as follows:

1. Basilar space free, wings broad.....*Calopteryx*.
2. Basilar space reticulated, wings narrower.....*Heterarina*.

CALOPTERYX, Leach.

Only two species are known within our limits. Two different species—*C. elegans* and *C. dimidiata*,

have been taken in Kentucky and doubtless will yet be found on this side of the great river.

The species of the genus are arranged in two groups, thus:

1. Wings spatulate, *i. e.* anterior and posterior margins of the wings not parallel.
 - (1.) Wings uniformly velvety black, (brownish in young).
 - (2.) Wings hyaline basally, apical third or fourth blackish.
2. Wings not spatulate, *i. e.*, anterior and posterior margins nearly parallel.*

*No representatives as yet recorded from the State.

1. *Calopteryx maculata*, Beauvois.

Length: of hind wing, ♂ 28 mm., ♀ 30; of abdomen ♂ and ♀ 37 mm.

The males are metallic blue or green; the antennæ, under parts of head and thorax, legs, a broad humeral stripe, the thoracic sutures and under parts of the abdominal segments 1-7 are black; segments 8-10 and inferior appendages below are light—sometimes the black extends to 10 or even to the appendages. The wings are velvety black in the adult, some shade of brown in the young.

The superior appendages are forcipate, at base nearly cylindrical, narrowing to the middle at which they suddenly expand interiorly to the somewhat swollen and slightly decurved apex; the distal half bears several stout denticles on its outer margin. The inferior appendages are shorter, truncate, somewhat curved inward and upward, with a sharp incurved tooth at inner angle.

The females have the head and thorax similar to the males, but with more blackish shades and the abdomen brassy brown with a pale light or white dorsal band on 8-10, broader on 9 and often including a part of 7. Abdominal appendages nearly as long as 10, slender, pointed and black. The wings are similar

to those of the young males, often darker apically, especially on the hind wings; the pterostigma (absent in the male) is milk white, broad and reticulated; it varies greatly in size, but is always relatively broad.

This species is found throughout the State, and is abundant in most localities. It prefers small streams, especially the meadow-brooks and the clear, cool rivulets from springs among the hills. It also occurs by the borders of larger living waters where the banks are overhung by foliage. In this form, the male does not always seize the female with his feet previous to clasping her prothorax with the abdominal appendages. He flits about her, when at rest, gradually approaching, and, finally, the female not attempting to avoid him, he poises himself with sufficient accuracy to pick her up by the prothorax, when they fly away together. The female places her eggs among the rubbish and mud along the borders of the ditches.

In central Ohio it occurs from May 15 to September; it is most abundant in June.

It is perhaps true of all of this sub-family, but especially true in case of *maculata* that the males engage in fierce battles. Two combatants will fly about each other, evidently with consuming rage, when one finally appears to have secured a position of advantage and darts at his enemy attempting, often successfully, to tear and damage his wings. These battles often last a long time, until the participants are apparently exhausted. Sometimes a third and a fourth happen along and "take a hand" when the melee becomes general, each doing his utmost to damage any other that he can seize.

1. *Calopteryx æquabilis*, Say.

Length; of hind wing ♂ 32 mm., ♀ 33; of abdomen ♂ and ♀ 40.

The male is metallic green; the following black; the head except the clypeus, thoracic carina, a narrow humeral stripe, more or less on thoracic sutures, the legs and the abdominal appendages. The wings are hyaline, except the tips, with a shade of brown which is golden at certain angles, the tips are deep brown to black, as follows: the anterior with one fourth or one third black, irregular on inner border, the posterior with one third or one half straight within.

The superior abdominal appendages are forcipate, on the inner surface there is a sinus at the middle followed by a stout tooth, the apical portion is thick, apex obtuse, outer margin denticulate; the inferiors are shorter, stout, and straight seen from above, strongly curved upwards, the apex with an incurved apical hook; the surface of these organs is rough and in optical section appears serrate.

The female agrees closely in color with the male, the tip of abdomen becoming brownish with a light band on 8-10; and on sides of 5-10; there are light lines above the thoracic feet. The abdominal appendages are shorter than 10, stout, acute. The wings are lighter apically than in the male; the pterostigma is narrow, not reticulated, milk white.

Compared with *maculata*, *æquabilis* is a little larger, but more slender; the body is more decidedly metallic green; the male appendages are similar, but differ sufficiently, they are rougher, that is, the denticles are more numerous and stouter, the strong tooth on the inner curve is wanting in *maculata*, the inferior are straighter, stouter and rougher than in *maculata*. The wings besides their difference in color are not quite so spatulate; the pterostigma is very different.

Æquabilis has been taken thus far only in the central part of the state in the first of summer. Its habits appear to be similar to those of *maculata* except it has

not been noticed about rivulets, as it prefers the borders of larger streams.

HETÆRINA, Hagen.

As yet two only of the several charming species accredited to America have been taken in Ohio. Others, however, occur in states south and west, so there are still regional species that may be added. In habits they resemble *Calopteryx*; their bronzed body, narrow, hyaline wings with brilliant, basal areas in the males, at once distinguish them.

1. Tips of the wings, especially the anterior, brown; base of fore wings, crimson, hind, brown.....*tricolor*.
2. Tips of the wings of male not spotted with brown; base of both pairs crimson.....*americana*.

Hetærina americana, Fabricius.

Length; of hind wing, ♂ 28 mm., ♀ 30; of abdomen ♂ 36 mm., ♀ 32 mm.

In the males the head and thorax are coppery red, in the fully adult, in younger examples metallic green; the labrum and labium are pale with a black dot in the center of the former; the genæ and mid-dorsal carina are black; there is a white humeral line, a similar one on first lateral suture, a broader stripe at the second suture with the ventral surface and the posterior lateral border of the metathorax white; all the white lines and stripes are bordered more or less with black. The wings are hyaline with a shade of brown at the tips and with the basal fourth bright red except costa of fore wing: these basal patches are pale in the young on the front wings and brown on the hind ones. The pterostigma is very small, yellowish in the young, light brown in the fully adult. The dorsum of the abdomen is metallic green, becoming obscure and coppery with age, yellowish at the sides; the venter is blackish except on 1-2 and 9-10 which are yellowish, there are yellow-

ish narrow interrupted rings on 3-7, and a more or less distinct mid-dorsal, light line on 2-7.

The superior abdominal appendages are bifurcated, light below and darker above especially towards the apex; the outer surface is denticulate in the middle; there are two smooth horizontally flattened protuberances on the inner side, the proximal one is the larger, the rounded apexes of these processes are directed away from each other.

The inferior appendages are broad at base, then narrow and cylindrical, the truncated apex reaches to the larger tubercle of superiors and bears a stout denticle on its inner angle.

The females have the head, thorax and abdomen metallic green, the last becoming obscure with age. There are markings of other colors as follows; antennæ (except basal joints), a dot in middle of labrum, mid-dorsal carina, the tarsi, the outer side of legs and sternum black; the under side of head and thorax, sides of abdomen (except a dark apical spot), basal interrupted ring on 1-7, a mid-dorsal line on 1-10; basal joints of antenna, labrum, edges of the prothorax, humeral stripe and stripes on the side as in the male, white. The wings are hyaline, costa black, basal third and front margin pale yellowish brown. Pterostigma white, surrounded by black veins. The abdominal appendages and valves are yellowish, the latter tipped with black.

This brilliant gem is peculiarly restricted in its scene of flight. It is rarely observed more than a few feet away from its accustomed habitat, the water's edge. Another notable habit is that of congregating, sometimes in companies of hundreds. These assemblies commence in the afternoon and do not disperse until the warmth of the following day awakens them to activity. Both sexes take part in these assemblies and they rest so compactly that a single sweep of the net

may capture scores of them. A slender, drooping twig of the willow, loaded with these beautiful insects looks like a string of rubies and presents a beautiful picture.

The species occurs throughout Ohio, and it may be found from mid-summer until late in October by running waters, especially where the flow is rapid over rocks and pebbles and the borders are overhung by the spray of willows or coarse aquatic plants.

Heterina tricolor, Burmeister.

Length of abdomen ♂ 41, ♀ 35, of hind wing ♂ 30, ♀ 30.

Male deep blackish brown, thorax reddish brown, mid-dorsal thoracic carina black, humerals narrow, pale, yellowish apical rings on 1-4; legs black; wings hyaline, tips of all brown, more on hind wings; basal fourth of fore wing crimson, except between the first and second antecubitals, hind wings brown at base except hind margin; pterostigma nearly black, small.

Abdominal appendages black, less forcipate than in *americana*, as long as 10, exteriorly toward the apex there are coarse teeth, within at base a blunt hairy tubercle followed by a blade whose margin is first excavated, then convex and truncated distally; the inferiors are half as long, upturned apically with two terminal sharp tubercles.

The female is bronze green ornamented with pale buff. The face, antennæ, except terminal half which is black, and occiput buff; prothorax has the posterior lobe elevated and rounded in the middle, bordered with buff and with a geminate, orange spot in the middle and with a wash of the same at the sides; thorax green, mid-dorsal black stripe, buff either side uniting with humeral of the same color; sides buff with green spot on each ring; legs green and pale, tarsi black; wings flavescent throughout; ptero-

stigma white. Abdominal dorsum with green and pale and interrupted apical yellow rings on 2-7; ten with a dorsal carina and apical thorn; appendages conical pointed; valves short, dark.

This very handsome species occurs along the Ohio river and ascends the larger streams as far as the central district. It is not rare, but far less abundant in its range than *americana*. It flies much more rapidly than the other, otherwise its habits appear to be similar. It prefers the borders of streams where the flow is rapid.

THE SECOND SUB-FAMILY.

AGRIONINÆ.

This group includes the smallest dragonflies, in fact all Ohio species are small. Not so in tropical America, where representatives are known that are the most gigantic of living odonates.

Our feebler inhabitants of the river bottoms may be seen in numbers on any warm summer day flitting among the sedges of the shallows or busy placing their eggs among floating aquatics. They are not seen flying high in the air or patrolling the beach in search of mates or food, for they seek their kind and prey in the low thickets of aquatic foliage. Many are dull in color, many are brilliant; green, blue and yellow are favorite colors. All are graceful and charming.

The genera may be outlined and limited by the following synoptically arranged characters:

1. Median and submedian sectors arising nearer the arculus than the nodus.....*Lestes*.
Median and submedian sectors arising near the nodus.....2.
2. Bristles on the legs, long,—each about twice as long as the distance from the base of one to the next.....*Argia*.
Bristles on the legs shorter.....3.
3. No ventral spine at end of 8 in the female.....4.
A ventral spine at end of 8 in female.....5.

4. No postocular spots.....*Erythromma*.
 Two postocular spots.....*Nehalennia*.
 5. The tenth segment of the male a little prolonged above, the
 process bifid; pterostigmas on fore and hind wings of male of
 different color.....6.
 The tenth segment of male without the superior bifid process
 (Except in *exsulans* and *fischeri*). Pterostigmas on wings of
 male similar.....*Enallagma*.
 6. No postocular spots.....*Amphiagron*.
 Two postocular spots.....7.
 7. Pterostigma remote from the costa in the male.....*Anomalagrion*.
 Pterostigma normal in position in the male.....*Ischnura*.

LESTES, Leach.

In W. F. Kirby's Catalogue of the odonates of the world, thirteen species of *Lestes* are ascribed to the Nearctic region; of these, eight have been taken in the state and there is, at least, one more that is very likely a resident, viz: *L. urina* as it has been taken in Illinois and Pennsylvania

Our species belong to three groups, separated by the relative length of the inferior and superior abdominal appendages of the males:

1. Inferior pair shorter than half the length of the superiors,
congener, (urina).
2. The same more than half, but no longer than the superiors:
 - (1) Inferior appendages of the male sigmoid.....*unguiculata*.
 - (2) Same straight, abruptly widened apically.....*uncata*.
 - (3) Same not widened apically.....*disjuncta*.
 - (4) Same gradually and slightly widened, a little larger than *disjuncta*, two teeth on the inside of the superiors, basal one larger, (equal in *disjuncta*).....*forcipata*.
 - (5) Same long, bent downward apically, abomen of the male very long.....*rectangularis*.
 - (6) Same long, very slender not dilated apically.....*vigilax*.
3. The same longer than the superiors apex turned inward,
inæqualis.

Lestes congener, Hagen.

Length: of hind wing, ♂ 18-22 mm., ♀ 22 mm.; of abdomen ♂ 27-31 mm., ♀ 28 mm.

The general color of both sexes is blackish bronze. The labrum, anteclypeus, genæ, under side of the head,

a narrow humeral stripe (sides parallel) the prothoracic borders, mid-dorsal carina (obscure in some) the sides of the thorax and abdomen and stripes on the femora and tibiæ yellowish white. There are also whitish apical and basal interrupted rings on 2-7 of the abdomen and a trace of a mid-dorsal white line. segments 9 and 10, rear of head and under parts of thorax in the male are pruinose. The wings are hyaline, pterostigma reddish brown, covering two cells.

The male abdominal appendages are forcipate, longer than 10, reddish on the outside basally, otherwise black, denticulate externally, apex somewhat swollen; on the inner surface there is a strong pointed proximal tooth, followed by a sinus, this followed by a blade, the inner edge of which bears sharp teeth. The short inferior appendages are black with their obtuse apices turned towards the mid-line.

The female differs in having the mid-dorsal line of abdomen plainer than in the male; the humeral stripes wider and the pterostigma lighter. The slender abdominal appendages are light without and black within; the valves are light, with tips and lower edge blackish, serrate and narrow.

Congener probably occurs in the greater part of the state. It has been taken at Columbus in the fall only, flying well into October.

Lestes unguiculata, Hagen.

Length: of abdomen ♂ 28 mm., ♀ 27 mm.; of hind wing ♂ 19 mm., ♀ 21 mm.

The color of the head and thorax blackish bronze above, dorsum of the abdomen metallic green; the labrum, genæ, under parts of head and thorax, greater part of the sides of the latter, and humeral stripe yellowish. The wings are hyaline, pterostigma brown with the ends whitish; the coxæ are light, the femora and tibiæ, striped with light and black, tarsi black.

Abdominal segments 1-7 are light on the sides, while the last three are black or bronze throughout, there are narrow interrupted basal rings on 2-7.

The male abdominal appendages are forcipate, brownish at base, black apically, denticulate without, on the inner margin is a blade which is narrow concave at the inner margin and denticulate, this blade is preceded by a sharp backwardly directed spine; the inferiors are black, except on the under side of the swollen base, long and sigmoid.

The female has the appendages slender, reddish with black tips. Her colors differ little from those of the male; the humerals are more conspicuous and widest below, the rear of the head has a yellow band from eye to eye—obscure in old specimens; there is a faint mid-dorsal line on the abdomen, and both sexes are more or less pruinose when adult.

This species has been found very abundant in the northern parts, near the lake and in the central section. It is on the wing from mid-summer until October.

Lestes uncata, Kirby.

Length: of the abdomen ♂ 31 mm., ♀ 28 mm., of the hind wing ♂ 22 mm., ♀ 24 mm.

The color of both sexes is metallic green, becoming blackish on the last abdominal segments. The following are yellowish white: labrum, genae, clypeus anteriorly, labium, sternum and sides of thorax (except a blackish wash on sides of metathorax), a humeral line, mid-dorsal carina more or less in the female, the sides of 1-7, basal rings on the same, the coxæ, the femora interiorly, and the tibiæ exteriorly. The following are black: the tarsi, exterior of femora, interior of tibiæ apical rings on 2-9, the last two abdominal segments in the male, and the pterostigma which is terminated by white veins.

The female has the sides of the thorax clear yellowish and less black on the abdomen; the appendages are light and the valves black with light shade above; the basal half of abdominal ring 1 is yellow, and the basal rings on 2-7 are interrupted (not in the male).

The superior male abdominal appendages are much like those of *unguiculata*, while the inferiors differ totally, as they are straight with a broad terminal expansion, making them securiform when seen from above.

This species occurs in most parts of the state and in abundance; it appears during mid-summer.

Lestes disjuncta, Selys.

Length: of abdomen ♂ 30 mm., ♀ 28 mm.; of hind wing ♂ 20 mm., of ♀ 22 mm.

Head and thorax blackish brown, abdomen metallic green with the last three segments blackish. The following parts are yellow: lips, genæ, anteclypeus, mid dorsal carina, humeral stripes, sides of thorax, femora interiorly and tibæ exteriorly, sides of abdominal rings 1-7, and narrow, basal, interrupted rings on 2-7 of the female and young males, not discernible in adult males. The sides of the metathorax of the females is blackish, and in the males there is at least a dark wash at the second lateral suture. The humeral is wider in the female, and in both sexes it is narrower above.

The superior male abdominal appendages are black, forcipate, rather coarsely denticulate without, and with two equal acute teeth within, the edge of the blade-like piece between them is straight and serrate; the inferiors are reddish brown, straight, somewhat laterally expanded distally, and concave on the upper side or spoon shaped. The female appendages are of the usual shape, blackish within and at apex; the valves are light with a dark shade through the middle.

Both sexes are more or less pruinose on the rear of head, thorax, base and apex of abdomen.

This species is common and wide spread.

Lestes forcipata, Rambur.

Lenth: of abdomen ♂ 33 mm., ♀ 31 mm.; of hind ♂ 22 mm., ♀ 24 mm.

Color blackish bronze, abdomen brighter.

The following yellowish or greenish white: anteclypens, labrum, genæ, labium, sternum of the thorax, coxæ, stripes, alternating with black upon the legs, thoracic carina, borders of the prothorax, sides of the thorax, abdominal joints, and basal interrupted rings on 3-7. The humerals in both sexes are wide, narrower above. The pterostigma is large, blackish brown with the veins at the end whitish. The ninth segment of the male is conspicuously pruinose.

The superior abdominal appendages of the male are reddish outwardly at the base, otherwise black, forcipate, with a few coarse teeth on the outside, within a blade preceded by a stout tooth and terminated by a prominent angle, the blade is followed by a deep rounded sinus. The inferior appendages are reddish, somewhat expanded distally and slightly curved inwards. The appendages of the female are light without and dark within; the valves are black on the lower border and light above.

The species is easily separated from *disjuncta* by its larger size, by the unequal teeth at the end of the lamina of the male abdominal appendages, by the wider humeral stripes about equal in the sexes and by the fact that the inferior male appendages are widened before the apices.

Taken commonly at Columbus, April 24, 1896. Also at Sandusky in June.

Lestes rectangularis, Say.

Length: Abdomen of ♂ 40 mm., of the ♀ 33 mm.; hind wing ♂ 22 mm, ♀ 23 mm.

Head, thorax, and abdomen of the female above and the last four abdominal segments of the male blackish brown: the abdomen of the female is sometimes greenish bronze with a mid-dorsal light line on 1-2 or 3. The anteclypeus, lips, genæ, under parts of the head and thorax, the thoracic carina, humerals, and sides of the thorax are yellowish or greenish white. The legs are pale with black as follows: a narrow stripe (may be wanting) on the exterior of the second and third femora; two on the first pair; also on the inner side of first tibiæ, the ends of the tarsal joints and the claws are brownish. In the female the stripes on the legs are wider and the tarsi blacker than in the male. In the male the top of 1 and 2 are brown; 3-6 testaceous with basal lighter rings and apical darker ones. In the female 1-10 are yellowish on the sides, the same extending over the dorsum as narrow basal rings on 1-6. The superior appendages of the male are testaceous, blackish on apical third, forcipate, no denticles out side; the lamina on the inside is short with long and slender, terminal and minute marginal teeth. The inferior appendages are black, exceeding the lamina of the superiors and bent downward at the end. The appendages of the female are slender, conical, testaceous, tips black. The valves are narrow and black below.

Rectangularis occurs abundantly in all parts and may be recognized by the very long male abdomen and pale color of body and legs.

Lestes vigilax, Hagen.

Length: of abdomen ♂ 40 mm., ♀ 37 mm.; of hind wing ♂ 26 mm., ♀ 27 mm.

Bright metallic green obscure towards the end of the abdomen, and covered by pruinose on rear of head, thorax, base and apex of abdomen in the fully adult.

The males are marked with black, yellowish and bluish white as follows: white—genæ, lips, under parts of thorax, irregular bands before the lateral sutures, humeral line (often faint), in some the edge of the carina, coxæ, trochanters, more or less of the inner side of the femora, and pleuræ of abdominal joints 1-6; black—legs and feet except as mentioned above, antennæ, mid-dorsal thoracic carinæ (its edges sometimes light), and the superior abdominal appendages. The pterostigma is yellowish in both sexes, surrounded by black veins and covers about three cells.

The female differs from the male in having wider humeral, and carinal yellowish stripes, sides of thorax yellow, the light on the femora more pronounced, the light of the abdominal pleuræ extending over the dorsum as narrow basal rings, and the greater part of 9 and 10 yellow,

The superior male appendages are long, less curved than in the preceding species, the ends are somewhat enlarged and obliquely truncated. The blade of the inner side is preceded and followed by a tooth, its edges are not straight but coarsely crenated. The inferior appendages are pale, very slender, and reach nearly to the end of the superior, they are slightly bent inwards at apex. The appendages of the female are yellow, the valves of the same color.

This slender species is very active and graceful in its movements. It has been recorded only for the lake district. In the marshes at Sandusky Bay it occurs in immense numbers.

Lestes inequalis, Walsh.

Length: of abdomen ♂ 39 mm., ♀ 37; of the hind wing ♂ 27, ♀ 28.

Metallic green, with the last three abdominal joints blackish. The markings of yellow or bluish white are as follows: male—anteclypeus, lips, genæ, rear of head, under parts and sides of thorax below, an exceedingly narrow stripe on the carina and humeral suture, two stripes on the femora, most of the tibiæ and the pleuræ of the abdominal segments; there are very narrow basal rings on 3-7. The antennæ, tarsi and stripes on tibiæ and femora are black. The pterostigma is dark brown covering two to three cells. The female differs in having more black upon the legs, the humeral and carinal stripes wider.

The male abdominal appendages are black; the superiors are forcipate with a few spines on the outer curve, within a stout acute tooth precedes the usual blade which is narrow, the edge curved and serrate. The inferiors are slender and strongly bent inwards at apex. The anal appendages of the female are slender, rather long and blackish in some examples, light in others; the valves are narrow and black except on the upper bordèr.

This beautiful species is quite as active and wary as *vigilax*, which it closely resembles, it is easily separated however; the males by their peculiar inferior appendages, bright yellow sides of thorax and absence of humeral strips; the female by the yellow rear of the head, bright yellow on sides of thorax, darker valves and pterostigma and the narrower humeral stripes (sometimes wanting as in the male).

It has been taken only in northern localities.

ARGIA, Rambur.

The species of this genus differ only slightly from those of other genera following, yet they have a "personality" that no observer can long fail to appreciate. They prefer the brook-sides and some of the species rarely wander to other localities; the nymphs live in the

clearer, running waters; to this there is one exception, the young of *putrida* live also in deep water of Lake Erie, and the nymphs swarm about its shores and islands.

Our five species fall into the two groups defined by the number of cells covered by the pterostigma.

- A. Pterostigma covering more than one cell (one and a part of another).....*putrida*.
 B. Pterostigma covering one cell; males as follows:
- (1). Violet and black, 8, 9 and 10 violet; inferior appendages thick, much longer than the superiors and slightly notched...*violacea*.
 - (2). Bluish and black; 9 and 10 blue; inferior appendages longer than the superior, apex bifid, upper branch longer*tibialis*.
 - (3). Light blue and black; 8, 9 and 10 blue; inferior appendages bifid, branches equal.....*apicalis*.
 - (4) Deep blue and black ; 8, 9, and 10 blue; inferior appendages longer, strongly bifid, branches divaricate, lower longer, stout, *sedula*.

. *Argia putrida*, Hagen.

Length ; of abdomen ♂ 33, ♀ 31 ; of hind wings ♂ 24, ♀ 25.

The young are clay colored to light brown, the older males are darker to black obscured by pruinose especially on the head, thorax and segments 9 and 10. Three pale antehumeral stripes, also one on the sides of thorax and narrow pale basal rings on 3-7. Segments 8-10 are somewhat thickened with the last excised, sides of the excision thickened and produced backwards into rounded tubercles. The abdominal appendages are very short, black, the superiors are flattened, obliquely rounded at the end with two teeth on the lower and outer side, one at the lower inner apex, the other on the outer middle face, there is a sulcus between them ; the inferiors are much wider vertically, beveled to an irregular tuberculate edge posteriorly and terminating above in finger-like projection that lies between the tubercles of the superiors.

The young females have a similar coloration to the young males. The fully adults are light blue marked

with black as follows : antennæ, lines about the vertex and frons, lines on the sides and edges of prothorax humeral and second lateral sutures and dorsum of the abdomen. The blue of the sides extend as basal rings on 3-7; ten is blue. The appendages are pale, short and blunt; the valves short, pale smoky below, serrated.

Putrida occurs throughout the State, in vast numbers along Lake Erie and about the islands; it often comes on ship-board far from land. It flies from May to October. The female, usually attended by the male, oviposits on submerged timbers and moss, and alga-laden stones. It is not uncommon, to see the female and her consort descend beneath the water and to remain submerged for what would appear to be a long time.

The following observations were made one day on its habit of ovipositing under water. Five pairs were noted on a timber of a dock; they were from barely covered to six inches under water; the following notes were made at the time.

PAIR 1. ♂ abandoned ♀, emerged and flew away after five minutes, ♂ remained one hour.

PAIR 2. ♂ abandoned ♀ in seven minutes, ♂ remained fifty-five minutes; after exposure to the air for a short time she returned beneath the water for fifteen minutes.

PAIR 3. ♂ remained submerged twenty minutes, ♀ thirty; she flashed her wings and immediately returned for twenty-five minutes.

PAIR 4. They were disturbed, emerged and flew away together.

PAIR 5. They were seen to alight on the dock just above the water and slowly back down until they were covered.

Argia violacea, Hagen.

Length: of abdomen ♂ 26, ♀ 25; of hind wing ♂ 20, ♀ 21.

The color of the adult male is violet ornamented with black as follows: antennæ, dorsum of prothorax in part, mid-dorsal and humeral stripes, the latter bifid beneath the wings, the upper part of the first and the whole of the second lateral sutures, stripes on femora and tibiæ, the sides of 2, apical lateral spots extending as rings on 3-6, all of 7, the abdominal appendages, the venter of the abdomen (widest on 8-10). The sides and venter of thorax, coxæ and greater part of legs pale. The pterostigma of both sexes is light yellow or brown. Wings slightly fumose.

The female has the violet less bright than the male, the younger ones clay colored, the black on sides of dorsum of 2-6 is in bands rather than spots leaving basal rings, however, there is a mid-dorsal line on 7.

In the males 10 is excised as in *putrida* but the posterior angles are not knoblike but sharp. The superior appendages are short, in profile the sides are parallel and the apex rounded, from above they are broader with apex obliquely truncated, beneath they are excavated apically with a stout curved process at the inner angle; the concavity contains a tuft of hairs. The inferiors are much longer and deeper, bifid with the upper, pointed, larger prong directed towards the superiors; the lower, rounded one is directed downward.

The appendages of the female are pale, short, blunt and the valves are also pale and serrate.

The species is common along the borders of ditches and streams. Oviposition takes place as in other *Argias*—often in pairs, on submerged plants and rubbish. It is everywhere its proper habitat is found, occurring in mid summer.

Argia tibialis, Rambur.

Length: of abdomen ♂ 27, ♀ 27; of the hind wing ♂ 21, ♀ 22.

Color bronze black variegated with lilac or blue as follows: frons, clypeus, lips, broad stripe each side of thoracic dorsum; sides of thorax with second lateral suture black, more or less of sides of 1-7 more in female, with basal yellow rings on 3-7 in both sexes, the dorsum of 9 and 10 in the male. The legs have more or less of pale, pterostigma dark brown.

The male has 10 incised as in the preceding species, although not so deeply and the sides of the incisions are more nearly vertical. The appendages are short; the superior at first cylindrical then apically divided by a deep groove extending obliquely across it, the upper branch is wide, apex rounded, in profile somewhat wedge shaped, the lower is pointed and recurved downward and inward. The inferiors are stouter, longer, bifid, the upper stouter branch is pointed, the point reaching the groove in the superiors, the lower is smaller situated on the inner side of the former and points downward.

The appendages of the female are very short and blunt, the valves short and broad, dark in color.

This species is not common but has a wide range.

Argia apicalis, Say.

Length: of abdomen ♂ 31, ♀ 30; of hind wing ♂ 23, ♀ 25.

The male is pale blue with black marks as follows: Antennæ, vertex, prothorax except a blue spot each side, inferior humeral, mid dorsal carina, dorsum of 1-6 (the same extends on 3-6 as an apical ring) and the whole of 7. There are basal light rings on 3-7 and an imperfect mid-dorsal on 1-6

The female is light brown until fully adult, then as blue as the male. Her markings differ slightly: the inferior humeral is small or wanting, there is more black on the abdomen, the legs are paler, and the pterostigma lighter.

The superior appendages of the male are short; in profile they are narrow, end rounded, within there are two long teeth, the inner longer, obtuse, the outer acute, they are turned downward and outward toward the inferiors. The inferiors are much longer and stouter, equally bifid, the lower branch conical, the upper stouter, more pointed.

The female appendages are light in color, of the usual form. The species is not uncommon on the rocks along the larger streams. In no other of our species are the sexes so nearly similar.

Argia sedula, Hagen.

Length: of abdomen ♂ 26, ♀ 26; of the hind wing ♂ 18, ♀ 20.

The male is black, marked with deep blue. The frons, clypeus, labrum, postocular spots, the sides of the prothorax and a spot each side of its dorsum, antehumeral stripes, the sides of the thorax (divided by a black line on second suture) stripes on femora and tibiæ (pale like sides of thorax) the sides and apex of the first abdominal ring, the sides, two basal dorsal spots on two, basal rings on 1-7, the whole of 8-10 and sides of 3-7. The wings are slightly fumose, pterostigma light brown.

The female is clay colored and light olive, differing totally in appearance from the male; her wings are a little more fumescent and the stigma lighter.

The superior male appendages are longer than those of the preceding species, and are somewhat curved within, the ends are rounded with a pointed tooth on the lower inner angle and another on the

outer side acting as a stop as it impinges against the edge of 10. The inferiors are much longer, strongly bifid; the upper branch smaller, rounded, the lower stout, directed downward and backward, the edges are strongly denticulate, and the apex acute.

The appendages of the female are rather long and slender, the valves narrow, light colored.

The handsomest of our *Argias*, is rather common along larger streams in the southern part of the state.

ERYTHROMMA, Charpentier.

The single North American species of this genus occurs sparingly in this state; indeed it may be considered as rare.

Erythromma conditum, Hagen.

Length: of abdomen ♂ ♀ 28; of hind wing ♂ 20, ♀ 23.

The general color is black in both sexes, marked with blue and yellow in the male, as follows: blue, front of head (except postclypeus) labium, anterior border and spot on sides of prothorax, a wide humeral sinuous within, a mid-band on sides and thorax, stripes on the femora and tibiæ, the sides and apical rings on 1 and 2, interrupted basal rings on 3-7, and the whole of 8 and 9; yellow, labium and posthumeral (pale,) and the sides of the metathorax (bright). The female differs in having more black and paler blue on the head, the sides of the thorax with more and deeper yellow, the blue humeral narrower and paler, the first abdominal has a small square basal, black spot with sides and apical ring blue, the dorsum of 2-10 black, except the interrupted basal rings.

Pterostigma of both sexes yellowish brown. Posterior border of the prothorax in ♂ entire, in ♀ with five small lobes.

The superior abdominal appendages of the male are as long as 10; somewhat thicker at base then excavated within, curved inward at apex, which ends in a sharp point; in profile it is slightly narrow at base, and apically decurved. The inferiors are shorter in profile, wedge shape, from above broadened within at the end, making the outline securiform. The appendages of the female are slender, pale; the valves are short and narrow, also pale.

NEHALENIA, Hagen.

This genus consists of few and elegant species, perhaps none of the family are more beautiful. Three are known within the limits of the United States; two of these occur abundantly in Ohio.

The two species differ as follows:

Metallic green and blue.....*irene*.
Bronze, black and yellow.....*posita*.

Nehalennia irene, Hagen.

Length: of abdomen ♂ 20, ♀ 21; of hind wing ♂ 13, ♀ 15.

Metallic green marked with yellow or yellowish white as follows; post clypeus, genæ, borders of the labrum, labium, underside of head, sides of thorax posteriorly, under sides of abdomen, and narrow interrupted basal rings on 3-6. An apical spot on 8 the dorsum of 9 and 10 blue. The legs are whitish with black lines; tarsi ringed. Pterostigma pale yellow.

The female differs from the above in having the yellow a little deeper, and that on the sides of thorax, and

abdomen somewhat broader. The sides of 9 and 10 are bluish, there is more or less of an apical spot on 8 and the posterior border of 10, both blue. The green on 7-10 both sexes is obscured with blackish.

The posterior border of the prothorax of the male is faintly lobed; on either side there is a shallow sinus and in the middle a broad process with its upper border sinuate. That of the female has three large, round lobes, subequal, the middle rounder

The posterior border of 10 is excised, denticulate in the male. The superior appendages are very short, black, with two branches; the upper outer one is broad, obtuse, hairy; the lower more cylindrical, slenderer, apex obtuse; these branches are somewhat twisted on each other like the parts of the beak of the cross bill; the lower branch appears to be movably articulated to the upper. The inferior appendages are a little longer, turned upward and inward ending in a black denticle. The female appendages are short, thick, cones, yellow; the ovate valves are yellow with black processes.

It occurs about cool springs and streams of cool quiet water in mid-summer.

Nehalennia posita, Hagen.

Length: of abdomen ♂ 19, ♀ 19; of hind wing of ♂ 12, ♀ 14.

Blackish bronze marked with bright yellow or greenish yellow. The anterior border of the frons, base of antennæ, genæ, anterior half of labrum, under parts of head, humeral stripe which is interrupted, sides of thorax, anterior border and sides of prothorax, legs, under parts and sides of abdomen, apical ring on 1, basal rings on 2-7, and geminate basal spot on 9 yellow.

The postocular spots are round and greenish yellow; the second lateral suture is black; there are also black stripes on the legs and rings on the tarsi.

The female has the marks a little paler than the male.

The tenth segment of the male is short, posterior border with a forked upturned process. Superior appendages very short, yellow, thick above, a tooth at the superior angle (upper branch), the organ then turns downward and inward, becoming thin below and ending in an obtuse angle. The inferior appendages are about the same length, arise from a thick base, then narrow to a hand-like termination, the fingers of which are represented by five corneous denticles. The appendages and valves of the female are yellow, the processes short and dark.

This pretty species appears early and remains until late in September. It is abundant throughout the state.

AMPHIAGRION, Selys.

This is a genus of one species; one that ranges from equatorial America, at least as far north as Lake Erie and on the Atlantic Coast to Maine. In central Ohio it is extremely common about runs from springs. It occurs throughout the state.

Amphiagron saucium, Burmeister.

Length: of abdomen ♂ 18, ♀ 17; of hind wing ♂ 14, ♀ 15.

Red and dull black. Male, top of head black, anteclypeus, genæ and labium red, under parts of head, thorax and legs pale reddish, the latter with or without faint black lines; upper part of prothorax and thorax black; pterostigma reddish; segments 1-6 wholly red, 7 partly, the rest entirely blackish. Female, head as in the male except the black gives place to reddish on the rear; thoracic dorsum with a

broad stripe of black abdominal rings 3-9 with more or less black apically above, 10 reddish. All colors paler.

The posterior border of ten in the male has a deep round sinus; the appendages are about equal to 10, the lower longer than the superior; the superior has the upper branch prismatic, short, ending within in a stout denticle; the lower branch is finger-like in profile, turned down, obtuse, from above the two are lyre-shaped. The inferiors have a thick base and taper to an obtuse angle, sides straight. Both are rufous. The female appendages are short cones, rufous, the valves narrow, pointed, the processes short and rufous.

It is not unusual to find examples of females much larger than the average given above.

ENALLAGMA, Charpentier.

This genus comprehends moderate sized species of singularly varied and beautiful colors and our fauna is comparatively rich since thirteen species have already been captured within the state. They appear to take the place occupied by Agrions in Europe. Several of these charming and abundant forms appear early in the season, and representatives of the genus are abroad until late in September.

The species may be arranged in two groups or divisions on obvious characters, as follows;

1. Males with an apical spot* on the dorsum of the second abdominal ring; female with the dorsal band the entire length of 2.
2. Dorsum of 2, in both sexes, with a band; in the female 10 is blue or green.

*Individuals in certain species of this division have this spot covering much of or the whole of the dorsum of 2; but anteriorly it is always narrow

FIRST DIVISION.

The species of this group are all blue or green and black, or greenish and pale when teneral. They have three antenodal cells (Selys) and can be most easily separated by the character of the abdominal appendages of the male seen in profile:

- (1). Superiors with two equal branches, separated by a deep rounded sinus; inferiors as long.....*ebrium*.
- (2). Superiors as long as 10, the upper branch long, decurved apically, lower very short directed downward; the slender inferiors reaching the lower branch of the superiors
aspersum.
- (3). Superiors longer than 10, the upper branch more slender than in *aspersum*, the lower directed downwards and inwards: the inferiors reaching nearly one third of their length beyond the lower branch of the superiors.....*traviatum*.
- (4). Superiors exceeding half of 10, broad, excavated at distal extremity, sinus occupied by a large, pale, tubercle, lower angle (branch) prominent.....*civile*.
- (5). Superior appendages similar to the last, a little shorter, less wide apically in profile, the lower angle not so prominent
carunculatum.
- (6). Superior appendages short, wedge-shape, slightly curved upward at apex; inferiors decidedly longer, upper edge straight,
hageni.
- (7). Superiors relatively somewhat longer than in the last, base thick, apex turned down and within; inferiors slightly exceeding them.....*geminatum*.
- (8). Superiors short, upper branch short, distally rectangular, lower branch longer, directed upwards, obtuse; inferiors as long as upper branch.....*doubledayi*.

SECOND DIVISION.

The species are blue and black (*exsulans* and *divagans*) and orange or green and black (*signatum*, *pollutum* and *fischeri*.)

They are separable as in the former group by profile view of the male abdominal appendages.

- (1). Superiors half as long as 10, two branches, upper thick, lower longer, slenderer, sinus deep; inferiors acute, as long as upper branch of superiors.....*exsulans*.
- (2). Superiors less than half of 10, scarcely divided, upper part thick and rounded, lower slender directed downward; inferiors a little longer.....*divagans*.

- (3). Superiors more than half of 10, two widely divaricate branches, the upper thicker, slightly longer; inferiors a little shorter than the inferior branch of superiors.....*fischeri*.
- (4). Superiors longer than 10, end obliquely truncate with a tooth (lower branch) at outer third; inferiors slender.....*signatum*.
- (5). Superiors shorter than 10, securiform; inferiors as long as lower angle of superiors, very slender.....*pollutum*.

Enallagma ebrium, Hagen.

Length: of abdomen ♂ 25, ♀ 23; of hind wing of ♂ 17, ♀ 18.

The male is bright blue marked with black. The occiput, vertex, antennæ, and postclypeus are black; occipital spots large ovate and connected, the prothorax has a line on sides, posterior border and an ovate spot each side blue; thorax with a broad mid-dorsal, humeral and greater part of legs black; black on abdomen as follows: square basal spot on 1, apical spot and ring on 2-6 (these spots are successively larger, pointed anteriorly and occupy from one fourth to one half of the dorsum of the joints), the whole of 7 and 10, and the appendages. The female differs in the ground color which is yellowish green, the black markings of head and thorax are similar to those of the male, the legs are lighter, the pterostigma is light yellow, the entire thoracic dorsum is black except interrupted basal rings on 2-7.

The superior male appendages from above are divaricate, curved toward the middle-line and have a pointed hooklet just before the end within; in profile bifid, the upper branch straight, stout, obtuse; the lower narrower curved down then up making the sinus broad and rounded. The inferiors are as long as the superiors, curved slightly upward and inward, they are blue at base then black.

The female appendages are stout, about the length of 10, pale and the valves including the process yellow. The black sternal line includes the ventral spine of 8.

This species is exceedingly abundant along the marshy borders of Lake Erie. Common in June, by the end of July pretty rare. The female oviposits among floating *Utricularia*, algæ and stems of aquatics.

Enallagma aspersum, Hagen.

Length: of abdomen ♂ 25, ♀ 24; of hind wing ♂ and ♀ 18.

Male, blue and black; head black, front and rear blue, there is a black line at the base of the labrum and a broader one between the frons and clypeus; prothorax black, sides posterior border and triangular spot each side the dorsum blue; thorax blue with a moderately wide mid-dorsal and humeral stripe black; tarsi black, legs striped with black and pale blue; pterostigma black; abdomen blue with much black as follows: basal quadrate spot on dorsum of 1, a shield-formed apical one on 2 with apical black ring in connection with it, apical two thirds of dorsum of 3, entire dorsum of 4-6 except narrow interrupted basal rings, basal half of 7 and dorsum of 10. Female has the blue lighter, large ovate occipital spots, more black on the front of head, prothorax with very little blue, dorsum of 1-10 more or less black, apical blue ring on 1, basal interrupted ones on 2-6, large oblong blue patch covering basal two thirds of each side of dorsum of 7, and much smaller ones similarly placed on 8. Pterostigma lighter.

The superior appendages of the male are black divaricate, nearly as long as 10, curved inwards with an internal hooklet before the obtuse end; in profile the upper branch has the end rounded obliquely and capitate; lower branch short, directed downwards and backwards, apex turned inwards. Lower appendages directed upwards, as long as the lower branch of superiors. The appendages of the female are black cylindrical, ends obtuse; the valves are narrow, pale, with the processes black.

This pretty species has been taken on the herbage about ponds, and flying over water, in central and northern Ohio in May and July.

Enallagma traviatum, Selys.

Length of abdomen ♂ ♀ 24; hind wing ♂ 17, ♀ 18.

Male blue and green. Head green, sometimes appearing blue, black as follows: stripe connecting the bases of the antennæ and the anterior ocellus, a stripe behind the ocelli produced laterally and divided on a level with the antenna sending one branch to the antenna and another to the compound eye, this latter is continued backwards along the margin of the eye and returned on the posterior part of the head and so surrounds the postocular spot on each side; a stripe connecting the ocelli, a dash in front of the anterior ocellus and a small point each side on labrum. Thorax with a mid-dorsal stripe composed of three fine lines and a humeral stripe, black. Legs pale, in most specimens a black line on the outer side of all the femora, abdomen blue, dark green as follows; an angular dorsal spot on 1, a patch strongly widened posteriorly and an apical ring on 2, whole dorsum, strongly narrowed or interrupted at base, on 3-7, a triangular basal patch on 8 and the whole dorsum of 10. In dry specimens these colors become faded and their outlines are hard to follow. The superior appendages of the male are much like those of *aspersum*, but are slightly longer and narrower; the inferior branch on each side is produced downward and inward towards the middle line so that the apices are separated only by about the width of the superior branch. The inferiors protrude about one third of their length beyond the apices of the inferior lobe of the superiors.

The female is colored similar to the male, but the following are noticable differences. The three fine black

lines forming the mid-dorsal thoracic stripe are separated by pale yellow, the dorsal patch on 8 is longer, reaching more than half the length of the segment, and the whole dorsum of 10 is blue.

The males are separated from those of *aspersum* by coloration of the abdomen. In the latter species one-half of 7 and all of 8 and 9 are blue, while in *traviatum* only 8 and 9 are blue.

The females of *aspersum* have a blue patch reaching three-fourths the length of 7 on each side, and a round spot on each side of the base of 8, blue, while *traviatum* has 8, 9 and 10 blue with the exception of the dark green basal patch on 8.

The species has been taken at Cincinnati (Dury) and at Akron in June. Seemingly common in various parts of the State.

Enallagma civile, Hagen.

Length: of abdomen ♂ 26, ♀ 28; of hind wing ♂ 19, ♀ 21.

The male is blue and black. Head with blue, as follows: large postocular spots, genæ, transverse stripe on frons below, clypeus except a black line at base of post-clypeus and labrum; the prothorax has the posterior edge blue; the legs are striped with pale blue and black, the tarsi faintly ringed with dark at distal ends of joints; pterostigma dark brown; abdomen with black as follows; square dorso-basal spot on 1, apical shield and ring on 2 occupying half the dorsum, apical third of 3-5, half of six, all of 7 except basal interrupted ring and the dorsum of 10 including the appendages.

The female differs in having the blue ground color usually paler, some individuals remaining with the pale or brownish teneral color, more black on the head, and the dorsum of all the abdominal segments black.

The male abdominal appendages from above are about the length of 10, divaricate, compressed, obtuse with a small denticle before the end on the inner side; in profile wider apically excavated, lower angle, (or branch) prominent, nearly as long as the upper slightly decurved branch, projecting from the apical excavation is an ovate, pale tubercle, the organ is slightly constricted at the middle. The lower appendages are curved upward, attaining the lower angle of the superior appendages.

The female appendages are rather long cylindrical, pointed; the valves ovate narrow, processes black.

This beautiful species appears to occur throughout the state and to be common in June especially south.

Enallagma carunculatum, Morse.

Length: of abdomen ♂ 27, ♀ 27; of hind wing ♂ 20, ♀ 21.

This species closely resembles the preceding so closely, indeed, that both have stood under one label in the cabinets of specialists for years until Morse separated them by naming and defining the present species in 1895. Now that the differences have been pointed out, the wonder is that experts could have united them. The females are distinguished with more difficulty than the males.

The males are separated readily, first by dorso-abdominal spots and second by the abdominal appendages. In *carunculatum* the apical black on rings 2-7 covers two thirds their length, in *civile* only one third; again the superior appendages are shorter, less compressed, hence more nearly cylindrical, the apex less spreading so that the tubercle which occupies the sinus is not so broad vertically, the tubercle is different in shape being narrow and curved like a new moon with rounded ends, and it lies in a groove on the inner lower face of the appendage.

Carunculatum is equally or even more abundant than *civile* especially in the northern parts of the state where lakes and reservoirs abound. It has been noted in myriads about Mercer county reservoir and at Sandusky Bay in July. At the latter place *civile* becomes common and practically disappears while *carunculatum* is numerous. It remains late in the season after most other species of the genus have disappeared.

Enallagma hageni, Walsh.

Length: of abdomen ♂ 13, ♀ 24; of hind wing of ♂ 16, ♀ 17.

The male is blue and black; head black above, while the genæ, labrum, anteclypeus lower border of frons, and long and narrow postocular spots are blue; prothorax black with posterior edge pale blue, mid-dorsal and humeral stripes black; legs bluish, femora and tibiæ black outwardly, tarsi dark at the articulations, pterostigma black. The dorsum of abdomen is black, as follows: a square basal area on 1; a round apical with ring on 2, apical one-third on 2-4, one-half of 5-6, all of 7 except interrupted basal ring and all of 10, including the appendages.

The tenth ring of the male is deeply excavated, the superior appendages are half as long as 10 depressed, quadrangular seen from above, apical side slightly concave with a soft tubercle projecting slightly beyond, making the outline somewhat convex, inner side with broad process at base, then concave to the angle which projects slightly inward, the outer angle is slightly rounded. On the upper surface there is a diagonal ridge from the inner apical angle; the inferiors are longer than superiors and forcipate; in profile the depressed superiors are curved upwards somewhat apically; the inferiors are straight on the upper border, apex slightly up-curved, lower border first convex, then concave then

convex. The surface of both appendages are tuberculate, more marked on the inferiors.

Hageni has been taken in few localities and always about ponds and "cat holes"; it must be regarded as uncommon or rare.

Enallagma geminatum, Kellicott.

Length; of abdomen ♂ 20, ♀ 19; of hind wing ♂ ♀ 15.

Male. Head: labrum and brows blue, clypeus and vertex black, post-ocular spots cuneiform, not connected, blue; prothorax black edged with blue, scarcely bilobed. Thorax black above with a blue stripe each side (this is sometimes divided as in *N. posita*); sides blue with a black line on the suture. Wings hyaline, pterostigma black; legs black and pale, tarsi black. Abdomen brassy black, blue as follows: 1, apical ring and a lateral spot connected with it; 2, a basal ring interrupted dorsally, this ring is sometimes very wide and the interruption also, there is a lateral stripe connected with the ring; 3-6, basal interrupted rings; 8-9, wholly; abdomen beneath pale blue with brown shades apically; the abdominal appendages are black, agreeing very closely in form with those of *divagans*; they are relatively stouter, and from above the outline is more oblong; there is a sharp tooth on the lower edge of the inner face, the upcurved apex of the lower branch (referring to the type *exsulans*) is a little stouter, and more obtuse than in *divagans*, while the upper one is a little less prominent; the inferior appendages are a little longer than the superior with the acute apex curved upward and inward.

Female. Very similar to the male. The blue of the front of the head of the male is pale blue or brownish; the post-ocular spots and humeral stripes a little paler; the abdomen is black above, the sides pale blue,

sternal membrane black; there is an apical ring on 1; 3-7 have a basal pale blue ring with a wide interruption dorsally; on 8 there is a large blue spot on either side, these are separated dorsally by a black line of varying width; the appendages are black, the valves pale or faded brown.

This pretty and smallest species of the genus in our area is abundant from the latter part of May until well into September; it occurs in all parts of the state and has been taken from New York to Illinois. The females are often as deeply colored as the males. Both sexes may be found in the warmest part of the day flying low over floating herbage.

The female oviposits very much like *Ischnura verticalis* among algæ and debris at the surface of still water.

Enallagma doubledayi, Selys.

Length: of abdomen ♂ 25, ♀ 24; of hind wing of ♂ 17, ♀ 18.

The male is blue and black. Head black with lower part of face blue, a black line on clypeo-frontal suture; prothorax black, posterior edge blue, thorax with usual mid-dorsal and humeral black stripes, legs with blue and black, tarsi black, pterostigma black; abdomen much like that of *hageni*: first ring with small basal patch on dorsum, on 2 a shield-formed one with apical ring, 3-5 with apical one third black, 6 two thirds, all of 7 and 10.

The female differs from the male as follows; on the thorax and head she is yellowish, where the male is blue, her legs are pale with the apical half of the femora blackish outwardly and her abdominal segments are green above.

The abdominal appendages of the male are short projecting beyond 10 equal to half of its length; the superiors arise from a broad oblique base, become

narrower (more abruptly and deeply on the inner side) then expand to a broad, truncated slightly concave termination, a pale, depressed tubercle projects beyond giving a convex outline, the inner angle of the chitinous part is acute and slightly recurved; cephalad of this angle the anterior end of the obliquely placed, compressed, pale tubercle projects at an obtuse angle: in profile the appendage has the upper and lower sides nearly parallel, the end truncated at nearly a right angle with edges rounded, the tubercle projecting below and beyond making the outline rounded and projecting upward beyond the upper truncation. The inferiors are light at base, black at apex, rather slender shorter than the superiors, directed upward, base broad concave or sinuous below.

The appendages of the female are dark brown, conical.

The species has been taken at Columbus in May.

Enallagma exsulans, Hagen.

Length: of abdomen ♂ 27, ♀ 26; hind wing of ♂ 18, ♀ 20.

The male is bright blue and black. The head is black above with wedged-shaped, connected postocular spots blue, face blue with post-clypeus and a transverse band at base of labrum black; prothorax black with transverse line in front, the sides, spots upon the posterior border, a triangular spot each side of the dorsum, and a geminate oblong one between them; thorax blue with wide mid-dorsal, and humerals black, legs black with pale stripes, tarsi pale with dark rings; pterostigma brown pale edged. Abdomen slender, blue with black on the dorsum as follows: much of 1, a narrow band on 2 widest apically, the whole of 3-7, except interrupted apical rings, a narrow band on 8 not reaching the apical border, and on 10 often much narrowed posteriorly. The female is green and black; head and pro-

thorax marked as in the male; the humerals have a bright brown stripe through the middle covering both sides of the suture; legs paler; pterostigma yellow; dorsum of abdominal segments 1-8 black with apical rings 2-7, segments 9 and 10 are blue with two triangular, basal, black spots on 9, or nearly as often with a single spot covering from one third to two thirds of the top of the ring.

The border of 10 in the male has a bifid process above; the abdominal appendages are black, about half as long as 10, bifid, hairy; from above the sides of the upper branch are nearly parallel, obtuse, outer angle rounded, inner acute and recurved, the lower branch thicker, longer, obtuse, smooth; in profile both branches are obtuse, the upper shorter, the whole with the appearance of a clumsy hand of a cray fish.

The inferiors are black, curved upwards, shorter than the lower branch of superiors. The appendages of the female are very short, conical, blue; the ovate valves and processes are pale.

Exsulans is one of the most common and graceful species of the *Agrions*. It occurs everywhere, from June until September about all sorts of water living and stagnant.

Enallagma divagans, Selys.

Length: of abdomen ♂ 23, ♀ 24; of hind wing ♂ 16, ♀ 19.

The male is blue and black. Head black, blue, as follows: narrow, ovate connected occipital spots, front except post-clypeus and base of labrum; prothorax black with anterior lobe blue, a triangular blue spot each side of the dorsum of the posterior lobe and a dot of blue on the posterior margin; thorax black with narrow parallel stripes,—one each side, legs blue and black, pterostigma dark brown with lighter borders.

Abdomen slender, blue, dorsum black as follows: narrow band on 1 and 2, whole dorsum of 3-7 and 10, except narrow basal blue rings on 3-7. Female differs slightly, blue paler or greenish, legs paler, pterostigma yellow, humerals black with a bright brown streak along the suture (narrower than in *exsulans*), dorsum of abdominal segment 1-8 black, a large basal spot on 9 black, the whole of 10 blue.

The posterior margin of 10, in the male, with two processes above; appendages black, short, upper branch swollen, small process on inner upper angle, from the outer side below arises the lower branch which is slender, incurved, directed downward and bears a light cushion on the inner surface; the lower appendage is slender, acute, arises from a wide base longer than the lower branch of the superiors. The female appendages are short cones, black; the valves pale.

This species appears to be rare in most parts of the state.

Enallagma fischeri, Kellicott.

Length: of abdomen. ♂ ♀ 24 mm.; hind wing, ♂ 17 mm.; ♀ 19 mm.

Male black; orange, green and blue. Labrum, anteclypeus, genæ and frons orange; the labrum has three black points at base; vertex, occiput, upper part of eyes and antennæ black; cuneiform post-oculars connected and greenish blue; head below pale yellow. The prothorax is black above, with orange or green, as follows: anterior lobe with a broad transverse line, middle lobe with a geminate spot in the center and a larger spatulate one each side, the posterior lobe with three small spots below and on sides pale orange. The "thorax" bronze-black with dorsal caudina (sometimes only anteriorly) and humeral stripe bright orange; the legs yellow, with a black line on the outside of the femora and tibiæ (these lines are lightest on the hind pair).

The wings are hyaline, pterostigma small, reddish brown. The abdomen is slender, yellowish-green; dorsum of 1-8 and 10 bronze-black, 9 blue, sides and below yellowish-green anteriorly and bluish posteriorly; the tenth segment is prolonged and bifid to about the same extent as in *Enallagma exsulans*; the superior anal appendages are one-fourth shorter than 10, black, bifid, the upper branches divaricate, curved inward and bearing a minute hook at the inner distal angle; the inferior branches are stouter, shorter, obtuse, converging with a slight curve outward the inferior appendages are yellow, tips blackish, they turn outward and upward so that the tips rest in the forks of the superiors.

Female.—Head as in the male, except that the colors are less vivid; prothorax and thorax are similar except the mid-dorsal carina is more strongly marked with yellow; pterostigma lighter; abdominal dorsum is wholly bronze-black, although somewhat narrowed on 1, 2, 9, and 10, below greenish-yellow, ventral spine on 8 prominent, valves yellow.

Fischeri is an abundant and elegant insect, occurring throughout the state in the early part of summer.

Enallagma signatum, Hagen.

Length: of abdomen ♂ 28, ♀ 27; of hind wing ♂ 18, ♀ 20.

The male is dark yellow and black. Yellow on the head as follows: narrow, parallel, connected occipital spots, frons, clypeus and lips—there is a black point at middle of base of labrum and some irregular patches of same on postclypeus—prothorax black with sides, posterior border, a spot each side and a geminate one in the middle line yellow; thorax yellow with wide bronze black mid-dorsal and humeral narrowest above; legs and pterostigma yellow. Abdomen yellow marked

with black on the back of 1-8 and 10, basal yellow rings on 1-7.

The male abdominal appendages yellow, tips black, longer than 10, compressed; from above sides parallel, end round internal tooth; from side upper line straight lower divergent, shortest, hence the end is obliquely truncated with tooth at lower angle; inferiors slender curved inwards, much shorter than the superiors.

The female has the same general colors, usually a little paler; the post-clypeus is all black, the legs are yellow but have narrow black stripes; the dorsum of rings 1-9 are black, 10 yellow, sometimes the apex of 9. The slender appendages are all yellow, valves and processes the same.

Signatum is very numerous about canals, slow rivers and ponds.

Enallagma pollutum, Hagen.

Length of abdomen ♂ 29, ♀ 29; of hind wing ♂ 19, ♀ 20.

Male bright yellow, greenish yellow, pale blue and black. The occipital spots are long, narrow, connected greenish-yellow; the frons including the antennæ and rings or half rings about the ocelli, face and lips, except two transverse black lines in the postclypeus and three points at base of labrum yellow; prothorax yellow below and on sides, top black with large anterior spot, one on each side, another double one in the middle and the posterior edge yellow; the thorax is yellow with black mid-dorsal and a narrow humeral with irregular edges, the humeral is sometimes a mere brown stain; the legs are yellow with spines and rings on tarsi and claws dark brown. Abdomen attenuate wider posteriorly, dorsum black as follows: 1, except apical yellow ring, all of 2-8 except basal bluish ring on 3-7 (9 is blue), 10 with a cross of black, the rest blue.

The abdominal appendages are yellow, brownish above and at tips, about the length of 10. In profile the superiors are securiform; on the upper side curved upwards, truncated obliquely from below upwards and extended downwards at lower angle; from above the outer side is nearly straight, the inner concave, end obtuse with a projecting edge before the end on the inner side, inside below there is a cushion-like process exceeding the posterior edge making the same convex, this process turns forward and ends in a free curved piece resembling a halfclosed hand. The inferiors are slender curved inwards, much shorter than the superiors.

The female has the same colors as the male, although the yellow is not so bright, the head is similar marked; the yellow areas and spots of the prothorax are larger; the thorax has a mid-dorsal black stripe, the humeral suture is black with a brownish wash on each side but no real humeral stripe, the femora have a dotted line and a solid line of black, the tibiæ have an interrupted black line. Abdominal rings 1-9 are black dorsally with the usual interrupted basal rings; all of the dorsum of 10 and the posterior margin of 9 are bluish.

The conical appendages are dark and the valves and processes light.

Pollutum is exceedingly abundant along borders of marshes, on shores of Lake Erie and the larger interior lakes.

ISCHNURA Charpentier.

Three species of this genus occur in Eastern America,—*ramburii* along the Atlantic coast, *prognatha*, Virginia and *verticalis* everywhere. Only the last has been detected in the state. These forms are small, characterized by unlike pterostigma on the fore and hind wings, that of the fore wings is darker than the other but it reaches the costa, a fact which separates the present genus from the next.

Ischnura verticalis, Say.

Length: of abdomen ♂ 20, ♀ 21; of hind wing ♂ 13, ♀ 15.

These measurements are averages of a series, but individuals are found which are much larger and others that are smaller.

The male is green, bronze, black and blue. The top of head, post clypeus, base of labrum and antennæ are black, the rest green including the round occipital spots; prothorax black with anterior edge and sides green; dorsum of thorax black with narrow green stripes each side (sometimes interrupted as in *N. posita*) the rest green, legs greenish with black stripes on femora and tibiæ, tarsi and claws ringed with brown; pterostigma of fore wings brown, hind wings light yellow. The abdomen is green below and on sides extending as interrupted basal rings on 2-7; the dorsum of 1-7 and 10 are otherwise black; 8 and 9 are blue with a lateral half band on each black. The posterior dorsal edge of 10 has a bifid upturned process; the superior appendages are black above, depressed, turned downwards and inwards, expanded apically, the angles rounded especially the inner; the inferiors are longer, light below, black above, curved inwards; in profile they are bifid, the upper branch short and erect, the lower slender straight.

The females are of two forms (a) black and green (pruinose) (b) orange and bronze black.

(b) Top of head, postclypeus, base of labrum black, anteclypeus greenish. rear of head orange including the large connected ovate occipital spots which are confluent below with orange of rear of head. Thorax as in male, bright orange taking the place of green. Legs yellow with narrow stripes on tibiæ, and rings on tarsi and claws black. The 1 and 2 are all orange except more or less of an apical ring, 3 orange except a narrow dorsal band on posterior two thirds. All the others

greenish yellow on sides and black on dorsum; valves and short appendages, orange, processes black.

(a) Pale green and black as in male, the whole covered with a bluish bloom; the apex of dorsum of 2-7 darker, 8-10 darker, appendages and valves pale, processes blackish. Pterostigma on all wings light yellow.

Verticalis is without question the most abundant and ubiquitous species. It is one of the first to appear and one of the last on the wing in the fall. It may be found about all sorts of water courses and ponds.

ANOMALAGRION, Selys.

There is but one species in the genus and that is American occurring in both North and South America. It has been found in many quarters of the state.

Anomalagrion hastatum, Say.

Length: of abdomen ♂ 18. ♀ 20; of hind wing ♂ 10, ♀ 12.

Male is black and yellow; the head is black; yellow as follows: minute occipital spots, genæ, base of antennæ, front, anteclypeus, labrum, except black line at base, and the underparts; prothorax black with yellow broken lines on the borders; thorax black with two narrow white lines, yellow on sides and below, legs yellow black half stripe on femora, traces on the tibiæ. Pterostigma of anterior wings are ovate, on hind wings black rhomboidal. Abdomen is yellow, black bronze as follows: dorsum of 1-3, basal lance shaped and apical shield-shape spots of 4 and 5, the whole of 6 and basal half of 7.

The posterior margin of 10 has a long bifid spine.

The appendages are half as long as 10, yellow; superior appendages from above bifid, inner branch broad rounded, outer narrow, straight, pointed,

longer; the inferiors are stout, curved upward and inward, black at tip.

The female orange and black, head black and orange, pattern as in the male except the rear is orange; prothorax black with light lines on margin, sides orange; thorax orange with a wide mid-dorsal spot black; pterostigma light yellow; abdomen orange black as follows: small triangle in middle of 1, same at base of 2, rings at apex of 2-4, all of 5-8, basal triangles each sides of 9. The appendage and valves orange, the extreme tips of the processes black.

THIRD SUB-FAMILY.

GOMPHINÆ

This group includes species of strong individuality, their form and habits are unlike those of other groups.

The rigid spike-like abdomen, rather small and separated eyes are characters that define them without mistake. Among them are our bulkiest species, none are really small. Their habitats are various: some are found only about the rapid streams or waded tossed lakes, others by the reedy pools, while others haunt the sloughs mantled by lily-pads. They do not fly about in apparent sportiveness as do the *Libellulas*; the females rest among the adjacent foliage, or on the ground in some near by pathway; repairing at intervals to the water's edge, or skimming the roughened surface of the rapid stream or disturbed lake for oviposition; the males rest nearer the water, skirt the bordering aquates, or explore the water far from shore in search of the ovipositing females. Copulation is at rest in low herbage or high up in trees. The female oviposits unattended by the male and the eggs are washed from the tip of the abdomen by repeated dips into the water, either in some

quiet nook among the weeds or in other species far out on the rough surface of swift stream or wind disturbed lake. Most species fly in early summer, some in mid, and a few late in summer.

The genera represented may be defined and separated as follows:

I.

Median lobe of the labium bifid.

A. Basilar space free; triangles of front wings crossed; females with genital valves. (*Legion, Petaluria, Selys.*)

1. Triangles of the front wings with the upper side longer than the inner, outer longest; superior appendages of the male much widened beyond the middle; pterostigma very long, *Tachopteryx*. (Not yet taken in the state.)

II.

Median lobial lobe entire.

Basilar space free; female without genital lobes.

B. A part or all of the triangles crossed, membranule small or wanting. (*Legion Gomphoides, Selys*).

1. Legs long, hind femora reaching to the apex of 2; triangles crossed; internal and supra triangular spaces free.....*Hagenius*.

C. Triangles and supratrilinear spaces free; membranule very small or wanting. (*Legion Gomphus Selys*).

1. Inferior appendages bifid, branches nearly contiguous, straight, up-curved at apex.....*Ophiogomphus*.
2. Inferior appendages of the male bifid, branches divergent; superiors but little longer than 10, divergent. Vulvar lamina considerably shorter than 9.

(1). Hind femora of moderate length with many short spines,
Gomphus.

(2). Hind femora long (reaching apex of 2) spines many with an inferior row of 5-7. Much longer than the rest,

Dromogomphus.

HAGENIUS, Selys.

There is only one known species in North America; this is fairly common, at least in Northern Ohio. It prefers the borders of sluggish streams and bayous.

Hagenius brevistylus. Selys.

Length: of abdomen ♂ and ♀ 55-60; of hind wing ♂ and ♀ 48-52.

The male is black and yellow. Head yellow, black as follows: occiput (rear yellow), vertex, base of frons antennæ, lines between frons and clypeus and at base of labrum. There is a stout vertical cone each side; the occiput is convex with a marginal fringe of black hairs. Prothorax relatively small with a geminate spot in the middle posteriorly; the dorsum of the thorax is black with yellow marks; semi-collar, short mid-dorsal carina, narrow curved line each side, narrow humerals; the sides are yellow with two parallel black bands in the middle separated by a yellow line, the latter interrupted at the metathoracic stigmata; the last thoracic is posteriorly edged with black. The legs are black, coxæ with yellow spots. The wings are slightly flavescent, costa yellow to the pterostigma which is long 5 mm., yellowish, covering 6-8 cells. The abdomen is black with a mid-dorsal yellow band on 1-8, more or less interrupted at apex of 3-7, on 8 there is a large basal trowel shaped triangle; the sides of 1-9 are yellow; 8 and 9 are slightly expanded laterally; the yellow on side of 8 occupies the entire length, on 9 it is lunate, shorter than the ring.

The abdominal appendages are shorter than 10, black. The posterior border of 10 is straight, superiors wide apart, slightly curved inwards, outer angle rounded, apex obtuse; in profile the upper border is curved downwards, apex prolonged in a sharp spine, anterior to it near the inner border there is another shorter and stouter one, and on the outer edge near the base there is a downwardly and outwardly directed process. The inferiors are united, broad, apex slightly excavated, apex directed upwards.

The female is very similar; 8 and 9 are considerably expanded laterally; appendages black, as long as

10; vulvar lamina covering one-fourth of 9, black, apex excavated, angles sharp.

OPHIOGOMPHUS, Selys.

There are several closely related forms of this group of elegant species. One only has been captured within our limits. It occurs in early summer about swift water of larger streams, usually flying with and in a similar manner to *Gomphus fraternus* and *G. externus* in parts where these occur.

Ophiogomphus rupinsulensis, Walsh.

Length: of abdomen ♂ 40, ♀ 38; of hind wing ♂ 30, ♀ 32 mm.

Bright yellowish green and pale brown. Face and occiput green, the latter slightly sinuous each side, cilia long and black, vertex blackish, vesicle straight, slightly swollen at the ends, antennæ black; thorax with a narrow pale antehumeral not reaching the shoulder, humeral complete and similar in width and color, sides uniformly yellowish-green, also the legs except the knees, inner surface of tibiæ and tarsi which are blackish; wings hyaline, costa green, veins black, pterostigma brown, covering four or five cells. Abdomen slender, 8-9 strongly dilated; brown with elongated yellow spots on dorsum of 1-10, conspicuous on 2 and 10, ears on 2 yellow, large yellow spots on sides of 7-9.

Abdominal appendages yellow; superiors longer than 10, stout hairy, obtuse, somewhat divaricate curving towards the mid-line, under surface with black tubercles; inferior not so wide, a little shorter, obliquely truncated; in profile strongly excavated before the apex, a stout process directed upward at outer angle of the truncation.

Female similar in color, but differing as follows: vertex lighter, humerals fainter and the dorsal spots

on abdomen less sharply defined. The abdomen is stout 8 and 9 somewhat expanded; the appendages are long, yellow, acute; the vulvar lamina nearly as long as 9, divided to the base, branches nearly cylindrical, pointed, apex bent outward and upward, clawlike.

It has not been taken later than June 20 in Central Ohio.

GOMPHUS, Leach.

This genus is well represented in our fauna; fourteen species have been taken and a few more are sure to be added in the future.

Baron De-Selys has arranged the species in groups defined as follows:

I Group, (Indian).

II Group. Front of thorax with six broad black bands; 7, 8 and 9 much dilated; membranule moderate. Anal appendages of the male black.

III Group. Front of the thorax yellow with six lines or bands, more or less broad; segments 7, 8 and 9 somewhat dilated; membranule very small; anal appendages black, superiors as long as 9, inferiors almost as long.

IV Group. Front of thorax olivaceous, with 4 or 6 lines or bands, brown, more or less distinct; segments 7 and 8 moderately expanded; anal appendages yellow or light brown, superiors as long as 10, inferiors nearly as long.

V Group. Front of thorax with an interrupted, mesothoracic semi-collar and two cuneiform spots (stripes) yellow; sides yellow with two black rays, confluent at two points; pterostigma short, black; face mostly black; anal appendages brown, superiors longer than the 10th segment.

VI. Group. Front of the thorax black with two antehumeral wide bands and a superior antehumeral

point yellow; sides yellow with a black, interrupted band; face yellow; anal appendages yellow, as long as 10.

VII. Pterostigma long; front indented, front of thorax brown with two isolated, narrow, straight lines, a vestige of a humeral and a mesothoracic semi-collar interrupted in the middle all yellowish green; abdomen long, slightly dilated posteriorly.

Our species are distributed in these groups as follows:

II. *dilatatus* and *vastus*,

III. *quadricolor*, *fraternus*, *externus* and *graslinellus*,

IV. *villosipes*, *furcifer*, *exilis*, *lividus* and *spicatus*,

VI. *spiniceps* and *plagiatus*,

VII. *notatus*.

The species may be separated with little difficulty by the following characters.

II.

1. Large, male abdomen 50 mm; face yellow with two narrow transverse black bands.....*dilatatus*.
2. Medium, male abdomen 38 mm.; face yellow with two broad transverse black bands.....*vastus*.

III.

1. Dorsum of 9-10 black.....(1) and (2).
2. Dorsum of 9-10 with a yellow band.....(3) and (4).
- (1). Small, male abdomen 32 mm.; no yellow on dorsum of 8,
quadricolor.
- (2). Medium, male abdomen 38 mm.; yellow triangle on dorsum of 8 (sometimes a faint yellow band on 9.....*fraternus*.
- (3). Medium, superior abdominal appendages of the male slender, obliquely truncated and excavated at apical fourth.....*externus*.
- (4). Medium, male superior appendages stouter, obliquely truncated with a prominent tooth at outer angle.....*graslinellus*.

IV.

1. Medium size, male abdomen 35 mm.; antehumeral stripes slightly divergent below.
- (1). Superior male appendages yellow, truncate with inwardly directed spine at the inner distal angle.

- (a). Male and female occiput with a spine in the middle....*villosipes*.
- (b). Without the occipital spines.....*furcifer*.
- (2). Superior appendages brown, pointed, an acute tooth representing the outer distal angle.
 - (a). From side view the male superior appendages have a strong, acute tooth near the middle of the inner, inferior edge,
spicatus.
 - (b). From side view the male superior appendages have obtuse prominence near the apex of the inner, inferior edge.....*lividus*.
- 2. Small, male abdomen 30 mm.; antehumeral more divergent below.
 - (1). Face yellow, occiput straight.....*exilis*.

VI.

- 1. Large, black, 9 long.....*spiciceps*.
- 2. Large, brown, 9 slightly longer than 8.....*plagiatus*.

VII.

- 1. Large, brown and yellow.....*notatus*.

GROUP II.

Gomphus dilatatus, Rambur.

Length: of abdomen ♂ 50, ♀ 47; of hind wing ♂ 40, ♀ 40.

Male black and yellow; head yellow, the following black: borders of labrum and vertical line in the middle, a transverse line between clypeus and frons, the vertex antennæ; and the vertical vesicle is straight, occiput rather narrow, convex with a fringe of black cilia. The prothorax black, sides yellow with a large geminate spot centrally of the same: the thorax is yellow, black as follows: a mid-dorsal stripe with parallel sides, not reaching the front margin, an ante-humeral and humeral—both widely separated by a narrow yellow line and two lines on the side; legs black with coxae and under side of fore tibiae yellow; the wings are hyaline, costa yellow; pterostigma moderate covering five cells, yellow surrounded by heavy black veins. The abdomen is black, yellow as follows: sides of 1-2, dorsal band on 1-4, lanceolate apical spot on 5-7, large triangular apical spot on side of 8 and oblong one on side of 9.

The ears on 2 are yellow, edges black; joints 3-6 are slender, especially 3.

The appendages are black divaricate; the superiors as long as 10, slender, acuminate, apex obliquely truncate on outer distal fourth, there is a minute tubercle at beginning of the obliquity, in profile arched; the inferiors equally spreading nearly as long, up turned at the apex.

Female similar; vulvar scale elongate, of two lamellæ which are narrower towards the end and turned outwards.

This fine species has been taken only in the central part of the State in June. It is evidently rare. One male is known in which the triangles are all one crossed.

Gomphus vastus, Walsh.

Length of abdomen ♂ and ♀ 38; of hind wing ♂ and ♀ 23.

Male black marked with greenish yellow. Head with yellow, as follows: occiput, except the extreme edge, two spots at rear of eyes, frons in the middle, anterior half of postclypeus, labrum on either side, the genæ and the lateral lobes of the labium. The occiput is slightly concave. Prothorax black with yellow front edge, spot each side and in middle of posterior edge; thorax with yellow semicollar, upper half of carina, antehumerals, narrow humerals and sides, on the latter there is a black line in the front of the stigma and one at the second lateral suture. Legs and feet black with anterior femora yellow on the outside. Pterostigma brown covering four or five cells; costa green on extreme edge, the fore wings slightly flavescens on basal fourth. The abdomen is slender 7, 8 and 9 very much expanded laterally; shiny black with pale olive mid-dorsal interrupted band on 2-7; this is broad and halberd-shaped on 2, narrow and basal on 3-6, basal triangle on 7, the apical edge of 7 is bright

yellow, also a spot on basal edge each side of 8 and the whole lateral expansion of 9, the dorsum of 1 and the sides of 1 and 2 are light green.

The appendages are black, a little longer than 10; the superiors from above are divaricate, base broad, gradually narrowing with the apex obliquely truncated making the inner angle acute; in profile they are arched with a tooth at outer angle of the apical truncation, apex slightly turned upward. The inferiors reach the truncation of the superiors, a little more divaricate, apex turned up and obtuse.

The female differs in having a small black thorn either side of the vertical vesicle, the abdomen a little stouter, the mid-dorsal more distinct, 7, 8, and 9 not quite so much dilated and the spots at base of 8 faint. The appendages are cylindrical acuminate, black, longer than 10; the vulvar lamina longer than half of 9, bifid for one third its length, branches acuminate, approximated. This is an exceedingly common odonate along the shore of Lake Erie.

The females fly far out over the waves dipping the abdomen in the water as they fly to wash off the eggs. During June and early in July they may be found on any sunny shore of the lake or bays. They capolate at rest in trees and shrubs.

GROUP III.

Gomphus quadricolor, Walsh.

Length: of abdomen ♂ and ♀ 32 mm; of hind wing ♂ 26, ♀ 27 mm.

Male black and yellow. Face and occiput yellow; vertex black; vertical vesicle slightly excavated in the middle, occiput very convex. Prothorax black or dark brown with yellow spots on the sides and middle; dorsum of the thorax brown, mid-dorsal carinae in part yellow also a broad ante-humeral and a narrow humeral, sides yellow with two well marked oblique

bands narrow; coxae yellow, legs black with little pale on the inside of the femora; costa yellowish, pterostigma light brown covering three cells on fore wings. Abdomen slender, moderately expanded at 8 and 9, and four on hind wings black, yellow as follows: sides of 1 and 2 including the ear like appendages, expansion of 8 and 9, dorsal band from 1-8—broad on 1 and 2; narrow, lanceolate, apical, very small triangle on 8.

The superior appendages of the male are black, longer than 10, pointed with the apex directed outward; in profile there is a broad expansion downward with a backwardly directed tooth near outer third. The inferiors are nearly as long, more divaricate and turned upward at apex.

The female is stouter, occiput less strongly convex, vertex lighter, more pale or even olive on femora, dorsal band less pronounced, expansions on 8-9 slight not so bright yellow. The appendages are conical and black; the vulvar lamina is exceedingly short, emarginate, lobes round and thick; the posterior border of 8 is thickened and emarginate so there are four rounded bodies at this level.

This pretty species has been taken in Central Ohio late in May and as late as June 15. It rests on rocks projecting from rapids on the banks near by the most rapid parts of large streams.

Gomphus fraternus, Say.

Length of abdomen ♂ and ♀ 38; of hind wing ♂ 31, ♀ 32.

Male black and greenish yellow, Head; occiput yellow, strongly convex, fringed with black hairs, rear black, yellow at border of eyes, vertex and antennae black, the whole face yellow, labium brownish. Prothorax black, bright yellow anterior edge, olive spot each side and two geminate ones in middle above. The thoracic carina is yellow with narrow black, parallel,

band each side not quite reaching the anterior border of mesothorax, a broad black antehumeral separated except at one point above from the narrower humeral by a yellow line; sides yellow with second lateral suture black and a band below reaching the mesothorac stigma a little above; wings with the costa green; pterostigma brown, covering three or three and a half cells; legs and feet black. The abdomen with well marked dorsal yellow band on 1-8, a broad space on 1, three lobed on 2, narrow, extending nearly the whole length of 3-6, on 7 half as long as ring, on 8 small triangle; the sides of 1-2 yellow, on the lateral expansions of 8 a large bright yellow spot separated from an apical one by irregular brown shade, and all of the sides of 9.

The appendages are blackish, longer than 10, from above divaricate, base broad, tapering, apex acuminate, in profile arched, apex obliquely truncated upward; inferiors more spreading, reaching beyond the lower angle of the truncation which is slightly prolonged, apex turned upward, obtuse.

The female differs in having the occiput concave with an obtuse process in the middle, the humeral and ante-humeral connected for a wider space, a yellow stripe on outer side of first femur and sometimes on third; the abdomen is stouter, and the expansion of the apex not so broad. The appendages black and pointed; the lamina reaches the middle of 9, bifid in apical third, branches turned outwards at apex.

Fraternus is common in most parts, in May, June, and first days of July; it is only found by the shore of the great water or by considerable streams, then about the most rapid reaches. The females oviposit by washing the eggs into the rapids or the breaking waves.

Gomphus externus, Selys.

Length: of abdomen, ♂ 40, ♀ 40; of hind wing ♂ 34, ♀ 35.

Male black and greenish yellow. Head; occiput not at all or slightly convex, yellow fringed with black hairs, rear black with a stripe proceeding downward from the occiput and outer border yellow, vertex black with a small spot on each side below the occiput yellowish green, antennæ black, whole face yellow, margins of mouth brownish.

Prothorax black, anterior border bright yellow, above with a spot each side and a geminate spot between, yellowish. Thoracic carina yellow with a black band each side, interrupted anteriorly, a broad, black antehumeral separated below from the humeral by yellow, first and second lateral sutures and an abbreviated line between them reaching nearly to the metastigma black, remainder of thorax greenish yellow; costa green, pterostigma brown covering about four cells, legs black with the exception of the anterior femora each of which have a greenish yellow vitta on the inner side. Dorsal band of abdomen yellow as follows, a patch broadest behind on 1, broad and three lobed on 2, broad at base, gradually narrowed but not reaching the apex on 3-6, a triangular basal on 7 and 8, reaching the whole length of the segment on 9; laterally sides of 1 and 2 and part of 3, partially obscured spots on base of 4-7; a basal and a small apical spot on 8, whole length of 9, yellowish. Appendages longer than 10, from above divaricate, tapering gradually from base, outer distal angle obtuse, inner distal angle acuminate, apex obliquely truncate, from side arched; inferiors nearly as long as the superiors, apex turned upwards.

The appendages of this form are very much like those of *fraternus*, but the superiors have a more prominent outer distal angle and the inner distal angle is not so strongly produced.

The female has the occiput straight, not "rising in the middle in two confluent curves" (Walsh), nor is

“the space between the lateral thoracic lines livid,” but of the more usual greenish yellow hue ; the vertical thorns are black and conical ; the posterior femora are either with or without external vittæ, in this regard agreeing with the female of *fraternus*. † has been said that the latter has no vertical thorns, and that the females of *externus* and *fraternus* may thus be separated ; this will not do, for the female *fraternus* has long slender, black or yellow vertical thorns ; they are easily separated, however, by the difference in the occiput—*fraternus* with a spine in the middle of the border, *externus* having the same straight or slightly concave—*externus* is larger and the vitta ♀ is almost as conspicuous as in *externus*.

Easily separated from *fraternus* by the wide yellow vitta on the ninth abdominal segment, its larger size and straight or concave occiput.

Common along the Olentangy river at Delaware and Columbus in June.

Gomphus graslinellus, Walsh.

Length of abdomen ♂ and ♀ 39, of hind wing ♂ 33, ♀ 34.

Male black, yellow and greenish yellow. Head; occiput yellow, slightly convex, fringed with short, black hairs, rear yellow with the upper parts of the orbits brownish or black, vertex and antennæ black. Prothorax black with a bright yellow spot on the anterior border, base with a spot each side and one between them yellowish ; thoracic carina brown with a similar colored space each side, humeral and antehumeral bands present, separated for their whole length by a narrow yellow stripe, first and second lateral sutures margined with brown ; wings with the costæ greenish yellow ; legs, femora and tarsi black, tibiæ black with a yellow dorsal band as follows : a rather wide, uniform band on 1 and 2, a narrower,

tapering patch on 3-6 in no case reaching the apex, a triangular, basal patch on 7 and 8, a wide vitta widening gradually as it approaches the apex on 9 and an elongate spot on 10; laterally segments 1, 2 and base of 3 are greenish yellow, 4-7 have obscure basal patches, and 8 and 9 have the lower border wholly bright yellow. Superior appendages brown, from above divaricate, sides nearly parallel, outer distal angle nearly a right angle, inner distal angle produced into an oblique acuminate process, apex slightly concave; inferior appendage nearly as long as the superior, spreading, curved upward and inward at the tip.

The female is stronger, abdominal segments 8 and 9 are not so strongly dilated, the front femora are yellowish vittate below and the occiput is concave with a prominence in the middle; appendages pointed, dark, the lamina is short.

Separated from *fraternus* by the wide vitta on 9, and from *externus* as well as *fraternus* by the greenish yellow stripe on the superior side of all the tibiae.

The species flies in central Ohio during June and the first part of July. Four pairs taken in this locality are in the University collection.

GROUP IV.

Gomphus villosipes, Selys.

Length of abdomen. ♂ 38, ♀ 39; of hind wing ♂ 31, ♀ 33.

The color is black, olive, yellow, and brown. In the male the rear of the eyes is yellow below; black above; occiput yellow, extreme edge black, cilia black; convex, stout, black; spine in the center; vertex black, end of the vesicle yellow; whole front and lips yellow. Prothorax black, yellow spot on sides and double one in middle of second lobes, yellow spot in middle of third

lobe. Thorax light olive, black, marked as follows; stripe each side the carina not forming a collar, an antehumeral and humeral well separated, a line in front of the stigma and the upper part of the second suture; the legs are black yellow as follows; inside of femora of first pair, narrow stripe on external side of tibiæ of all pairs; wings with costa olive, pterostigma yellow. The abdomen is black with olive dorsal band on 1-7, 8 and 9 all brown lighter on the sides, moderately dilated, sides of 1-7 more or less olive, 9 yellow including the appendages,

The superior appendages are as long as 10, divaricate wide at base, tapering, outer apical angle rounded, inner produced into a long, black tipped spine set obliquely inward; in profile greatly curved, apical third directed obliquely upward. Inferiors with spreading apices blackish, curved up at apex.

Female differs in being stouter and a little larger and in having more yellow on the sides of the abdomen. In one specimen the spine on the occiput is quadridentate above, the same organ in some males shows two similar teeth, while in others it is simply acuminate. The vulvar lamina is triangular, one third as long as 9 with the apex two parted, contiguous.

The species is on the wing at Columbus during the latter half of May and the first part of June.

Gomphus furcifer, Hagen.

Length: of abdomen ♂ and ♀ 36, hind wing 30.

Colors black, olive, brown and yellow. Male, occiput very slightly convex, olive and fringed with black hairs, rear of head yellow below, black above, whole face olive, mandibles and vertex black. Prothorax with an irregular, yellow spot near the front margin, posterior to this a lateral spot each side and two geminate spots on the vertex olive; mesothoracic carina olive bounded each side by brown which in some

specimens is obscure ; a humeral and an antehumeral present, usually united above ; first and second lateral sutures obscurely margined with brown. Dorsal line on abdomen present on 1-7, 10 nearly all yellow. Appendages yellow, spreading, shorter than 10, sides nearly parallel, outer distal angle prominent, tipped with a black denticle, inner angle produced into an oblique horn-like process, apex truncate, inferiors longer than the superiors, strongly divaricate, yellow, turned upward and black at tip.

The female has the vulvar scale short, triangular divided at the apex with the ends rounded.

Readily separated from *villosipes* by the male appendages, and by the absence of the spine on the occiput.

Taken at Licking Reservoir, June 14, and at Kent, June 21. Does not seem to be common.

Gomphus exilis, Selys.

Length : of abdomen ♂ 30, ♀ 32 ; hind wing ♂ 24, ♀ 26.

Colors black, olive, yellow and brown. Male occiput yellow or olive, straight and ciliate above, rear of head brown or brownish, front margin of prothorax yellow, posteriorly with an olive spot each side and a geminate one of the same color between them ; brown each side of the thoracic carina, humeral and antehumeral bands present, more or less obscurely separated by olive, space between first and second lateral sutures brown, legs brown or black, all the tibiae vittate with olive above, feet black ; wings, costa greenish, pterostigma brown. Abdomen black, yellow dorsal band present on segments 1-9, segments 8 and 9 with ventral edges yellow, 10 wholly brown or with a small yellow marking dorsally.

Superior appendages as long as 10, divaricate conical, acute at apex, from side view a triangular process

may be seen on the under side ; inferiors shorter than superiors, divaricate and turned up at tip from side view.

The female differs in having the tenth segment wholly yellow, the legs, front pair femora yellow below and blackish above, middle femora the same, hind femora yellow except at apex, the coxae and trochanters of all the legs yellow. Vulvar lamina short, not more than a fifth as long as 9, triangular, divided, the two lobes separated with their apexes rounded.

This species is common in all parts of the state in the latter part of May, June, and fore part of July. It has been taken at Columbus as early as May 9th. Canals and ponds are its favorite resorts.

Gomphus lividus, Selys.

Length of abdomen ♂ 34-36, ♀ 36, hind wing ♂ 30-32, ♀ 34.

Colors fuscous, olive and yellow. Male, occiput convex, ciliated with black hairs, face yellow, vertex and antennæ fuscous, rear of head olive, largely overlaid with brown. Prothorax fuscous, front border, a posterior, geminate spot and a spot each side olive ; thoracic carina fuscous narrowly margined each side with the same color, humeral and antehumeral bands fuscous obscurely divided for part of their extent by olive, space between the first and second lateral sutures fuscous, as is an oblique band on the posterior margin of the thorax ; legs fuscous with the superior side of all the tibiæ and hind metatarsi marked with olive ; wings, costa olive, pterostigma yellowish brown. Abdomen, dorsal band present on 1-9, this band is abbreviated on 5-8, on 9 it is wide and continuous ; sides of 1-2 and 8-9 olive below, basal spot on 3-7 ; superior appendages brown, nearly one and a half times as long as 10, divaricate, widest at base, gradually tapering, outer distal angle has the appear-

ance of a small denticle, inner distal angle strongly concave; from side view an inferior prominence occupies the outer third. Inferiors more spreading than the superiors, of nearly the same length, and, from side view turned upward at the tip.

The female has the occiput straight, and the legs more olive than those of the male. This species may be easily separated from *villosipes* and *furcifer* by its fuscous instead of black color; and by the superior appendages of the male, which instead of the inner distal angle being produced into a process which points obliquely inward, as in those species, the prominence of this angle takes the general direction of the body of appendage. From *exilis* it may be readily separated by its color and larger size.

Gomphus spicatus, Selys.

Length of abdomen ♂ 35, ♀ 35, hind wing ♀ 27, ♂ 30.

Colors olive, brown and fuscous. Male; occiput olive, regularly convex, ciliated with black hairs on the superior margin: prothorax fuscous with the usual lighter markings. Mid-dorsal carina margined, each side with brown; humeral and antehumeral bands present, brown, obscurely separated by olive for at least part of their extent, space between the first and second lateral sutures brown, none of the brown markings on the thorax are as conspicuous as in the foregoing species of this group. Legs fuscous, all the tibiæ vittate with olive above; wings, costa yellow; pterostigma brown, covering four cells and part of a fifth. Abdomen, dorsal band present, segments 8-9 yellow on the inferior edge of the lateral surface. Superior appendages divaricate, as long as 10, wedge shaped with an acute projection near the middle of the outer border, apex acuminate. From side view, near the middle of

the inner margin is a prominent acute projection. Inferiors more spreading than the superiors, from side view gradually curved from base to apex. The female differs in having the occiput suddenly prominent in the middle and front femora wholly olive and hind femora olive with apex fuscous. The vulvar lamina is about one fourth as long as 9, divided lengthwise, the tips separated; so that it has the appearance of being composed of two wedge-shaped parts with acute apexes.

The slight contrast in the colors of the thorax, and the acute spine on the under side of the middle of the inner edge of the superior appendage of the male, are characteristics of this species.

Spicatus frequents the borders of wave beaten shores or rushing rivers; the males, during the warm sunny hours, make frequent excursions over the crested waves, after each of which they return to shore for rest, the females generally remain in the herbage or higher on trees near by, flying out occasionally to deposit their eggs in the disturbed waters and often bringing back a consort to the place of rest.

A common species in parts of Northern Ohio in June.

GROUP VI.

Gomphus spiniceps, Walsh.

Length of abdomen ♂ 48, ♀ 47, hind wing ♂ 36, ♀ 39.

Male; colors black, olive and yellow; head black with an olive band on the post-frons. On the vertex there is a U-shaped elevation, the upper angles of which are tooth-like, and between this and the eye on either side there is a small yellowish spine; occiput nearly straight, olivaceous above. Thorax and dorsum black with brownish reflection, mesothoracic

collar, a short, broad stripe each side and antehumeral ray, spatulate above, olive; sides paler, with an olivaceous stripe beneath each wing, olivaceous below; wings hyaline, veins and costa black, pterostigma reddish brown, 5 millim. long; membranule very narrow, whitish; legs black. Abdomen black, 8 and 9 strongly dilated, 9 almost as long as 8+10; 1, 2, 8 and 9 olivaceous on the sides, 1-8 with dorsal yellow spots as follows: 1, apical, triangular; 2, lanceolate, nearly the entire length; 3, 4, 5 and 6, basal, oblong; 7 and 8, basal, triangular; appendages black, divaricate, superiors longer than 10, acute, depressed, slightly turned up at apex and having eight or ten minute crenulations on the lower, outer edge apically, inferiors not quite so long, hamulate at apex.

The female differs in the abdomen being much stouter, 8 and 9 not dilated and in the possession of a small notch in the middle of the occiput. The vulvar lamina is very short and rounded at the apex.

The species has been taken at Sugar Grove and Akron in September. Four specimens were captured and many more seen at Sugar Grove, September 4th, 1894. They were observed flying late in the afternoon, and ovipositing in a small brook that was rippling over pebbles. They continued to fly until it was so dark that the eye could not follow them. Pairs at rest; the female oviposits in a manner similar to that of the *Libellulas*.

Gomphus plagiatus, Selys.

NOTE—Regarding the identity of Ohio specimens which I believe to be *plagiatus*, at the present time, there is some doubt. This species and *notatus* are apparently very close. Dr. Calvert has kindly sent me specimens of *plagiatus* taken in Texas. A dozen specimens taken at Sandusky June 20, '96 and referred to by Prof. Kellicott in Jour. Cin. Soc. Nat. Hist. XIX,

66 as *notatus* agree with the above mentioned specimens of *plagiatus*. Mr. C. C. Adams who has studied the specimens of both species in the museum of Comparative Zoology recently states that the female of *plagiatus* has the vulvar lamina emarginated in the middle while the same is rounded in *notatus*. The Sandusky females agree with *plagiatus* in this regard.

Because of the doubt existing in my mind, I give Dr. Calvert's description of *plagiatus* in full below.

Olive green. Brown predominating on thoracic dorsum so as to leave a narrow antehumeral stripe, notably divergent from above downwards from its fellow of the opposite side, and the mid dorsal carina yellow (teneral) or green; sides pale, a line in front of the metastigma and on the second lateral suture, brown. Abdomen long, 1-6 brown with a pale green mid-dorsal spot or stripe, 7-10 yellowish.

Male: Hind margin of occiput slightly convex, Superior appendages with teeth, apex obliquely truncated (when viewed from above), the acuter angle on the inner side, usually no tubercle at the outer (obtuse) angle. Inferior appendages one-fourth shorter.

Female: Hind margin of occiput straight. Vulvar lamina very short, less than one-tenth of 9, emarginated in the middle, tips on either side of emargination acute.

Length of abdomen ♂ 40-45, ♀ 44-49; hind wing ♂ 32-35, ♀ 35.5-37.

Mr. C. C. Adams makes the statement that the females of *plagiatus* and *notatus* may be separated by the vulvar laminæ. This is emarginated in the middle in *plagiatus* and rounded in *notatus*.

One female specimen taken at Wauseon July 1, 1896, I am of the opinion belongs here. It measures as follows:

Length of abdomen 42, of hind wing 38 millimeters.

GROUP VII.

Gomphus notatus, Ramb.

Dr Calvert states that *Gomphus notatus* seems to differ from *plagiatus* according to specimens in the Museum of Comparative Zoology by its smaller size, slightly concave occiput (slightly convex in *plagiatus*) 8th segment of the abdomen dark brown with a mid-dorsal yellow triangular spot, (this segment pale brown in *plagiatus*) and no well marked external ante-apical angle on superior appendages as exists in *plagiatus*.

DROMOGOMPHUS, Selys.

Two species of this genus have been taken in the State; *spinosus* is common in all parts, *spoliatus* is abundant in the Maumee Valley. The species when flying usually follow close to the banks of quiet streams and canals, and are not so fond of rippling water as are many species of the genus *Gomphus*.

The two species may be separated as follows :

1. Abdominal segments 7-10 almost entirely yellow, the distal part of hind femora black.....*spoliatus*.
2. Abdominal segments 7-10 almost entirely black. hind femora all black.....*spinosus*.

Dromogomphus spinosus, Selys.

Length : of abdomen ♂ 41 ♀ 42, hind wing ♂ 35, ♀ 37.

Male; colors black, brown, olive and yellow. Head; occiput olive, regularly convex, ciliated; front olive with sutures margined with black; vertex and mandibles black: Prothorax black, yellow dorsally; mid-dorsal carina olive, a fine band each side uniting above and below with the antehumeral, a broad humeral and an antehumeral united above and below, brown, remainder of thorax olive; legs and feet black, front

tibiæ vittate with olive beneath. Abdomen; dorsal band present on all the segments, sides of 1-2 and base of 3 olive, sides of 7-10 more or less marked with yellow, superior appendages black, from above wedge-shaped, acuminate at tip; from side view, tips slightly elevated, inferior appendages from above slightly more spreading than the superiors, gradually curved, from side view four fifths as long as the superiors, gradually curved, apex blunt.

The female differs in the stouter form of the abdomen, in the occiput being concave in the middle where it bears an angular tooth, and in the humerals and antehumerals being separated above.

The vulvar lamina is about a third as long as 9, triangular in general outline and divided at the apex with the two parts divaricate, pointed.

The species is distributed all over the State.

The female has been observed often ovipositing in a manner similar to *Maccromia illinoisensis*, that is by skimming the water and every few feet or rods touching it with the abdominal tip, scarcely checking her speed; at other times I have seen them drop down from an overhanging tree and repeatedly tap the water, remaining in one place after the manner of *Libellula*. Pairs were noticed to fly up into tree tops and remain in union for a considerable time.

Dromogomphus spoliatus, Selys.

Length of abdomen ♂ 45, ♀ 47, hind wing ♂ 36, ♀ 39.

Male; colors brown, yellow and black. Head; occiput yellow, convex, ciliated with light colored hair, face yellow, vertex brown; prothorax yellow irregularly marked with brown, mid-dorsal carina yellow, margined each side with brown which gradually widens anteriorly, humeral and antehumeral bands present, separated; first and second lateral sutures and

more or less of the space between them brown, remainder of the thorax and all the coxae yellow; legs and feet, all the tibiæ and tarsi, front femora except an inferior, yellow vitta on each, middle femora and distal part of hind femora, black; the hind femora have dark lines laterally and superiorly for their whole length; costa yellowish, pterostigma light brown covering four cells. Abdomen; dorsal line present on 1-6, sides of 1-3, basal, transverse band on 4-6, all of segments 7-10, yellow; segments 7-10 are often largely suffused with brown above and the extreme ventral edge is always brown in fully matured specimens. Superior appendages yellow, in form resembling those of *spinosus*; inferiors from above gradually divaricate, more spreading than the superiors, wide at base and gradually narrowed; from side view yellow at base, black distally, shorter than the superiors, suddenly turned up at apex and produced above into an acute projection.

The female differs in its larger size and stouter abdomen and in the occiput being rather suddenly prominent at the middle. This prominence does not form a spine as in *spinosus* but simply an obtuse angle. The vulvar lamina is nearly a third as long as 9, triangular in general outline, the apex is divided; the two parts divaricate, acuminate, and turned outward at the tips.

The species is common in north western Ohio along the Maumee River and its tributaries, and the Ohio Canal. I have never seen this species fly up into trees during copulation as is stated regarding *spinosus*. Both male and female fly along the bank with a swift, regular flight, coming to rest on bare spots close to the water where copulation takes place. The female oviposits similar to *Libellula*. The queer thing about this gomphid is that females are as often taken as males.

FOURTH SUB-FAMILY.

CORDULEGASTERINÆ.

The members of this sub-family are all large insects. Less than ten species have been described from America north of Mexico. None of these seem to be common, so far as individuals are concerned, at least they are not often taken. I have seen so few specimens on the wing that I do not feel justified in giving anything of their habits in the field.

CORDULEGASTER, Leach.

Two species have been taken in the state; they may be separated as follows :

1. Large species, abdominal segments 2-7 nearly encircled by yellow,
erroneous.
2. Smaller species, yellow on abdomen takes the form of spear-shaped markings on the dorsum of segments 2-8.....*obliquus.*

Cordulegaster erroneus, Hagen.

Length of abdomen ♂ 53-56, ♀ 62, hind wing ♂ 44-47, ♀ 50.

Female; colors black, brown and yellow. Head; anterior part of vertex, nasus, genæ, disk of labrum, and labium, yellow; occiput yellow behind, brownish yellow in front, ciliated above with long yellowish hairs; remainder brown. Thorax; in front two oblique bands pointed below and abbreviated at both ends, on each side two oblique bands abbreviated at the ends, and a spot above between them, the posterior ventral surface and a spot between each pair of wings yellow, remainder black; legs and feet black; veins of wings and pterostigma black. Abdomen, a ventral and a lateral spot each side on 1, a transverse median band, oblique on the sides and continued by the ventral spots on 1, and a ventral and lateral spot distally

each side on 2; a median band and a small lateral spot distally on 3; a median band on 4-7 obscurely abbreviated above; and a triangular lateral spot each side on 8 yellow; remainder black. Vulvar lamina three times as long as 9, eight millimeters, wide at base, gradually narrowed with apex rounded, divided except at base, the two parts contiguous; appendages short, black, apex angular.

The male is colored similar to the female: superior appendages short, not as long as 10, two small interior teeth. Inferior appendages three-fourths as long as the superiors.

The female was taken, while resting above a cold spring on a hillside at Sugar Grove, July 5, 1891.

Cordulegaster obliquus, Say.

Length: of abdomen ♂ 52, ♀ 58, hindwing ♂ 44, ♀ 48.

Male; colors black, yellow and brown. Head; rhinarium, mandibles and posterior part of vertex black, eyes brown, remainder yellowish. Thorax; an antehumeral band widest above and abbreviated at both ends, two lateral bands with a row of more or less obscured spots, posterior part of venter, and a spot between each pair of wings yellow, remainder brownish-black. Legs and feet black. Costa yellow in front, veins and pterostigma black. Abdomen; a ventral spot each side on 1, a dorsal band and two lateral spots on 2, a dorsal and a ventral band on 3, dorsal bands in the form of spear-shaped spots on 4-8, yellow, remainder black. Superior appendages from above about three fourths as long as 10, slightly divaricate, sides nearly parallel, abruptly pointed at the apex; from side view straight, cut obliquely upwards at apex which is pointed and slightly elevated. Inferior appendages from side view about two thirds as long as

the superiors, straight, prominent at the outer distal angle and bearing a forward curving tooth.

The female is colored similar to the male.

Taken at Orwell, Ashtabula County, June 1895.

FIFTH SUB-FAMILY.

ÆSCHNINÆ.

The members of this sub-family found in Ohio are medium sized to very large insects. It includes some of the most hardy forms, being the first to appear on the wing in spring and the last to disappear in the fall. The eyes are contiguous for nearly their entire width in both sexes, wings are long and broad and the anal angles of the hind pair are rounded in the female and prominent in the male (except *Anax*). As a usual thing they do not spend so much time flying over the water as some of the preceding forms. They are common about fields and sunny places in woodlands, and are continually busy catching flies and other small insects for food.

The female is attended by the male much of the time and it is a common thing to see pairs take long excursions over the water, flying three or four feet above its surface. The female seems to prefer to oviposit in stagnant pools and ponds where the surface is covered by duck weed and other aquatic plants.

The genera may be separated as follows ;

1. Triangle once crossed..... *Gomphæschna*
Triangle with more than one transversal.....2
2. Subnodal sector furcate in the hind wings.....3
Subnodal sector not furcate in the hind wings.....5
3. Anal angle of male rounded, thorax uniform green.....*Anax*
Anal angle of hind wing of male acute, thorax brown, banded
with green.....4

4. Expanse more than 110 millim., abdomen of male and female not strongly constricted at three.....*Epiæschna*
 Expanse less than 100 millim., abdomen strongly constricted at three.....*Æschna*
5. Fore wing broadest at the nodus, two lemon yellow spots laterally on thorax.....*Fonscolombia*
 Fore wing broadest at nodus, two whitish bands laterally on thorax *Basiaeschna*

ANAX, Leach.

This genus differs from all other members of the *Æschninæ* in the male having the anal angles of the hind wings rounded. The species are very large and their flight is strong. *A. junius* is an exceedingly abundant form in all parts of the state. *A. longipes* has never been taken in Ohio, but Mr. Charles Dury is confident he identified the species on the wing at Cincinnati in May 1898.

The following table will serve to separate these two species :

1. Front above with a fuscous spot surrounded by green and the whole by blue.....*junius*.
2. No markings on front above.....*longipes*.

Anax junius, Drury.

Length: of abdomen ♂ 53-57 ♀ 53, hind wing ♂ 50-52, ♀ 54.

Colors ; male, green, blue and fuscous.

Head; front green, a black spot above surrounded by green, then by fuscous; mandibles black, other mouth parts green; eyes fuscous occiput greenish in the middle; rear of eyes, superior margin and middle fuscous, lateral parts green

Thorax green; femora brown, tibiæ and tarsi black; wings hyaline, costa yellow, other veins fuscous or brown; pterostigma yellow, membranule large, white anteriorly, fuscous posteriorly. The base of the abdomen corresponds in color to the thorax, blue begins at the anterior third of the second segment and is more or less apparent on several segments, but

fuscous predominates. The colors are so changed in dry specimens that it is difficult to define their exact outlines. Male superior appendages as long as 9+10. From above gradually widening from base; inner border suddenly excavated near the apex; an acute spine at outer distal angle; a median, longitudinal thickening traverses the whole length of each appendage. Inferior appendage short about one sixth as long as the superiors, distal end truncate.

The female differs in having the occiput twice tuberculate posteriorly, and in not having so strong a constriction at abdominal segment three. The appendages are as long as 9+10, foliate, pointed at apex.

This species has been taken at Columbus as early as March 21st, and has been observed on the wing during the first days of November. It oviposits usually while attended by the male. The pair may be seen flying over stagnant water where sedges and the like abound; at intervals they drop down and alight on some object near the water's surface; soon the female may be seen with her abdomen beneath the surface of the water depositing her eggs. Nymphs of various sizes may be secured from ponds and ditches at most any time of year.

Anax longipes, Hagen.

Length of abdomen ♂ 55-58, ♀ 52-60, hind wing ♂ 51-53 ♀ 49-56.

The following from Hagen's description, *Psyche* 1890, Vol V, 303, will enable the student to identify the species:

Male, eyes dark reddish brown, head, thorax and base of abdomen green; abdomen brick red; front green, without any spot above; vertex, antennæ and occiput black; eyes behind with a very large, elongated green spot; legs black, femora yellow. Wings hyaline, venation black, costa yellow, pterostigma narrow, yellow.

Female, head, thorax, legs and the two basal segments green; eyes blue, the hind margin of the occiput on each side yellow; second segment with a transversal brownish median stripe on each side; abdomen from the third segment brown.

Hagen's description was taken from living specimens.

GOMPHAESCHNA, Selys.

The insects of this genus have been taken in the State only at Columbus. Either they are not common or we have not learned how to procure them, for but few specimens have been taken or even seen.

Gomphaeschna furcillata, Say.

Length: of abdomen ♂ 44, ♀ 41; hind wing ♂ ♀ 36.

Male, color black and brown. Head, eyes brown, front brownish the posterior extremities in the form of a band grayish, disk marked with yellowish; antennæ yellow; behind the eyes black.

Thorax brown, a narrow humeral band and two lateral bands black; the first lateral band is abbreviated above, the posterior one is narrow and reaches to the base of the hind wing; between the inferior portions of the humeral stripes there are two yellow markings resembling marks of parenthesis. Femora brown, tibiæ and tarsi black; wings; costa yellow, pterostigma and veins brown. Abdomen black, the apex of each segment and ventral markings obscure brownish. Superior appendages as long as 9+10 inferior edge abruptly widened at basal fourth, both edges gradually widening from thence to apex, a longitudinal thickening at middle, apex rounded, inferior appendages two fifths as long as the superiors; the distal third divided, with the branches divaricate.

The colors of living specimens are very much brighter than in dry specimens. Thus what I have called brown or yellow is really greenish originally.

Taken at Columbus June 13.

This species differs from any other species of the sub-family in our fauna in the form of the abdomen. The widening again after the constriction at three is not present, but a very gradual narrowing continues from thence to apex.

FONSCOLOMBIA, Selys.

The single representative of this genus is quite common in Ohio. It flies along streams where fallen trees and drift-wood abound. Its glossy wings correspond so closely to the water that it is seen with difficulty. The female has been observed resting on the trunks and branches of trees and shrubs, sometimes twenty feet or more above the ground. This is one of the species which the collector is not likely to procure until he understands its habits. After that he considers it a common form.

Fonscolombia vinosa, Say.

Length of abdomen ♂ 50 ♀ 50. hind wing ♂ 42 ♀ 44.

Male; color reddish brown, darker in fully matured specimens. Two conspicuous yellow spots on each side of thorax; wings slightly brown at base, veins reddish, pterostigma yellow. Abdomen; mid-dorsal carina present on 2-8, auricles on 2 yellow, two or three small yellow spots usually present on sides of 4-8; superior appendages as long as 9+10, widest beyond the middle, narrowed from thence towards apex which is bluntly angular, a longitudinal, median thickening present.

Inferior appendages one third as long, yellow, conical, notched and brown at apex.

The female has the hind wing wider and the anal angle rounded.

Taken in all sections of Ohio in August and September.

BASIÆSCHNA, Selys.

The single species of this genus is abundant at times, while some seasons pass without its being observed at all. It is on the wing early, specimens having been procured at Columbus as early as the middle of April.

Basiæschna janata, Say.

Length: of abdomen ♂ ♀ 43, hind wing ♂ ♀ 36.

Colors; brown and fuscous. Male; front greenish, above yellow or greenish, with a median, longitudinal, impressed, black marking; occiput and rear of eyes largely yellowish. Thorax, mid-dorsal carina fuscous bordered each side by greenish; two greenish yellow bands edged with fuscous on each side; wings clouded at base, veins brown, pterostigma yellow, membranule white. Abdomen constricted at 3, superior appendages as long as 9+10, narrow at base, very gradually widening to beyond the middle. Here there is a bend and the general direction is directly backward, instead of obliquely downward and backwards as before. The apical third is flattened. Inferior appendages conical, one half as long as the superiors.

The female appendages are shorter, straight, and anal angle of hind wing rounded.

EPIÆSCHNA, Selys.

Like the two preceding genera this one contains only a single species. It is the bulkiest dragonfly of our fauna. *Macromia taeniolata* approaches it in expanse but not in size of body. This species differs from other species of the sub-family in the less obvious constriction at abdominal segment three.

Epiæschna heros, Fab.

Length: of abdomen ♂ 65 ♀ 67, hind wing ♂ 55 ♀ 60.

Male; colors brown and green. Front green darker approaching brown above, margin of mouth brown. Thorax brown, an antehumeral band and two lateral bands with a spot between their superior ends, green. Wings yellowish, veins and pterostigma brown; legs; femora brown at base, black at apex, tibiæ and tarsi black. Abdomen brown marked with bright green which becomes obscure in dry specimens; 10 with a mid-dorsal tooth.

Superior appendages, basal third narrow, remainder widened, median longitudinal carina present, inferior edge hairy. Inferior appendage one half as long as superiors, oblong, notched at apex.

The female lacks the spine on the dorsum of 10, but has a spined projection ventrally on that segment. She also has the rear of the eyes elevated so that a prominent projection is formed each side of the occiput.

The species flies during early summer. When on the wing it is continually catching insects, great number, of which are required to satisfy its voracious appetite. It is one of the few dragonflies that often enter buildings.

ÆSCHNA, Fabricius.

The species of this genus fly very commonly from August until the end of warm weather in the fall. In protected places along the edge of woods, one may find all of our Ohio forms flying together most any time in September. The different species are so much alike that one can not with certainty recognize them on the wing. Like the other members of this sub-family they take long excursions over sunny fields in search of flies and other insects for food. The three species of the genus taken in Ohio may be separated as follows:

1. Male, anal triangle of hind wing with three cells; a prominent spine at inferior distal angle of superior appendages. Female, genital valve strongly elevated at apex, vulvular process long, 2 millim.....*constricta*.

2. Male, anal triangle with two cells; superior appendages with longitudinal carina not denticulated. Female, genital valve not strongly elevated at apex, vulvular process short.....*verticalis*.
3. Male, anal triangle of two cells; longitudinal carina of superior appendages with apical third denticulated.....*clepsydra*.*

*We have not succeeded in identifying the female of this species.

Æschna constricta, Say.

Length of abdomen ♂ 52-58, ♀ 53-55, hind wing ♂ 43-46 ♀ 45.

Colors fuscous, brown and green. Male; front green, with a T-shaped black spot above; occiput yellow, lateral projections black; back of eyes black. Thorax brown with an antehumeral and two lateral bands green, also green between each pair of wings, femora brown above fuscous beneath, tibiæ and tarsi black; wings, pterostigma fuscous, membranule white anteriorly, dark posteriorly, anal angle of hind wings three celled. Abdomen fuscous, banded and spotted with green, strongly constricted at 3; superior appendages as long as 9+10, inferior margin prominent, hairy, and thickened to form an inward projecting tubercle posteriorly; base narrow, inferior distal angle produced into a prominent spine. Inferior appendages one half as long as the superiors, concave above, conical, blunt and obscurely notched at apex.

Female, wings yellowish, especially in old specimens, appendages foliate, mucronate at tips, narrow at base, length 7 millimeters; genital valve slightly longer than 9, with a lateral emargination; apex elevated truncate; vulvular process 2 millimeters long and tipped with a bundle of hairs. Description of female taken from three specimens taken in copulation.

This is our commonest *Æschna* and is taken in all parts of the state.

Æschna verticalis, Hagen.

Length of abdomen, 50-53 ♀ 53, hind wing ♂ 44-47 ♀ 45.

Colors brown, fuscous and green. Male; markings on thorax and abdomen are variable in different specimens. There are only two cells in the anal triangle of hind wings which at once separates it from *constricta*. Superior appendages as long as 9+10, narrow at base, superior longitudinal carina not denticulated, apex with a short thorn directed obliquely downward. Inferior appendage one half as long, conical, angular at apex.

Female of the same form as the male, appendages narrow at base, oblong, rounded at apex, obscurely mucronate. Genital valve as long as 9 with a lateral emargination; apex not strongly elevated. Vulvular process short, not over one millimeter. The appendages only a little more than half as wide as in *constricta*. This description was taken from a female taken in copulation. When more material is procured it may be necessary to verify some statments.

This species flies with *constricta* but is not nearly so common.

Æschna clepsydra, Say.

Length of abdomen, ♂ 51 ♀ 50, hind wing ♂ 44, ♀ 43.

Colors brown, fuscous and green. Head, front green, nasus and rhinarium fuscous or brownish in some specimens. Mandibles and margins of mouth fuscous, a fuscous T spot above; occiput yellow in the middle, remainder fuscous; rear of eyes fuscous. Thorax brown, an antehumeral stripe and two lateral stripes green, also green between the wings above; femora and tibiæ brown above, fuscous beneath, tarsi fuscous; wings and pterostigma fuscous above, yellowish beneath, costa yellowish, other veins fuscous; anal triangle of two cells, membranule small.

Abdomen constricted at 3, fuscous marked with green; mid-dorsal carina present; appendages as long

as 9+10, narrow at base, inferior edge widened at basal third, width nearly uniform from thence to near the apex; longitudinal carina present, denticulated on posterior third; apex rounded and furnished with a spine which points obliquely downward.

SIXTH SUB-FAMILY.

CORDULINÆ.

The members of this sub-family are medium sized to large species, and unlike those of the preceding, are seldom seen except in the vicinity of water.

All I have seen ovipositing fly leisurely near the bank and strike the water from time to time with the tips of their abdomens to wash off the eggs. Some of the forms fly quite early in spring but none of them are on the wing late in the fall.

The following will aid the student in separating our genera:

1. Hypertriagonal space free, sectors of the arculus free at origin...2
Hypertriagonal space traversed, sectors of the arculus more or less united at origin..... 4
2. Hind wings with dark markings at least at base.....3
Hind wings without dark markings, colors metallic.
Somatochlora.
3. Hind wings, dark only at base with triangles free...*Tetragonuria*
Hind wings, dark at base, middle and apex, triangles traversed.
Epicordulia.
4. Large species, expanse over 90 millimeters, tenth segment of the abdomen black in both sexes.....*Macromia.*
Smaller species, expanse 70-75 millimeters, tenth segment light.
Didymops.

MACROMIA, Rambur.

The members of this genus are easily recognisable on the wing by the transverse yellow band of the abdomen. They are large species and fly from middle to late summer. Both males and females, in apparently

equal numbers, have been taken while flying over the surface of the water.

The following key will separate the species of the genus:

- Expanse less than 100 millimeters, no antehumeral stripe *illinoisensis*
 Expanse 110 millimeters or over, antehumeral stripe present *taeniolata*

Macromia taeniolata, Rambur.

Length of abdomen ♂ 58 ♀ 61, hind wing ♂ 52 ♀ 58.

Colors black, yellow and brown. Male; head large, front vertex black with two prominences above, frons metallic green with yellow spots superiorly, rhinarium fuscous; labrum olive, dark at middle and inferior edge. A faceted tubercle on the posterior edge of eye. Thorax fuscous with a distinct greenish reflection; yellow superiorly, part of antehumeral and a complete lateral band present, yellow. The latter entirely encircles the thorax, passing between the insertions of the two pairs of wings above and the second and third pairs of limbs below. Legs and feet black, the hind femora reaching the middle of the 2nd abdominal segment. Abdomen black, with superior yellow markings on segments 1-8. Superior appendages 3-5 millimeters in length, bent inwards at apical third, apex turned outwards; an emargination on the outer side extends from the base to beyond the middle where it terminates in a small tooth. Inferior appendage nearly as long as the superiors, conical, curving upwards towards the apex.

Female usually larger than the male, and in my specimens the superior yellow markings on 8 of the male are not present.

Female usually larger than the male, and in my specimens, the superior yellow markings on 8 of the

male are not present. The species is common in the north western part of the state along the Maumee River. The males fly well out, and consequently are seldom taken, the females oviposit among leaves and algæ near the shore.

Macromia illinoisensis, Walsh.

Length: of abdomen ♂ 48-50, ♀ 50; hind wing, ♂ 45 ♀ 46.

Male; colors fuscous, brown and yellow. Head very much as in *tæniolata*. Thorax brown or fuscous with metallic greenish reflections. Yellow before the base of the anterior wings, and lateral band present as in the latter species, but the antehumeral absent.

Wing hyaline often brownish tinted, more prominently at the apex. Superior yellow markings, often very small, on abdominal segments 2, 3, 4, 7 and 8, occupying nearly a third of 7 at base. This last is strikingly prominent when the species is on the wing. Superior appendages much as in *tæniolata*, but more gradually narrowed towards the apex; slightly longer than 10. Inferior appendage about as long as the superiors, conical, apex elevated. Female differs in having superior yellow markings on segments 2-7 and the wings are often more uniformly brownish.

The species flies most commonly during July, and may be seen at times some distance from water. I have taken the female flying over ripples of our larger streams, and a pair in copulation resting on a low bush not over two feet from the ground. It is more common than the preceding species and may be expected in any part of the state.

Its smaller size will separate it from *tæniolata*.

DIDYMOPS, Rambur.

The single species of this genus is commonly taken in Ohio. We have found it most common in May,

although it has been taken as early as April 25. At this early date the species was found in sunny places along the border of woods.

Didymops transversa, Say.

Length: of abdomen ♂ 36-38 ♀ 40; hind wing ♂ 33-35 ♀ 37.

Male; colors brown and yellowish. Head, front livid with frons and nasus brownish, frons above with an olive spot each side; rear of eyes yellowish, dark near the occiput. Thorax brown, a transverse band before base of the fore wings. mid-dorsal carina, a narrow humeral and a prominent lateral stripe, white; wings brownish at base, costa yellow, pterostigma and veins fuscous; legs, femora brown, tibiae yellowish above, fuscous below, tarsi black. Abdomen brown, all the segments more or less banded, a prominent whitish band at base of 7, and a spot each side at base of 8; 10 wholly whitish or yellowish.

Superior appendages 2 millimeters in length, widest at base, nearly straight, posterior third on the outer side narrowed, apex acute; inferior appendage about as long as superiors, edged with brown, conical, apex blunt and furnished superiorly with a pair of prominences.

Female larger than the male and the brown markings between costa and third vein at the base of the wings is noticeably longer.

EPICORDULIA Selys.

The two species of this genus are American. We have only one of these in Ohio. This one is common along all of our larger streams, canals, and lake shores during July and August.

Epicordulia princeps, Hagen.

Length: of abdomen ♂ 43 ♀ 47; hind wing ♂ 41 ♀ 45.

Colors; olive, brown and fuscous. Male; front olive, vertex brownish, antennæ black. Thorax thickly clothed with long, gray pile, ground color olive, anterior, lateral band prominent below, humeral and antehumeral bands present, but usually very nearly obscure. Legs, coxæ and trochanters olive, front and middle femora olive above, fuscous beneath, hind femora and all the tibiæ and tarsi fuscous. Wings with a basal patch, often greatly reduced on the front pair, a patch at nodus, sometimes wanting, and apex black. Abdomen constricted at 3, largely fuscous above; beneath and on the sides yellowish brown. Superior appendages club shaped in general outline; inferior, apical fourth excised, apex very bluntly pointed. Inferior appendage more than two thirds the length of the superiors, widest at base, gradually narrowing to apex, which is furnished with two upward directed projections.

Female similar to the male in color and form, vulvar lamina nearly as long as 9, divided for its entire length, the two parts divaricate, slightly curved inward at apex; appendages longer than 9+10.

The species is easily identified by the black markings on the wings, as none of our large forms except some of the *Libellulas* have such characters.

TETRAGONEURIA, Hagen.

Two species of this genus have been recorded for Ohio. These fly in the fore part of summer, and one is very common. Small ponds seem to attract these forms, but it is not unusual to find them flying over running water. They are the smallest species of the sub-family, *Cordulinæ*.

Tetragoneuria cynosura, Say.

Length: of abdomen ♂ 30, ♀ 27; hind wing ♂ 28, ♀ 29.

Male; frons, labrum and labium yellow, other parts of front olive. In some specimens the whole front is olive. Thorax with a covering of long pubescence, two angular, yellow spots in front of the inferior half of the second lateral suture, these spots and both sutures margined with metallic blue. Basal two thirds of front femora yellowish or light brown, remainder of legs dark brown to nearly black. Fore wings hyaline; hind wings with a basal streak between subcostal and median veins extending to first antecubital, the space at extreme base between submedian and post-costal veins and a triangular patch occupying the lower part of the anal triangle and part of at least three neighboring cells, fuscous; remainder hyaline.

The dark markings of the wings are variable, but in none of our specimens do they extend much beyond what I have indicated, they may be very much reduced however. Abdomen fuscous with yellow markings on the sides of segments 2-9. Superior appendages as long as 9+10, the apical two thirds (nearly) thickened. From above separated at base, gradually approaching one another for one half their length, then diverging to apex. Inferior appendage reaching the middle of the thickened portion of the superiors, oblong conical, expanded laterally at extreme apex.

Female vulvar lamina composed of two horn-like lobes whose apices reach beyond the extent of the ninth segment.

The species is a common one in all parts of Ohio.

Tetragoneuria semiaqua, Burm.

Length: of abdomen ♂ 26-27, ♀ 28; hind wing ♂ 25-28, ♀ 29.

This species is very close to *cynosura*. Color alone is used to characterize it. The fuscous at the base of the hind wing is much extended, and occupies nearly all the space between the base of this wing and a line

drawn from the anal angle to the fourth antecubital. Different specimens vary in this respect, in some the dark marking is slightly reduced while in others it is extended. This character is constant in Maine specimens, kindly loaned me by C. C. Adams, in New York specimens and in Indiana specimens, so that, in none I have seen is there necessity of confusion with *cynosura*.

Taken at Columbus and observed at Delaware, in May.

SEVENTH SUB-FAMILY.

LIBELLULINÆ.

Twenty-eight species of Ohio dragonflies fall under this sub-family. They are second to the AGRIONINÆ when number of species is considered, but are by far the most conspicuous forms of our odonat fauna in all situations, especially during the summer season. Stagnant pools and ponds, skirted by sedges, cat tails and water lilies are especially attractive to them. Here the males fly back and forth, catching small insects for food, and searching for the females. While pursuing this apparent pleasure many of them sacrifice their lives to satisfy the greedy appetite of the king bird who perches himself on a branch of a nearby tree where he can view the proceedings and swoop down whenever he is sure he can procure a dragonfly for his trouble. Presently at your feet you observe the female with wings almost motionless, waving up and down, and at each downward movement, striking the tip of her abdomen on the surface of the water. She is ovipositing. If with a water net a quantity of the debris near the bank be procured a dozen or more nymphs of various stages are usually included. Thus one might seat himself and write out nearly a full life history of a dragonfly from the material of a few minute's collecting.

The members of this sub-family are medium sized to large species with ample wings and short, thick bodies. In some species males and females are colored differently, while in others both sexes are alike. Most of the forms are easily collected on account of their abundance, but there are a few species that occur over large areas and are never common anywhere, these are usually procured with difficulty. The Ohio species are placed in ten genera which may be separated by the following table :

1. Hind wings very wide at base, fore wings, except in some cases at extreme base, entirely transparent.....3
2. Hind wings not extremely wide at base.....4
3. Base of hind wing black or brown for its entire width.....*Tramea*
Base of hind wing transparent with anal margin yellowish, or infuscated at anal angle.....*Pantala*.
4. Hind lobe of the prothorax large, bilobed.....5
Hind lobe of the prothorax small, entire.....10
5. Sectors of the arculus pedicellate.....6
Sectors of the arculus not pedicellate.....9
6. Both sectors of the triangle in the hind wings arising from its hind angle.....7
Lower sectors of the triangle in the hind wings arising from its hind angle, the upper from its outer side.....8
7. Nearly black species, extreme base of hind wings black, front white.....*Leucorhinia*.
Never black, extreme base, sometimes basal half, of hind wings yellowish brown, front variously colored but never pure white, *Diplax*.
8. Base of hind wings perfectly transparent, thorax unicolorous, last antecubital of front wings usually not continued to median vein..... *Mesothemis*.
Base of hind wings yellowish brown, thorax banded with black and olive, last antecubital of front wings usually continued to median vein..... *Pachydiplax*.
9. Small species, expanse about 30 millimeters, hamule of male not bifid..... *Perithemis*.
Larger species, hamule of male bifid.....*Celithemis*.
10. Male with a pair of ventral hooks on first abdominal segment, third tibiæ, as long as third femora.....*Plathemis*.
Male with no ventral hooks, female with third tibiæ at least a little longer than third femora.....*Libellula*.

PANTALA, Hagen.

The two species of this genus are large with hind wings very wide at base. Abdominal segments 3 and 4 each with two additional transverse carinæ, nodal sector waved.

1. Front yellow, anal margin of hind wing yellowish.....*flavescens*.
2. Front red, anal angle of hind wing with a fuscous spot.
hymenæa.

Pantala flavescens, Fab.

Length: of abdomen ♂ 32-34, ♀ 34; hind wing ♂ 40-42, ♀ 41.

Male; color yellowish brown. Front yellowish, margins of mouth, antennæ and basal part of vertex fuscous.

Thorax, mid-dorsal carina and vestiges of lateral bands present, fuscous; hind wing, anal margin and a small patch at apex flavescent. Abdomen with a maculate mid-dorsal band, sometimes absent on some of the segments. Superior appendages about 3 m.m. in length, yellow at base, remainder black, oblong, nearly contiguous, and furnished with an oblique spine at apex. Inferior appendage two thirds as long as superiors. Female like the male.

The species is a strong flyer and fully matured specimens are hard to take as they fly well out from the bank. Taken in all parts of Ohio during July and August.

Pantala hymenæa, Say.

Length: of abdomen ♂ 30-33, ♀ 31; hind wing ♂ 40-42, ♂ 42.

Male, color reddish brown. Front red, margin of mouth, antennæ and basal part of vertex fuscous. Rear of eyes narrowly yellowish on the sides, remainder brown. Hind wing with anal angle and oftentimes apex fuscous. Abdomen reddish brown, segments 8-10 with black dorsal band. Female similar to the

male. Easily separated from *flavescens* by the red base, and fuscous spot at anal angle of hind wing.

The species has been taken at Columbus (Osburn), Laramie Reservoir (Williamson), and Columbus, in July.

TRAMEA, Hagen.

This genus contains three Ohio species. The base of hind wing in all of them is wide and conspicuously colored. Abdominal segments 3 and 4 with one additional transverse carina, nodal sector not waved or broken.

1. Basal fourth or fifth of hind wings violet black.....*lacerata*.
Basal part of hind wings brown.....2.
2. Basal third of hind wings brown, hamule not exceeding the genital lobe in length, vulvar lamina shorter than 9.....*carolina*.
Basal fourth of hind wing brown, hamule exceeding the genital lobe, vulvar lamina as long as 9.....*onusta*.

Tramea lacerata, Hagen.

Length: of abdomen ♂ 37, ♀ 35; hind wing ♂ 42-45, ♀ 46.

Male, color brownish black. Front blackish, vertex and large part of frons metallic violet. Thorax with a greenish reflection, legs black, anterior wings hyaline, black at extreme base, hind wings violet black at base, the outer edge ragged, a triangular, hyaline space near the middle of the anal margin. A large light colored spot on the dorsum of the seventh abdominal segment, often obscure in dry specimens. Superior appendages as long as one half of 8+9+10, hamule shorter than the genital lobe.

The female has yellowish white markings on 3-7; on 3-5 these consist of a pair of small spots. Vulvar lamina one half as long as 9.

The species is common in all parts of the state during a large part of the summer.

Tamea carolina, Linn.

Length: of abdomen ♂ ♀ 32; hind wing ♂ ♀ 41.

Male, color reddish brown. Superior part of frons violet. Femora brownish at base, black at apex, tibiæ and tarsi black; front wings hyaline, extreme base yellowish, hind wings reddish brown at base for nearly a third of their length, within the space many of the fine veins are yellowish. Abdominal segments 8-10 black above. Superior appendages a little longer than 9+10, slender and pointed at apex. Inferior appendage nearly two thirds as long as the Superiors. Hamules as long as, or very slightly longer than the genital lobes. Female abdominal segments 8 and 9 black, vulvar lamina not quite as long as 9, bilobed.

A comparatively common species in various parts of the state during the summer months.

Tamea onusta, Hagen.

Length: of abdomen ♂ 31, ♀ 33; hind wing ♂ 38-41 ♀ 42.

Male, color reddish brown, vertex brown, front reddish brown, in the specimens before me not showing the violet present on the superior part of the frons in *carolina*. Femora brownish at base, black at apex, tibiæ and tarsi black; wings, anterior pair hyaline, extreme base brown, the reddish brown patch at the base of the posterior pair is narrower than in *carolina* and the outer edge is more ragged. Superior appendages a little longer than 9+10, hamules noticeably longer than the genital lobes.

Female vulvar lamina as long as 9, bilobed in its apical three fourths.

Taken at Columbus May 7, and at Cincinnati (Dury) May 23.

LIBELLULA, Linn.

In *Libellula* the posterior lobe of the prothorax is small and entire. The male is without hooks on the

first abdominal segment. Nine Ohio species are considered under this genus. Several of them are very common forms, while others are local or rare. None of them fly very early in Spring.

The following key will aid in separating the species:

1. Base of wings black nearly to middle for entire width.....*basalis*.
Base of wings transparent for at least a part of the width.....2
2. A dark colored patch of more or less extent at nodus of each wing.....3.
No dark patch at nodus.....6.
3. Dark marking at nodus entirely posterior to it, small.....4.
Dark marking at nodus surrounding it, much larger.....5.
4. Base of hind wing with a triangular, black patch which is produced at its outer angle, apex of wings transparent
quadrimaculata.
Base of hind wing with only the space between second and third veins, black, apex of wings fuscous, more prominently in the female.....*vibrans*.
5. Dark markings at base occupying nearly the anterior half of basal third of wing.....*pulchella*.
Dark markings at base small, situated near the middle of basal part of wing.....*semifasciata*.
6. Pterostigma prominently bicolored, yellow and black.....*cyanea*.
Pterostigma not bicolored.....7.
7. Wings with dark markings at base.....*exusta*.
Wings with no dark markings at base.....8.
8. Yellowish species, pterostigma yellowish with the veins above and below it black, costal third of wing membrane yellowish.
auripennis.
Dark species, pterostigma black, wings transparent except at apex in the female where they are fuscous.....*incesta*.

Libellula basalis, Say.

Length: of abdomen ♂ 29-31, ♀ 26; hind wing ♂ 41, ♀ 38.

Male, color blackish brown. Front yellowish to dark brown with a bluish tinge in fully matured specimens. Thorax with a mid-dorsal stripe yellow and a humeral and one lateral stripe dark in specimens not fully colored, in old specimens these markings are more or less obscured and the whole thorax is uniform blackish brown. Abdomen with a yellowish stripe each side which also is more or less obscured in old specimens.

Legs black, wings black on basal half to third, beyond this white, apical third clearly transparent.

The female usually lacks the white on the wings and the black at base is shorter and often reduced, especially on the fore wings, so that it has a smoky appearance. Apex of the wings often fuscous.

The species is very common and is usually the first species to attract the attention of the amateur collector. Like the other species of the genus, it prefers the vicinity of stagnant ponds where the sun's rays are unobstructed.

Libellula auripennis, Burmeister.

Length: of abdomen ♂ 36, ♀ 34; hind wing ♂ 38, ♀ 39.

Male, colors yellowish to brownish. Front in fully matured specimens shining brown, variable according to the stage of coloration of the specimen. In teneral specimens the mid-dorsal thoracic stripe is present, later this is obscured. The dorsal black stripe on the abdomen is apparently constant. Wings with a yellowish tinge, more prominent along the front margin, pterostigma yellowish, bounded by black veins.

The female is similar to the male, but has the apex of the wings smoky.

This species is quite distinct from other Ohio forms, but appears to be very close to *plumbea* of the eastern states. It may be separated from that species however by the absence of a brown, basal streak between subcostal and median veins.

Hagen reported this species from Ohio, but it has not been taken in recent years, until the past summer when specimens were procured at Cincinnati. It is probably a coast species by preference.

Libellula cyanea, Fabricius.

Length: of abdomen ♂ 30, ♀ 27; hind wing ♂ 35, ♀ 35.

Male, colors yellow and brown, wholly blue pruinose in old specimens. Front, mid-dorsal stripe and lateral spots on thorax, and abdomen each side, yellowish. In old specimens these markings are all obscured. Wings yellowish along the front margin, at base the space between subcostal and median veins black. Pterostigma bicolored, inner half sulphur yellow, outer half black.

The female has the wings decidedly black at apex, and in old specimens the yellow is encroached upon by brown.

The species so far has been taken in only one locality in the state. Here it has been observed two years in succession and no less than a dozen specimens taken, so we have no doubt that it is a permanent resident in Ohio.

Mr. J. B. Parker secured specimens at Danville in June 1897 and '98.

Libellula vibrans, Fabricius.

Length: of abdomen ♂ 40, ♀ 38; hind wing ♂ 46, ♀ 48.

Male, colors brown and yellowish, old specimens pruinose. Front olive, labrum and labium yellow, the latter black at middle, margins of mouth and mandibles black. Thorax yellow on the sides marked with black below, prothorax more or less black. Mid-dorsal stripe on thorax yellow. All these markings may become obsolete in old specimens. Abdomen yellow on the sides at first, but later no markings can be seen. Wings transparent, space between subcostal and median veins at base, a small spot at nodus, and extreme apex black.

The female has more black at apex of wings. This is the largest species of the genus in our fauna, the small nodal spots in connection with the basal space

between subcostal and median veins will characterize the species.

It is not a common form, but has been taken at Licking Reservoir and at Columbus (R. C. Osburn) in June.

Libellula incesta, Hagen.

Length: of abdomen ♂ 35-36, ♀ 32-33; hind wing ♂ 39, ♀ 40.

Male, yellowish to blue pruinose according to age. General specimens have the front, sides of thorax and abdomen yellowish. Fully matured specimens have the front dark, nasus metallic superiorly, thorax and abdomen uniform blue, pruinose. No nodal patch or basal coloration, but some specimens have the nodus very narrowly margined with fuscous on each side.

The female retains more or less of the yellowish on front, thorax and abdomen throughout life. Her wings are like those of the male except they are fuscous at apex.

The clear transparent wings without nodal or basal spots will serve to separate this species from all others.

This seems to be a widely distributed species in the state, and in places is abundant. At Sandusky it is on the wing in June and July.

Libellula exusta, Say.

Length: of abdomen ♂ 25, ♀ 23; hind wing ♂ 33, ♀ 31.

Mature male, front olive, labrum and labium yellowish, occiput black, front of thorax and abdomen pruinose, sides of thorax brownish, humerus darker. Fore wings with two, short, basal streaks fuscous extreme base brownish. Hind wings at base with space between subcosta and median vein, and a triangular spot behind submedian vein fuscous, membranule

white. The thorax and abdomen of teneral specimens are lighter colored and not pruinose.

Female similar to the male.

This is the smallest species of the genus, taken in the state.

Four males taken at Stewart's Lake in Portage County, June 21, 1898. Not reported from any other section.

Libellula quadrimaculata, Linn.

Length: of abdomen ♂ 30, ♀ 30; hind wing ♂ 35, ♀ 36.

Male, colors olive, fuscous and yellow. Frons above black, in front yellowish, nasus and rhinarium olive, labrum yellow in the middle, edges black, labium yellow on the side, black between; rear of eyes black with two yellow spots. Thorax with narrow humeral and side stripes black, and two prominent spots yellow, prothorax and legs black. Front wings yellowish at base, nodal spot small, fuscous, hind wings with a basal, fuscous patch below the submedian vein; superior to this yellowish, nodal spot as in the fore wings. Abdomen yellowish or olive with black on venter and dorsum of 7-10.

The female has a conspicuous row of yellow dashes on each side of the abdomen from segment 3 to 9.

This species has been taken in the central and northern parts of the state but seems to be rare. It is on the wing in June.

Libellula semifasciata, Burmeister.

Length: of abdomen ♂ 26-28, ♀ 25-27; hind wings ♂ 35-37, ♀ 36-38.

Male, colors yellowish and fuscous; front yellowish, largely replaced by red. Rear of eyes brown with yellowish outer margin. Thorax brownish yellow with two lighter colored lateral bands; femora at base

yellowish, remainder of legs and feet fuscous. Fore wings yellowish on basal third, space between bases of sectors of arculus and a space below this between submedian vein and postcosta fuscous, a patch surrounding nodus, and apex brown; hind wings like the fore wings except the fuscous below the submedian vein is wider and extends to base and usually in addition a brownish patch near middle of the anal margin. Abdomen yellowish with fuscous, dorsal band present on 6-10.

Female like the male except the extreme apex of wing is hyaline. I have seen some males also with this character apparent.

A common form in all sections of the state.

Libellula pulchella, Drury.

Length: of abdomen ♂ 33-35, ♀ 32; hind wings ♂ 40-44, ♀ 42.

Male, colors brown, yellowish and fuscous. Front brownish, two yellowish spots behind the eyes. Thorax with two yellowish, lateral bands. Wings, a patch at base, a patch surrounding nodus, and apex fuscous. The basal patch is one fourth or more of the length of the wings and gradually widened distally but at no point touches either costa or posterior margin. Dark markings of hind wings like those of fore wings. Anal margin of hind wings and patches alternating with dark markings on all the wings whitish especially in old specimens. Abdomen with a yellowish longitudinal band each side.

Female similar to the male, but whitish on the wings may be absent. Old specimens of both sexes are pruinose.

A common form everywhere during a large part of the summer and autumn.

PLATHEMIS, Hagen.

The single Ohio species of this genus has the appearance of a *Libellula*, but the pair of hooks on the under side of the first abdominal segment of the male characterizes that sex. The female is much like *L. pulchella*, but its much smaller size will separate it from that species.

Plathemis trimaculata, De Geer.

Length: of abdomen ♂ 28, ♀ 24; hind wing ♂ 32, ♀ 35.

Male, colors brown and yellowish. Front brown, labrum and labium yellowish, rear of eyes brown with two bright yellow spots on each side. Thorax each side with two oblique, white stripes each terminating below with a yellow spot. A row of oblique yellowish spots on each side of the abdomen from 2-9. Wings, at base with a brown patch which in width extends from above the subcosta to the postcosta and in length about one fourth the extent of the wing, at middle with a brown patch covering the whole width, and in length reaching from before the nodus to about the middle of the pterostigma, apex from thence hyaline.

The female has the basal patch brown as in the male, a large nodal patch not reaching the posterior margin, and the apex of the wing from the middle of the pterostigma, brown.

The species is common everywhere, and may be seen resting on logs and fences along the edges of woods, as well as flying over stagnant ponds and running streams.

CELITHEMIS, Hagen.

The members of this genus are all graceful and active species. The wings are ample and variously marked, even in the same species. As they fly along the margins of ponds and lakes they are very attractive

to the collector who at once is filled with a desire to procure specimens, but he may experience many disappointments before his prize is captured. They spend much of the time perched upon the tips of sticks and reeds near the waters edge. The female of some of the species remain in concealed places a great deal of the time and consequently are seldom taken, while with others this sex is taken as frequently as the male. The female is attended by the male a great deal of the time while ovipositing.

Our three species may be separated as follows :

1. Expanse not less than 65 m. m., wings uniform yellowish with brown markings, apex of wings beyond pterostigma with no apparent brown or fuscous markings..... *eponina*.
Expanse not more than 60. m.m. wings hyaline with brown, yellowish or fuscous markings, apex of wings beyond pterostigma marked with brown or fuscous.....2.
2. Wings with brown and yellowish markings, pterostigma reddish *elisa*.
Wings with fuscous or black markings, pterostigma black *fasciata*.

Celethemis eponina, Drury.

Length: of abdomen ♂ 25-27, ♀ 23-25; hind wing ♂ 31-33, ♀ 30-32.

Male; colors brown and yellowish. Front brownish, thorax with two, narrow, black, lateral bands, abdomen with dorsal and lateral bands present, yellow. Fore wings yellowish with a spot between arculus and outer side of triangle, a band at nodus not attaining the posterior margin and a band before the pterostigma usually reaching the posterior margin, brown. Hind wings yellowish with a patch attaining the base and extending to distal part of triangle, a spot near anal angle, a divided nodal band and band before pterostigma, brown. Any of these markings may be reduced.

The front of the female is usually yellow, and the ground color of the wings is lighter than in the male.

The markings of the wings are like those in the male but may be very much reduced, but not entirely absent.

An exceedingly abundant species in all sections. In the marshes around Sandusky Bay it is more common perhaps than any other dragonfly during July. Pairs in copulation were taken July 18, 1896.

Celeftemis elisa, Hagen.

Length: of abdomen ♂ 20-22, ♀ 19-20; hind wing ♂ 27, ♀ 25.

Colors: male, red, black and yellowish, front red; fore wings hyaline, base yellowish a point above the triangle, a spot beyond the nodus, and apex reddish brown; most of the cross veins along the costal margin, margined with brown, pterostigma yellowish to red.

Hind wings hyaline, with an elongated, irregular patch extending from base of wing to beyond the outer part of the triangle, a large patch below this not quite reaching the posterior or anal margin, a patch beyond nodus, and apex, reddish brown; the basal fourth of the wing where not occupied by brown is yellowish, pterostigma and cross veins as in the fore wings. Abdomen black, superior parts of 3-7, except apex, red.

In the female the front is yellowish, the color at the base of the hind wings is clearer than in the other sex, and abdominal segments 2-7 are yellow superiorly; otherwise like the male.

The form is very common in northern Ohio and has been taken in the southern part of the state. Differing from the preceding species, the females are taken much less commonly than the males.

Celithemis fasciata, Kirby.

Length: of abdomen ♂ 23, ♀ 21; hind wing ♂ 27-28, ♀ 27.

Male, colors black and yellow. Front; frons metallic blue, nasus, rhinarium and labrum yellow in

some specimens, black in others; labium yellow at the sides, black at middle, in one specimen the yellow parts are olive to brown. There is so much variation in these parts, that definite statements regarding them can not be formulated. Thorax in one specimen yellowish on the sides with two black bands, in another the yellowish is entirely absent. Fore wings hyaline, fuscous or black as follows: apex from distal part of pterostigma; a patch beginning at costa, nearer the pterostigma than the nodus and extending backwards half way across the wing; this patch is narrowed or nearly divided near its middle, making it somewhat hour-glass form; and a patch beginning at nodus below the subcosta and extending towards the base of the wing; at some point between nodus and triangle this patch is divided, sending a superior branch to base between subcostal and median veins, and an inferior branch to beyond the inner side of the triangle between the sectors of the arculus; a small patch including the superior part of the triangle connects with the inferior branch and sends a spur towards the base of the wing between submedian and postcostal veins. This spur and the superior branch mentioned above may or may not be interrupted by clear spaces. In the hind wings the apex and patch before the pterostigma are as in the fore wings, except the latter may be entirely divided. Distally the basal patch may be bounded below by the lower sector of the arculus or it may send back a process which in extreme cases reaches the lower sector of the triangle; the basal patch, also includes the entire triangle and a basal process which extends backwards and terminates on a level with the distal end of the membranule; included within the basal patch is a hyaline patch which occupies the space between median and submedian veins to arculus, and the space between median vein and superior sector of the arculus to a point above the

outer part of the triangle. In addition the hind wings have a nearly round spot before the anal angle. The abdomen is uniform black in all specimens before me, but I should suppose that in teneral specimens it might be otherwise.

The female has the extreme apex of all of the wings hyaline. The extremity of the distal process of the basal patch in the hind wings is separated from the main part in one specimen and exists as a separate spot. The spot before the anal angle is reduced in all my specimens, and in one specimen is very small. The front is yellowish and the abdomen has a dorsal band in the form of triangular spots on segments 2-8; various yellow markings are present on the sides of the abdomen in a teneral specimen but are absent in a mature specimen.

The species seem to prefer small lakes where the water is clear. Six specimens were taken in Summit County along the shores of Silver and Summit Lakes in June and July. June 23 was the earliest date that specimens were taken, at this time the females were teneral, but the males had full colors. Their actions in the field are like those *C. elisa*.

LEUCORHINIA, Brittinger.

This genus contains only one Ohio species.

The pterostigma is short and broad, not more than twice as long as broad, the wings are yellowish and black at base. The species is a common one and like other members of its family is attracted to strgant ponds.

Leucorhinia intacta, Hagen.

Length: of abdomen ♂ 23, ♀ 21; hind wing ♂ 24-26, ♀ 25.

Male, front white, labrum yellowish, labium black, brownish on the sides; rear of eyes black, feet and

legs black. Front wings black at extreme base, this color may extend outward a short distance between subcostal and median veins, and submedian and post-costal veins, thus forming two basal streaks. Hind wings black at base, here the color takes the form of a basal black streak and a basal triangle beneath. The abdomen is black with a superior yellow spot on the base of 7. In young specimens a dorsal spot is present on each of segments 2-7.

The female usually has more or less yellowish on the basal third of the wings, and the abdomen is stouter and marked with yellow on the sides as well as on the dorsum.

A common species.

DIPLAX, Charpentier.

Six Ohio species are included within this genus. Most of them are seldom seen flying over water but may be found in profusion in the adjoining marshes or lowlands. Males and females inhabit the same spot, and are each taken in nearly equal numbers. They are characterised while on the wing by their striking red bodies, which become dull brown in dry specimens. This red color is not apparent, however when the insect first emerges, and only comes gradually with increasing age. Old and worn specimens have lost the bright red and appear duller in coloration. One or more species may be found on the wing at any time between June 10, and the middle of October.

I offer the following Key which is largely taken from Calvert's work on the genus, as an aid in separating our species:

1. Basal half of hind wings yellowish.....5
Hind wings with extreme base, or not at all, yellowish.....2
2. Expanse over 60 millimeters, an additional carina on abdominal segment 4.....*corrupta*.
Expanse less than 60 millimeters, no additional carina on 4.....3

3. Male inferior appendage four fifths as long as the superiors; superiors with no prominent inferior tooth, but with 4-9 inferior denticles of which the distal one is the largest; female vulvar lamina entire.....*vicina*.
 Male inferior appendage about two thirds as long as the superiors; superiors with a prominent, inferior, median tooth on the basal side of which are 5-8 denticles; female vulvar lamina bifid.....4
4. Male genital hamule with a little more than its apical third bifid, posterior branch twice as wide as the anterior, front usually pinkish in fully developed specimens.....*rubicundula*.
 Genital hamule with apical fourth bifid, posterior branch at least four times wider than internal branch. Front usually whitish olive in fully developed specimens.....*obtrusa*.
5. Male superior appendages with a prominent, inferior, median tooth; female vulvar lamina bifid at apex.....*assimilata*.
 Male superior appendages with no prominent inferior tooth, but with 4-9 inferior denticles of which the distal one is the largest; female vulvar lamina entire.....*semicineta*.

Diplax rubicundula, Say.

Length: of abdomen ♂ 22-26, ♀ 22-24; hind wing ♂ 25-29, ♀ 26-28.

Male; front yellowish to reddish, wings hyaline, extreme base of both pairs yellowish, femora brownish at base and on the inner side, remainder of legs and feet black. Abdominal segments 3-10 black on the sides, and brown beneath. Genital hamules bifid for a little more than a third of their length, the anterior lobe longest, a little curved, and acute and tipped with black at apex; the posterior lobe is nearly triangular in outline with the apex rounded. Superior appendages with a prominent, inferior tooth at middle, bearing on its proximal side about seven teeth. Inferior appendage reaching nearly two thirds the length of the superiors and bearing a hook-like tooth on each side above. From below the inferior appendage is nearly conical with apex broad and slightly prominent at the sides.

The female is similar to the male in color and size. The vulvar lamina is bifid at apex.

This species is abundant from the middle of June to the first of October.

Diplax assimilata, Uhler.

Length: of abdomen ♂ 24-25, ♀ 22-25; hind wing ♂ 26-29, ♀ 26-30.

This and the above species vary considerably in size, and one would expect to find specimens both larger and smaller than the measurements given.

D. assimilata has been placed as a synonym of *rubicundula* by Calvert. but by others it is considered a distinct species. After a careful study of the anatomy of both, I am unable to give any constant character for their separation except the yellowish coloring of the basal half of the wings in *assimilata*.

Toledo July 30, Sandusky July 20, not uncommon at Columbus.

Diplax obtrusa, Hagen.

Length of abdomen ♂ 22-25, ♀ 24; hind wing ♂ 22-25, ♀ 23-25.

This species resembles *rubicundula* so much that it seems best to give simply the points of difference between the two species.

Genital hamules of the male with apical fourth bifid, the branches of the same length; posterior branch at least four times as wide as the internal branch.

The female is separated from the female of *rubicundula* by the vulvar lamina. In the last named species this is short, rather broad and bifid at the tip. The two lobes have the appearance of being inflated, are strongly convex below, and straight above and terminate rather abruptly; while in *obtrusa* the hamule, although short, and bifid at the apex, is narrower, the two lobes have an angular appearance, are only slightly convex below, and each slopes rather gradually to an acute point at apex. Instead of appearing inflated, the two lobes rather appear contracted.

In both sexes the front is more nearly white than in *rubicundula*.

The species is common in all parts of the state. It begins to fly in July and is most abundant in August and the first part of September.

Diplax vicina, Hagen.

Length: of abdomen ♂ 21-23, ♀ 20-24; hind wing ♂ 24-25, ♀ 22-25.

Colors as in *rubicundula*, yellowish in teneral specimens, red in fully matured specimens. Male, front reddish. legs and feet brown or at least not black, wings hyaline, yellowish at extreme base.

Genital hamules small, bifid for more than half their length from apex, the two branches of nearly the same width at base, the anterior one longer, curved and acutely pointed at apex; the posterior one widest near the middle and irregularly rounded at apex. Superior appendages widest half way between middle and apex, before the widest point are about five inferior teeth. Inferior appendage nearly four fifths as long as the superiors.

Female, vulvar lamina widest behind, distinctly projecting, hind margin entire.

Taken in all sections of the state, and appears later in autumn than any other species of the genus. Taken in copulation Nov. 7, at Columbus.

Diplax semicincta, Say.

Length: of abdomen ♂ 18-21, ♀ 17-21; hind wing ♂ 21-25, ♀ 20-24.5.

Colors, yellowish in teneral specimens, red in fully matured specimens. Male, front reddish to yellowish. Legs at base and inferior side of front femora reddish, remaining parts blackish. Basal part of front wings, sometimes to triangle, sometimes to nodus yellowish; hind wings, basal half yellowish.

Genital hamules bifid for apical half, the anterior branch shorter pointed and slightly hooked at apex, posterior lobe three times as broad as the anterior, apex rounded. Superior appendages with about six inferior teeth beyond the middle. Inferior appendage four fifths as long as the superiors.

Female colored like the male or with yellowish part of fore wings brighter than in that sex. Vulvar lamina short, only slightly projecting, posterior margin entire.

Taken at Columbus. Common at Sandusky in July.

Diplax corrupta, Hagen.

Length: of abdomen ♂ 26-29, ♀ 27-28; hind wing ♂ 28-30, ♀ 29-31.

Male, teneral, yellowish; front yellowish, thorax with an antehumeral, a narrow humeral, and two lateral bands terminated below by a bright yellow spot, graysih. Abdomen yellowish, sides with the ventral margins of the segments black; dorsal spots on 8 and 9. Legs, at base, and superior side of femora and tibiæ yellow, other parts black. Wings nyaline with veins and pterostigma yellowish.

The male when fully colored is red. The markings on the thorax are reduced to the two bright yellow points or spots on each side. The legs are like those of the teneral form. The venation of the wings is reddish. Genital hamules small, apical third bifid, anterior branch short, sickle form and acute at apex; posterior branch twice as long, several times as broad, directed obliquely outwards and backwards, rounded at apex. Superior appendages 2 m.m. in length, yellow, with a row of inferior, black denticles which begin near basal third and extend to where the appendage begins to narrow; apex tipped with an acute, black spine. Inferior appendage three fourths as long as the superiors.

Female colored like the male, except her front is lighter, usually yellowish. Vulvar lamina short, most prominent at the sides.

The large size of this species separates it from other Ohio members of the genus.

One should observe *corrupta* in the field for one season to become thoroughly acquainted with its variations. If he does not know it in all its stages to begin with, and if he is eager to obtain the greatest number of forms possible in a certain locality, he can easily convince himself that the various colorations it presents, represents at least three distinct species.

It is common in all parts of the state during July and August.

PERITHEMIS, Hagen.

In the single species of this genus, the hind wings are longer than the abdomen. Although very common around water, it is not conspicuous because of small size and rather secluded habits. It flies low and rests a part of the time on water plants or anything that projects above the water. While its colors are developing after emergence it may be found in the fields some distance from water. Males and females are taken usually in about equal numbers.

Perithemis domitia, Drury.

Length: of abdomen ♂ 14-15, ♀ 13-14; hind wing ♀ 19-20, ♀ 19-20.

Male, colors yellowish to brown, wings uniform yellowish or sometimes with a brownish point above the triangle. Thorax often with two olive, lateral bands or with each band represented by a small spot below the middle; these thoracic markings may be obscure or wanting. Abdomen nearly uniform brown in dry specimens.

Female, front wings with costal margin yellowish nearly to pterostigma, a patch at nodus extends

backwards almost to posterior margin, and a much smaller patch above the outer part of the triangle, brown; hind wings with costa and nodal patch as in the fore wings, but the other patch includes the triangle and is extended backwards nearly to the anal angle, and sends two branches to base, one between the subcostal and median veins and another between submedian and postcostal veins. These markings are subject to variation in extent and intensity of color.

Common in all parts of the state from June to September.

MESOTHEMIS, Hagen.

The single Ohio species of this genus is very common. The males are most often seen as they fly over open water a part of the time, the female usually remain among grass and weeds that grow either in or near the water; she is very attractive, but her green color protects her somewhat, and she may fly very near the collectors feet without being observed. She oviposits among low plants that grow in the water.

Mesothemis simplicicollis, Say.

Length: of abdomen ♂ 27-32, ♀ 29-31; hind wing ♂ 30-33, ♀ 32-34.

Male, colors black and green. Rear of eyes yellow marked with brown in such a manner that they appear chequered. Thorax green, legs black. Both thorax and abdomen blue pruinose in old males. Superior appendages yellow, a row of black denticles extending nearly the whole length of inferior edge. Inferior appendage brown, four fifths as long as the superiors.

In the female the abdomen is green with distal part of 4-7 and all of 8 and 9 dark brown above. All the segments more or less dark brown below. Vulvar lamina triangular, margin entire.

Abundant throughout the state, from May to September.

PACHYDIPLAX, Brauer.

This genus is represented by a single species.

The frons above and vertex are metallic blue, which character will separate it from related forms. It flies over shallow water where lilies and other water plants grow, here the female oviposits. Teneral specimens may be found a long distance from water.

Pachydiplax longipennis, Burm.

Length: of abdomen ♂ 20.29, ♀ 18-24; hind wing ♂ 25-33, ♀ 25-31.

Teneral male, front, labrum and labium yellowish, margins of mouth brown, frons above and vertex metallic blue. Thorax with mid-dorsal carina, an antehumeral stripe, abbreviated above, an irregular humeral stripe continued above by a transverse stripe before the antealar sinus, a wide, lateral stripe beneath the fore wings, one between the wings and all the posterior part of metathorax, yellow; otherwise brown. Legs; coxæ, trochanters and inner side of front tibiæ, yellowish; remainder including the feet dark brown. Wings yellowish at base, otherwise hyaline. Abdomen, venter and basal part at sides yellowish, dorsum brownish or blackish usually with a longitudinal row of yellow dashes on 2-8.

In the fully developed male the abdomen becomes pruinose and all the markings are obscured, the brown of the thorax becomes more or less greenish, and the hind wings have two longitudinal, dark brown, basal streaks, one between subcosta and median veins, the other between submedian and postcostal veins; both reach nearly to arculus. These latter may be present in teneral males.

The female is colored like the teneral male or pruinose in old specimens, her abdomen is widened posteriorly, her wings are yellowish at extreme base and the hind pair lack the longitudinal stripes.

Common in all parts of the state.

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NOTE.—Mr. E. B. Williamson concludes that *Enallagma Fischeri* is equivalent to Say's *antennata*. A conclusion which he states is concurred in by Mr. P. P. Calvert.



Ohio State Academy of Science

SPECIAL PAPERS No. 3.

THE PREGLACIAL DRAINAGE OF OHIO

Comprising the Results of
Researches made by Mem-
bers of the Academy of
Science, by the Aid of the
McMillin Research Fund

Some Drainage Modifications in Washington and Adjacent
Counties—With Illustrations and Map, . . . *By W. G. Tight, M. S.*

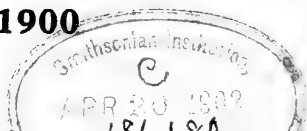
History of the Little Miami River—With Map,
By J. A. Bownocker, A. M.

Some Observations on the Preglacial Drainage of Wayne
and Adjacent Counties—With Map, . . . *By J. H. Todd, M. D.*

Preglacial Drainage Conditions in the Vicinity of Cincin-
nati, Ohio—With Map, *By Gerard Fowke*

Published by the Academy of Science
with the Emerson McMillin Research Fund.

DECEMBER, 1900



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December, 1900.

PRESS OF FRED. J. HEER, COLUMBUS, OHIO.

PREFACE.

AT the 1898 winter meeting of the Ohio State Academy of Science, Mr. Emerson E. McMillin, already a life member, through Professor W. R. Lazenby, tendered the Academy the sum of \$250.00 to be expended by the trustees in furthering original scientific researches in Ohio. The donor placed no restrictions upon the use of this fund except to express a desire that, so far as possible, it be used in aiding those who are competent and willing to give their time, but unable to contribute their expenses while employed in their researches; thus giving aid to such independent workers as lacked the necessary financial resources. Among the grants made by the trustees during 1899, from this fund, were \$50.00 each to Professors Tight and Bownocker, and \$10.00 to J. H. Todd, M. D., for the purpose of aiding them in studying the Preglacial Drainage of certain portions of Ohio. From this fund for 1900, Mr. Gerard Fowke was granted the sum of \$25.00, for a similar purpose. The results from the work prosecuted under these grants are herewith transmitted as No. 3 of the Series of Special Papers. Mr. Fowke has kindly consented to prepare an introduction, giving a short review of work previously done along this line of research in Ohio. The map facing preface illustrating the preglacial drainage of the entire State, so far as it has been worked out, has been prepared by Professor Tight.

The expense of publication has also been taken from Mr. McMillin's research fund, which he has been kind enough to continue for 1900.

Professor Raymond Osburn was granted \$50.00 in 1899 to aid in the study of the fishes of the State, and a similar sum was granted him in 1900. The results of Professor Osburn's researches are being prepared for publication and will constitute No. 4, of this series, and will be issued early in 1901.

F. M. WEBSTER, *Chairman,*

H. C. BEARDSLEE,

JOHN H. SCHAFFNER,

Trustees Ohio State Academy of Science.

INTRODUCTION.

FOR many years the abandoned water courses in Ohio have perplexed geologists. Most of them are attributed to streams in the immediate vicinity. Some, however, are in such situation that no existing river or creek could produce them unless very great alterations of level should take place. Others interlock in a manner which would require exceedingly rapid and violent changes in any stream now found within many miles, if their origin is to be thus explained. For example, each one of four ancient valleys located within the limits of Hamilton county, namely, back of Cincinnati, along Mill creek, at North Bend, and across the northern and western ends of the county, is accounted for by assuming that "the Miami river must have once followed this course." But it would be impossible for the Miami to excavate them, because all have a greater depth than the bed of the Ohio river; and the latter could never have been deeper than it is now, for below the mouth of Mill creek there is rock bottom. Besides, the Miami could form them only by accomplishing the improbable feat of eroding a deep channel and then, without any discoverable reason, deserting this course and carving a new one for itself through the bordering hills.

The same difficulty is encountered when the attempt is made to connect former and recent stream beds in various other parts of the State.

The great variation in width of different portions of the Ohio valley has also awaited explanation. A traveler from Pittsburg to Evansville will find the hills on either side alternately approaching the water and receding from it. In some parts they are so steep and come so near together, as to form a veritable gorge; again, level or terraced bottom lands a mile or even more in width intervene between the shores and the high lands. Moreover, there is no system or regularity about these changes. Sometimes there may be observed a gradual increase in width,

very slight it is true but still perceptible, the hills presenting gentle slopes and smooth, rounded outlines; then the valley begins to narrow, the hills are more sharply outlined, and presently the stream is running between precipitous walls. At intervals the valley will expand to a width much greater than is to be found for many miles above or below; and after holding a practically uniform width for some distance will rapidly contract.

Modifications of this character are usually asserted to be due to the diversified composition of strata through which the river makes its way. To the same cause, too, are assigned the frequent abrupt curves, some of them so sharp that the river seems almost to double back on itself. There are, to be sure, many degrees of hardness and of solubility in all the rocks through which the Ohio has cut its channel; and these properties would certainly be factors in the phenomena observed. But, even where these features are most pronounced, the rock seems to be tolerably homogeneous in its structure; and it does not seem reasonable to suppose that inequalities of this nature would be so capriciously distributed as would have to be the case were they the only or even the principal cause of such conditions.

In recent years much thought has been given to these questions, and some investigations conducted mainly by Prof. Tilt as shown by his article have given us the key to the problem. It is very easily answered; being simply the fact that prior to the glacial period the Ohio as a separate stream had no existence. Its present channel was occupied by a series of disconnected water courses, varying in size from small ravines to large rivers. The expansions in its course are the valleys of the larger pre-glacial streams; the abrupt curves and numerous windings result from the efforts of the stream to find the lowest level in broken and irregularly eroded country across which it must seek a path from one valley to another; and the narrows or gorges mark the places where it broke through the minor watersheds that obstructed its progress.

The following pages contain the result of examinations made within the past two years, under the auspices of the Ohio Academy of Science. There are some references in the text that

will inform the reader who wishes to pursue the subject further, where to obtain additional information.

Professor Tight whose previous researches have been largely carried out in the Muskingum and Hocking valleys has extended his work down the present Ohio valley as far as Manchester, in Adams county, where he locates a col which marked the line of division between the waters flowing east in the present bed of the Ohio and those flowing west. As some statements in the present paper can not be understood by those who are not aware of his discoveries in this region, it may be well to say that he has demonstrated that Kanawha river in preglacial times flowed westward from St. Albans, past Guyandotte, to the Scioto, and followed that valley northward. Into this river flowed all the creeks and rivulets rising east of the Manchester col. Beyond Circleville it has not been traced, as the old valley is obliterated by the drift deposits of the ice-sheet. Some data are at hand, however, as mentioned in Professor Bownocker's paper, indicating that it pursued a westerly course and left the State somewhere about the Celina reservoir.

The history of the Little Miami, as worked out by Professor Bownocker, is important in that it shows the general tendency of the drainage of southern Ohio toward the north and west. This would not be the case unless there was an outlet for the waters in that direction, such as old Kanawha seems to have furnished.

The chief value of Doctor Todd's article is to be found in the evidence which it presents that vast changes following the advent of the ice-sheet were by no means confined to the immediate region of the Muskingum and the Ohio, but reached to the borders of the Lakes, thus showing a probable northern outlet for the waters in that direction also.

The concluding paper treats of the Ohio river from the point where Professor Tight leaves it. The old waterways in this section being more plainly marked and less complicated than they are further east, the labor of deciphering has been less difficult.

A great field is opened up for those who are to continue these researches. There is probably not a stream in the State,

ancient or modern, which has not been more or less modified by the influences described, even to the extent, in many cases, of owing its origin to them. The work will be incomplete so long as any portion of the State remains uncharted. And it must extend still further before a complete history of the Ohio river can be written. As yet, we know nothing of the pre-glacial conditions below Louisville, or of the tributary streams in southern Indiana and western Kentucky.

It may not be out of place to call attention here to a matter which seems to have escaped notice heretofore.

The oldest land in Ohio is that along the Cincinnati axis, in the western part of the State. From here, through three geological eras, the Upper Silurian, Devonian, and Sub-Carboniferous, the slope was toward the southeast; consequently the surface flow must have been in the same general direction. It is quite possible that to this epoch are to be assigned the older erosion planes mentioned by Professor Tight in his present paper. Not only in Ohio, but in the neighboring States as well, are to be observed these old levels at an average elevation of about two hundred feet above the present streams. The suggestion is ventured that these represent drainage lines as they existed prior to the Appalachian uplift. Such valleys must have formed in the immense length of time during which surface waters sought the constantly receding ocean that bordered the swamps of the coal measure period. When these were uplifted into mountain ranges, the elevation must have been general enough to produce a considerable effect upon the region to the westward. Otherwise a trough would have resulted between the land just emerging from the sea and that which had so long stood above the waves. Had this been the case, it would seem that the ancient rivers must have turned toward either the north or the south, and flowed around the island on which they had their birth. Instead of this, however, we find the entire drainage of the newly risen country flowing back directly across the formations whose waste had assisted in building it up. It is a plausible supposition that the high level valleys pertain to a pre-Carboniferous drainage toward the southeast; while some at least, of the narrow and deep valleys cut through

or along them are features of a reversed drainage, of pre-glacial age, toward the northwest; and that it is the latter which has been again reversed and sent off to the southwest by the continental ice-sheet.

A serious objection, and one which may be fatal to this suggestion, is the great length of time that has elapsed since the Appalachians were formed. This is sufficient for subsequent erosion to have effaced all inequalities of level which prevailed in the central valleys at that period. However, minor oscillations may have occurred which would preserve or perpetuate the older valleys.

At any rate, whether any evidence now remains of it or not, there must have been a former drainage from western Ohio toward the eastward; and this drainage must have become reversed when the Allegheny plateau was raised to a sufficient elevation. The only escape from such conclusion is in assuming that all the teachings of our geologists, previous to this time, concerning the succession of formations, are erroneous. While very many errors, due to lack of data, have crept into our text-books, the sequence of geological deposits in this region seems well established. If not so early as herein intimated, these high-level valleys may still belong to a drainage period antedating either of those discussed in these papers.

GERARD FOWKE.

DRAINAGE MODIFICATIONS IN WASHINGTON AND ADJACENT COUNTIES.

BY G. W. TIGHT.

INTRODUCTION.

The study of the region treated of in this paper was undertaken as the natural out growth of the work previously done in the surrounding sections. The correlations of the preglacial drainage in the areas to the east, north and west left this region of the lower Muskingum somewhat isolated and very naturally raised the question as to its preglacial conditions of drainage. On account of the position which the region occupies, the restoration of the old drainage has a very important bearing on the interpretations already worked out for the surrounding regions. The problem is one which was recognized by Prof. E. B. Andrews and referred to in the second volume of the Ohio Survey, where he says: "The drainage features of the county (Washington) present some very interesting facts. The Ohio River, Little Muskingum, Duck Creek, and the Muskingum all converge towards a common center, the last three uniting with the former in Marietta township." "The slopes of nearly half a circle find their lowest point at a common center in Marietta township." And after a brief description of the stream courses he further states: "Thus it will be seen that the county presents a great variety of surface slopes. In the eastern half of the county the slope is southwestern and southern, while in the western, i. e., west of the Muskingum, it is chiefly northern and southwestern. While the general drainage of southeastern Ohio is to the southeast, the large streams, like the Muskingum and Hocking, flowing in a direction approximately at right angles to the direction of the Ohio, yet in Washington county we have almost every variety of direction." "What originally determined the flow of streams in these different directions it is impossible now to determine. In some parts of the state the dip of the strata determines the direction of drainage, but this can not be the case to any large extent in Washington county." And

again: "It is true that the direction of streams is, for limited distances, determined by the character of the strata of rocks in which they flow, the softer rocks yielding a passage while the harder resist. This will explain many of the crooked ways of our streams which would be otherwise utterly inexplicable. But this cause could not have determined the general direction of the streams in Washington county."

In Dr. S. P. Hildreth's Geological Report for 1838 he states, after a brief description of the old valley floors in this region: "From the frequency of these flat lands between the headwaters of the Little Hocking and the south branch of Wolf Creek, it is quite possible that at some remote period the waters of Wolf Creek were discharged into the Ohio instead of the Muskingum." "Great changes, evidently, have been made in the direction of all our water courses before they found their present levels."

While it is apparent that the earlier geologists partially recognized the problems presented by the topographic features of the region and made some observations and deductions there seems to have been no systematic endeavor to follow up the study.

As considerable field work, scattered through several years, had already been done in the region by the author, it was with pleasure that he suggested to the trustees of the Ohio State Academy of Science, upon their request for information concerning the problems in the field of geographic geology of the state, that this region be further studied, with a view to the more complete correlation of the data in hand and the publication of a report of the same. By the action of the trustees a grant was made to the author which enabled him to spend five weeks in field study. This grant was from the Hon. Emerson E. McMillin Special Research Fund of the Ohio State Academy of Science.

The field studies conducted under this grant in connection with the work previously done have enabled the author to make what he believes to be a correct solution of the problem of the preglacial drainage of the region.

While the conclusions reached, as a result of this work, seem to be thoroughly established, still the work can be con-

sidered as only fairly begun and this report is scarcely more than a preliminary statement which it is hoped will give a general view of the field and serve as a stimulus to more thorough and detailed work. Many interesting and important questions remain still to be answered by more extended field study. Some of these are indicated on the accompanying map. It is not expected but that, here and there, minor modifications of the results presented may arise from this more careful and detailed field study, but the main features of the preglacial drainage seem to be so thoroughly established as to leave little room for doubt in regard to the correctness of the general correlations. The matter will be presented very largely in the order in which it was worked out in the field studies. Some references will be made to earlier work and observations, but it is not intended that this shall be in any sense a completed monograph of the region. Most of the facts presented in the text find their expression in the accompanying map (Plate I) and illustrations in a form which will give to those not familiar with the region a clearer idea of the results. Much of the detailed data is purposely omitted from this paper and only such are given as bear directly on the general conclusions.

The author desires to take this opportunity to express his thanks to the generous donor of the Special Research Fund for this practical interest in pure science, and in the Ohio State Academy of Science, and to the trustees of the fund for their confidence in his ability to wisely expend the portion allotted to him. And furthermore, to express the hope that the results herein presented will prove of sufficient value to warrant this generosity and confidence.

LOCATION OF THE AREA.

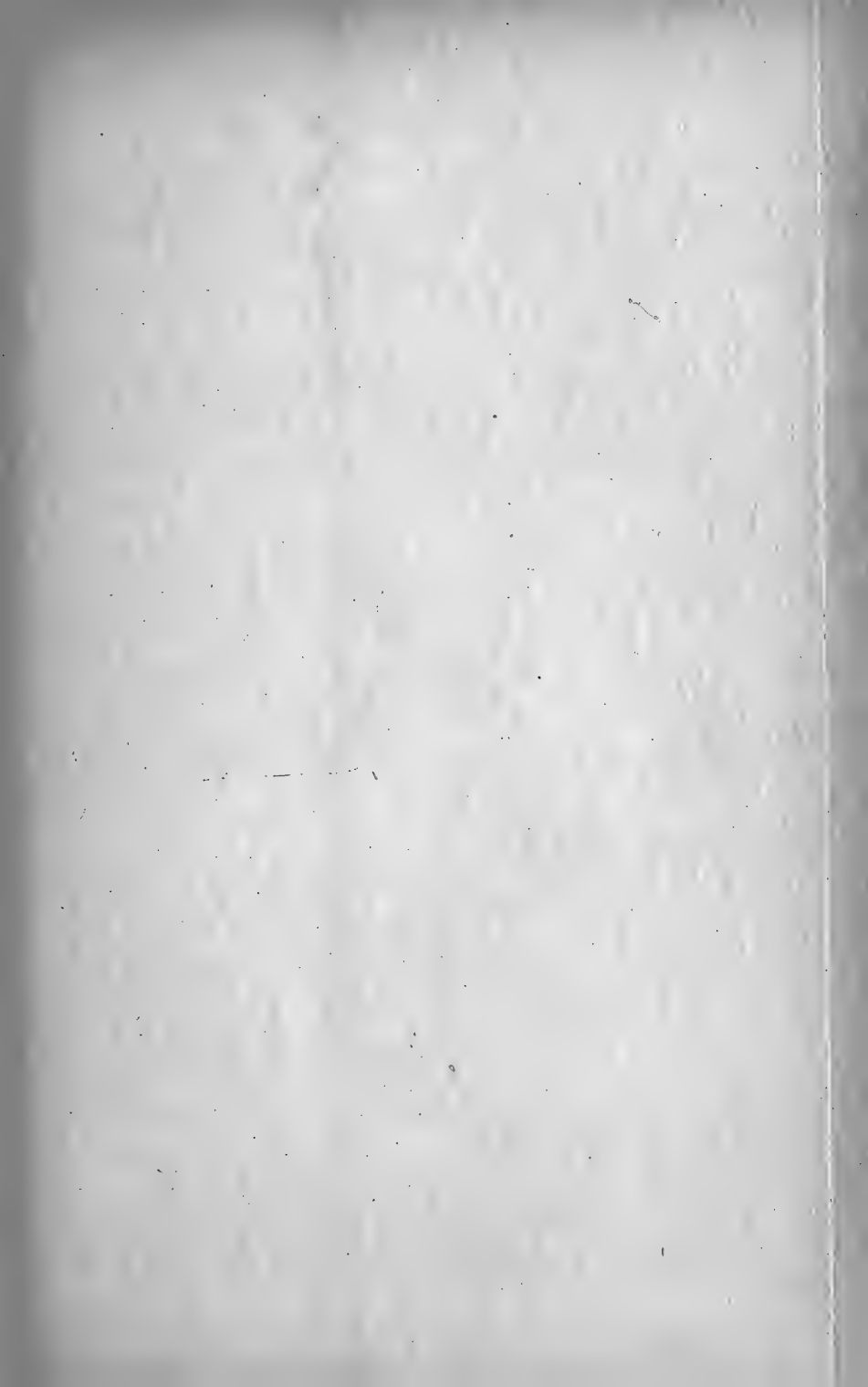
The region under consideration embraces all of Washington county and parts of all the counties which bound it in both Ohio and West Virginia. It includes the territory drained by the section of the Ohio from New Martinsville, W. Va., to the mouth of Shade River, Ohio, except that portion of the Muskingum above the north line of Morgan county, and of the Hocking above Athens, in Athens county. The section lying north of the

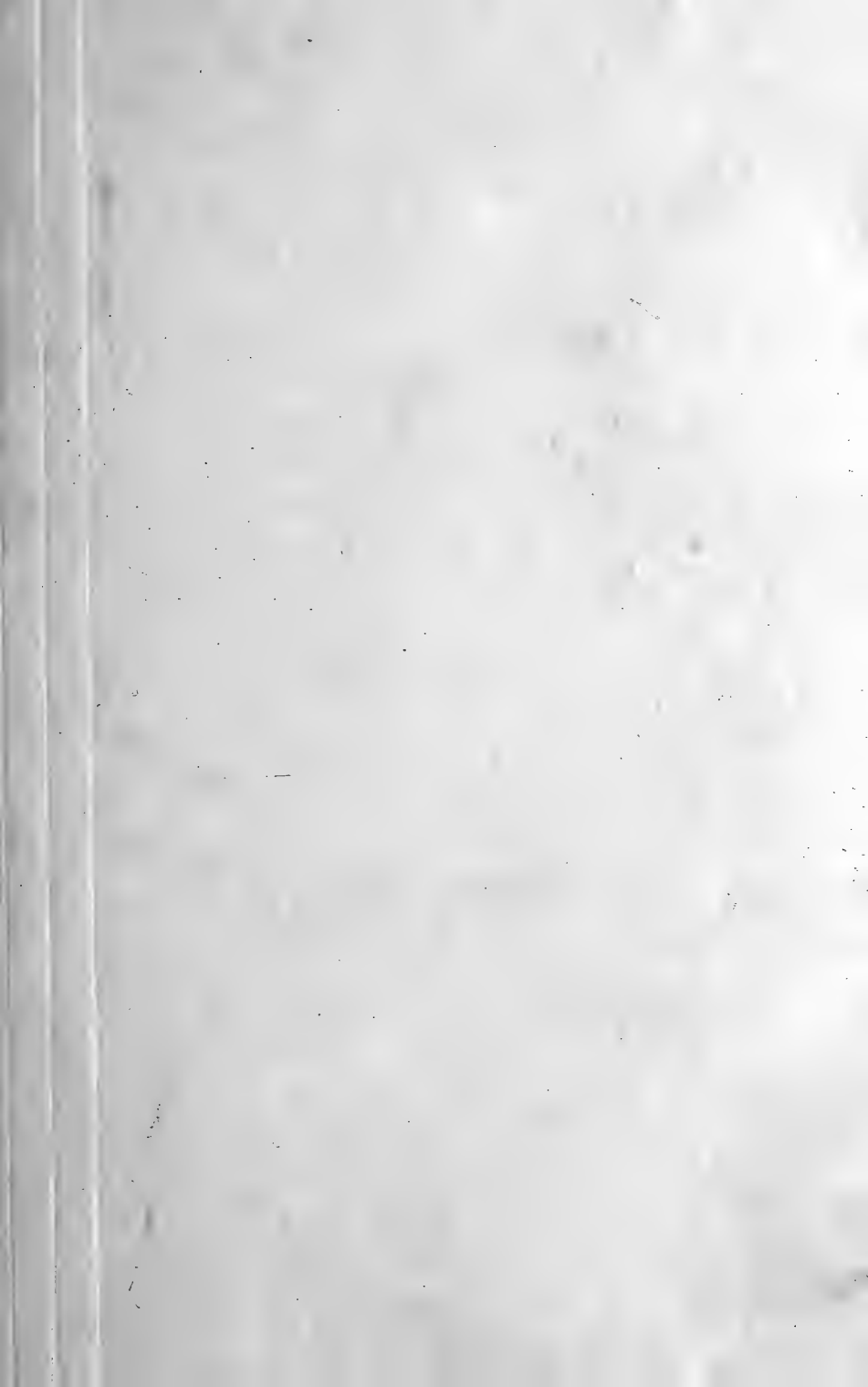
Ohio River and west of the Muskingum River has received most attention, as within this area the most important changes of drainage have taken place. Only a limited amount of time has been given to the section east of the Muskingum, in the Duck Creek and Little Muskingum basins, so that scarcely more than a few suggestions are offered concerning the modifications which have there taken place. The entire area considered lies far outside the glacial boundary of Professor G. F. Wright and the only deposits of glacial material are the gravel trains along the Ohio, Muskingum and Hocking and a few scattered erratics which occur at various elevations on the inter-fluvial tracts.

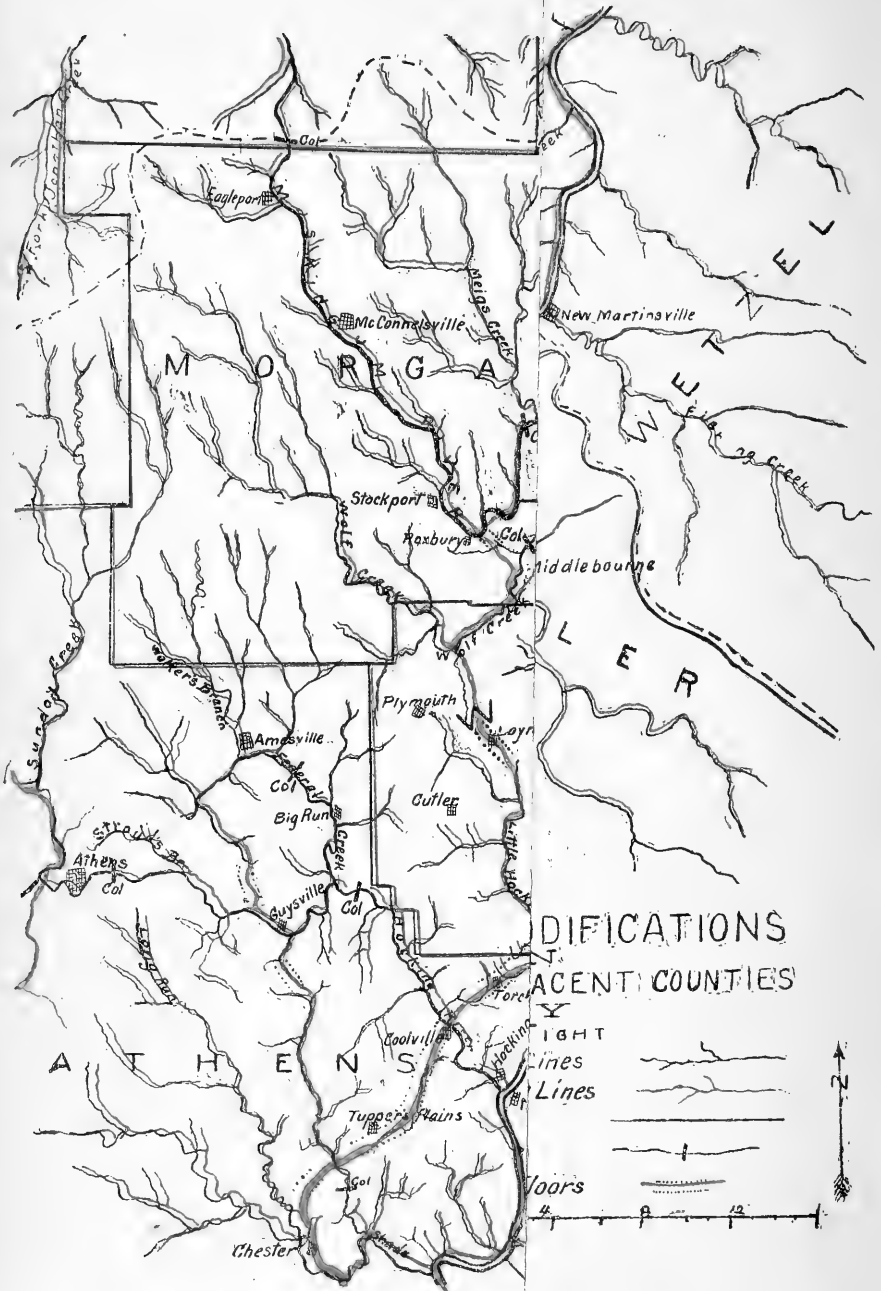
RELATION TO ADJACENT DRAINAGE.

Immediately to the north of this region is a large area now drained by the Muskingum. The preglacial drainage of this northern part of the Muskingum River has already been traced with considerable detail and the results published in the *Bulletins of the Scientific Laboratories of Denison University*, Volume VIII, Part 2, page 35; Volume IX, Part 2, page 33, and Volume XI, Article VIII. In these reports it is shown that the preglacial drainage consisted of a main stream which had its head in the upper waters of the Tuscarawas and flowed southeasterly past Dresden, Newark and into the present Scioto basin near Lockbourne, south of Columbus.

Into this main valley emptied many tributaries. Only three of these are of especial concern in this connection. They are, first, the Wills Creek valley which heads directly north of the Duck Creek basin and extends northward into the Tuscarawas above Dresden. This valley has not as yet been studied and it may be that the present valley is composed of several preglacial elements. Wills Creek has a very crooked course and as far as the data in hand now show, is an aggrading stream. It presents many interesting features well worthy of more careful study. Secondly, just west of the Wills Creek basin is the portion of the Muskingum River from the north Morgan county line to Dresden. It is shown in the works already referred to that this section of the Muskingum is reversed and that in preglacial times there was a col on the Muskingum at



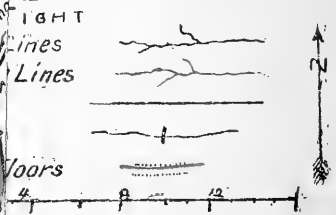




M O R G A N

A T H E N S

DIFICATIONS
ADJACENT COUNTIES



the north Morgan county line and from this col there was a small tributary ran northward into the main preglacial axis.

The third section is that of the Jonathan Creek which was tributary to this reversed Muskingum section at Zanesville. The headwaters of these northward flowing streams are shown on the accompanying map (Plate I).

To the east of the region lies the drainage basin of the Monongahela and upper Ohio. The modifications in this section have been very great and have been the object of study by many geologists. A summary of the work done by the earlier students, with newly added data, is given by Dr. T. C. Chamberlin and Mr. Frank Leverett in the American Journal of Science, Volume XLVII, No. 280. According to these authors there was an old col on the Ohio a little below New Martinsville, W. Va. Fishing Creek being the headwaters of the stream which flowed northward up the present Ohio's course above New Martinsville into the then northward discharging Monongahela. The region to the west and southwest remains open to further investigation.

CHARACTER OF THE BOUNDING WATERSHED.

The watershed which surrounds the region is a well marked topographic feature and quite regular in its general outlines. It rises to a nearly uniform elevation, being somewhat higher to the southeast and lower to the northwest. To the southeast it forms the divide between the tributaries of the Ohio and the Monongahela. It forms everywhere a high dividing ridge, except at the several points where it is cut through by the present drainage lines. Here the streams have narrow, gorge-like valleys and the elevation of the ridge persists surprisingly near to the stream courses. While the cols crossed by the streams must have been low they were evidently quite narrow gaps or else the ridge would show more of a lowering at these points. Only a small portion of the divide is shown on the map and this is cut in but two places, i. e., at the north Morgan county line and below New Martinsville.

DISTRIBUTION OF THE PRESENT DRAINAGE.

The distribution of the present drainage is shown on the map (Plate I) in black. The Ohio is the major stream and this crosses the region in a general southwesterly direction. The next larger stream is the Muskingum which crosses the Ohio on the northern side at Marietta. Next in importance is the Hocking which enters also on the northern side of the Ohio and has a general southeastern direction, rather abnormal to the course of the Ohio.

On the southern side of the Ohio the Little Kanawha enters at Parkersburg. East of the Little Kanawha lies the considerable basin of Middle Island Creek, which enters the Ohio just above St. Mary's. To the west and southwest of the Little Kanawha is the basin of the Big Kanawha. The modifications which have taken place on the Big Kanawha are discussed by the author and by Mr. Frank Leverett in the Denison University Bulletin, Volume IX, Part 2, Articles III and IV.

On the northern side of the Ohio and east of the Muskingum are the valleys of the Little Muskingum and Duck Creek, both tributary to the Ohio a little above the mouth of the Muskingum. West of the Muskingum and between it and the Hocking is the somewhat branched system of the Little Hocking. This has two main branches, the North Branch and the East Branch.

East of the North Branch of the Little Hocking and north of the Big Hocking is the basin of Federal Creek. This is a very peculiar stream as it flows in almost a circular course with many radial tributaries, those on the north side of the circle being much longer than those on the south side.

South of the lower portion of the Hocking is the Shade River system with its three main branches, East, Middle and West Forks.

The only other considerable stream in the region is Wolf Creek. This rises in northern Morgan county and flows southward and eastward and enters the Muskingum at Beverly. A short distance above its mouth it receives a tributary of consid-

erable size, South Fork. This tributary parallels the Muskingum for many miles but flows in the opposite direction.

It is seen that the present drainage is very much diversified and abnormal.

GENERAL TOPOGRAPHIC FEATURES.

The topographic features of the region are quite as varied as its drainage distribution. The present forms, being the resultant of at least two cycles of erosion, which in many ways were quite discordant, show every variety of combination of parts of each cycle. A few miles northwest of Marietta there is a group of very high points in the ridge which separates the headwaters of the East Fork of the Little Hocking and the South Fork of Wolf Creek, from the waters of the Muskingum and Ohio.

This ridge is the northward continuation of the high ridge in West Virginia which separates the waters of Middle Island Creek from those of the Little Kanawha. On a very high portion of this ridge and several miles north of Marietta is located a large Catholic Church which has a tall spire tipped with a gilded cross. This church serves as a convenient land mark for a radius of from twenty to thirty miles. A little south of the church on this same ridge is a high hill, marked on the map (Plate I) Horizon Hill, for from its summit there is an unobstructed view in every direction for many miles. From this elevated point of view the general surface of the region is seen to rise to the north, east and south and to sink to the west, in the direction of down the Ohio and the East Fork of the Little Hocking. With this general surface configuration all the larger streams are in general accord and suggest at once that their direction was largely determined by the slope of the general surface of the upland plain. From this high elevation the deep, narrow valleys that traverse the region are lost in perspective and a very fair picture is obtained of the old features as they existed before the work of the deeper erosion was accomplished. This old land surface was a gently rolling plain. The valleys were very broad Vs in cross section and the ridges and hills were low. The entire relief of the region ranged between 150-200

feet. The old slopes were well graded and the angles of slopes very low. It would have been considered very fair agricultural lands. A photograph taken from our standpoint gives a good idea of the features of this old form. The surface is seen now dotted with farm houses and the cultivated lands of the region are principally located on this old surface.

On closer inspection it is observed that this rolling surface is very deeply scarred by an extensive net work of narrow, deep valleys which are present almost every where over the region; the principal exception being along the present divide separating the waters of Wolf Creek from those of the Little Hocking. The reasons for this notable exception will appear later. In many places these deep valleys are scarcely more than narrow gorges. They vary in depth below the old surface from 100 to 250 feet, depending upon their proximity to the larger streams. Their slopes are so steep that they are rarely cultivated but are usually covered with timber. They are such a barrier to the construction of roads that over large areas there are two almost distinct systems of highways, one the valley roads and the other the ridge roads. These often parallel each other for many miles without connection. The valley roads pass over the ridges at the head water gaps where they are usually crossed by the ridge roads. There is everywhere a well marked change in the angle of the slopes between the old surface and the deeper valleys, indicating very clearly the line between the old erosion cycle and the more recent. So that the fact that the region has experienced a very wide spread rejuvenescence is very apparent.

The exceptions to these general features are rather local and require a more detailed treatment. They are the flat low lands associated with the present divides and the broad valleys of the larger streams.

CHARACTERS OF THE OHIO VALLEY.

The Ohio River valley where it enters the region in the vicinity of New Martinsville, is a very narrow gorge.

The bordering hills are very steep, often exposing vertical cliffs which rise to the level of the adjacent table land. The river

PLATE II.



TIGHT — Drainage Modifications.

1. View on the Ohio, looking up the 16-mile stretch at Long Reach.
2. Near view of Second Hill on Left Bank in 1. New Slope to the River. Old Slope away from the River.
3. View looking north across the Little Muskingum Basin. Characteristics of bird's eye views of South Eastern Ohio.

can scarcely be said to have a valley in the general usage of the term, for it is hardly more than a passage way through a rough and hilly country. The bottoms along the sides of the stream are very narrow or entirely wanting and the high water stages of the river wash the talus slopes on both sides of the river. Figures 1 and 2 of plate II show some of the features of this part of the valley.

Passing down the river towards Marietta, the valley becomes gradually wider and the bordering hills less high and abrupt. This is more noticeable where the larger streams enter the Ohio. There is a sharp bend in the valley at the mouth of Bull Creek where the river turns north towards Marietta and again at the mouth of the Muskingum at Marietta where the valley turns again towards the southwest. A little below Marietta there is a very considerable narrowing of the valley. This is so apparent that it is quite suggestive that possibly this might be the location of an old col in the ridge that separates the Middle Island creek and Little Kanawha basins and which appears so strongly developed on the north side of the Ohio between the head waters of east fork of little Hocking and the Muskingum.

A little below Marietta the valley turns to the south as far as the mouth of the Little Kanawha at Parkersburg. Throughout this portion the valley is quite broad but still the valley walls are quite steep and precipitous. In making the great bend at Parkersburg the river has cut back the hills on the West Virginia side so that the valley has extensive bottoms on the Ohio side. The valley width remains about constant from Parkersburg to the mouth of the Little Hocking but it narrows very rapidly from that point to the col marked on the map above the mouth of the Big Hocking. At this col the valley is only about three quarters of a mile wide and vertical cliffs form the valley walls. Below this col the valley broadens again gradually towards the southwest.

CHARACTERS OF THE MUSKINGUM VALLEY.

The Muskingum River crosses the north Morgan county line in a very narrow gorge-like valley. The bordering hills present very steep, often vertical faces to the river and rise from 250 to 350 feet above it.

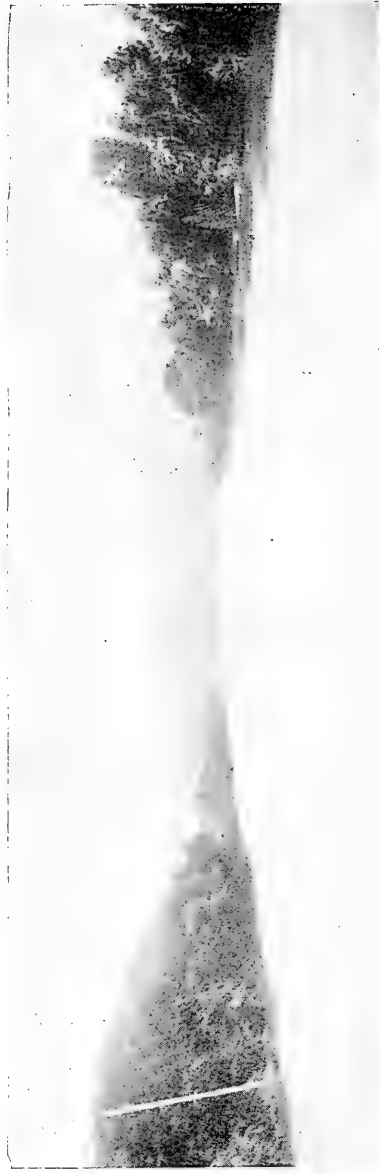
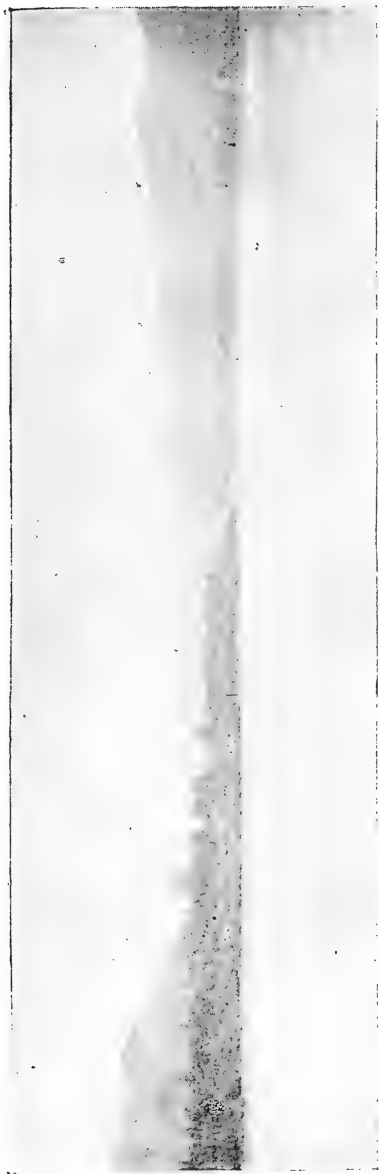
Passing southward the valley gradually broadens through Morgan county and reaches its maximum width, in this section, near Roxbury where it bends sharply to the north and becomes rapidly narrower and its walls more precipitous until at the col near the sharp bend to the south (Figure 2, plate III,) the valley is a narrow gorge. After passing the mouth of Meigs Creek the valley broadens again to the mouth of Wolf Creek, at Beverly, from which point it begins to narrow again on passing further down the stream, until it reaches a minimum at the point marked col on the map, a short distance above Lowell (Figure 1, plate III). From Lowell onward to its mouth it increases in size and width until at Marietta the valley is as large as that of the Ohio itself.

Throughout the course of the valley there are extensive gravel terraces in the broad and open portions but these are entirely absent in the narrow section above Meigs creek and but very slightly show in the Lowell narrows. These terraces are the gravel trains which head far up the Tuscarawas and Licking in the morainic belts of the glaciated area.

CHARACTERS OF THE LITTLE MUSKINGUM AND DUCK CREEK VALLEYS.

These valleys have not been studied as carefully as the others and only their very general features are referred to. The valley of the Little Muskingum is rather narrow throughout its entire length. It shows a marked tendency to broaden out at the points where it receives its largest tributaries. It is cut out of the floor of a broad basin-like valley of the old land surface. One of its remarkable features is its close parallelism to the Ohio through its entire length. A view from the divide which separates the Little Muskingum from the Ohio, (Figure 3, plate II), shows at a glance that the old valley of the Little Muskingum was very much larger and had reached a more advanced stage of planation than that of the stream which was later occupied by the Ohio. A view looking northward from this divide across the Little Muskingum country is in very striking contrast to one looking southward across the Ohio.

PLATE III.



TIGHT — Drainage Modifications.

1. Lowell Col on the Muskingum.

2

2. Meigs Creek Col on the Muskingum.

The valley of Duck Creek resembles much that of the Little Muskingum. The lower part of the valley is much broader and the hills more rounded than in the middle and upper sections. This lower course has the appearance of recent occupancy by a larger stream than originally cut the valley. This fact associated with some of the features farther up the valley suggests that there have been several modifications of the streams but they have not been fully worked out and are left with question marks on the map. The suggestions indicated on the map will serve as a working formula for further investigation.

CHARACTERS OF THE WOLF CREEK AND LITTLE HOCKING VALLEYS.

Wolf Creek heads in northern Morgan county on the divide which was crossed by the Muskingum when it broke over into this basin. It flows southward many miles closely parallel to the Muskingum, much as the Little Muskingum parallels the Ohio. Its valley is narrow and deep. It broadens gradually towards the south of the point where it turns eastward when it narrows rapidly to the col a few miles above its mouth. Near the mouth of the valley; just above the junction of its South Fork there is an old deserted ox bow of considerable interest. This ox bow seems to have been cut off at the time the flood waters cut out the col above. The valley is quite narrow at the cut off, The hill which occupies the center of the ox bow rises almost as high as the surrounding general surface. Below the mouth of the South Fork the valley is very broad and the hills more rolling.

This valley does not seem to have ever been cut down to the level of the deep channel of the Muskingum. It seems as though the lime stone stratum which forms the floor of the valley at its mouth had prevented the valley from becoming well graded to the level of the deeper channels of the larger streams.

The valley of the South Fork of Wolf Creek is very markedly different from that of the main creek. Throughout most of its length this valley is comparatively broad and open and bounded by more gently rolling hills. At places the walls are rather steep but that is the exception rather than the rule. In the upper waters the contrast with the head water features of the

main stream are most striking. The country around the head waters is rather flat or gently rolling with very deep soils. Many of the smaller tributaries rise in extensive swamp areas. These swamp areas often lie on the divide which separates the waters of Wolf Creek from those of the Little Hocking. The slope of this divide on the north side which is drained by the tributaries of Wolf Creek is much less dissected than the south slope which is drained by the tributaries of the Little Hocking.

The Little Hocking valley is divided into two main branches which are very similar to each other in characters and present no special modifications from the normal. They are rather narrow with moderately steep valley sides. Every where are present the marks of the recent rejuvenescence. The valley of the East Fork occupies much the broader depression in the old land surface. Several of its tributaries on the north side, like the head waters of the South Fork of Wolf Creek, rise in the flat tracts on the same divide. The tributaries on the south side of the East Fork are all short, as the East Fork, like the Little Muskingum, parallels the Ohio throughout its entire length and is separated from it by a high ridge but a few miles wide.

CHARACTERS OF THE HOCKING VALLEY BELOW ATHENS.

At Athens there is a large loop in the Hocking River and the valley is quite broad. Some distance below the city the present river has crossed an old col. The valley is not as narrow as might be expected but the presence of the old col is shown by the vertical cliffs that face the river and the persistency of the old water shed at its maximum elevation, up to the very walls of the valley.

Below this col the valley gradually widens and the walls become less precipitous, although they remain quite steep, to the bend at Guysville. Below this point the valley gradually narrows again to the mouth of Federal Creek. Below this the narrowing is much more abrupt and at the point marked col on the map the valley is a very narrow gorge with vertical rock walls. There were here several channel ways during the cutting out of the old col by the present river. Some of these were cut nearly

PLATE IV.



Hocking Valley, a few miles above Coolville.

to the present level of the river so that the bold rock cliffs and the numerous deep ravines present very picturesque scenery. Below this col the valley gradually broadens again and the walls become less precipitous as far down as Coolville, (plate IV). Between Coolville and its mouth the river again passes through a narrows. That the narrows at this point is the site of an old col is not so evident as in the other cases farther up the river.

CHARACTER OF THE FEDERAL CREEK VALLEY.

A study of this valley was not included under the outline planned for the work for the Academy, but it soon became evident, from the field work, that under one of the working hypotheses it might prove to be in the line of discharge of the waters of the Muskingum, so that its investigation became necessary. The divide separating the waters of Federal Creek from those of Wolf Creek and the Little Hocking was carefully examined for an abandoned valley floor, but none was found. There are some low cols in the divide which may possibly have been occupied by water during some of the high water stages associated with the drainage modifications.

The valley of Federal Creek is rather deep and narrow in its lower portion, but in the section around Amesville is much broader. All the tributaries on the northern side occupy rather broad valleys. The effects of the rejuvenescence which are so marked a feature throughout most of the region are less apparent in the Federal Creek basin than anywhere else in the entire region. The data upon which rests the location of the old col below Amesville are not as satisfactory as could be desired. The location is made more from the necessities of the case than from field observations.

CHARACTERS AND DISTRIBUTION OF THE OLD VALLEY FLOORS.

It is very evident that as soon as a river deserts any part of its valley, the abandoned portion will develop at once into a divide from which the waters will flow each way into the remaining sections of the river. This will be especially true if from any cause a river course is divided and one portion caused to

reverse its direction of flow. It therefore becomes a common characteristic of these abandoned valley floors that they are located on present divides and it follows that wherever found, the old streams crossed the present divides at such points. They will therefore be discussed in connection with the divides in which they occur. As already mentioned, these flat low lands associated with the present divides form one of the notable exceptions to the general topographic features. The most striking case of this kind is the divide which separates the waters of Wolf Creek from those of the East Fork of Little Hocking. In this divide there are three well marked cases and several less notable ones. Those at Layman, Barlow and Fleming are the most important. They were the subject of study by Dr. S. P. Hildreth who wrote as follows in his report of 1838 concerning the valley at Barlow.

“On Mr. Lawton’s farm, in Barlow, township, Washington county, in the midst of the marl region, is a locality of fossil fresh-water shells of the genus *Unio*. They are imbedded in coarse sand or gravel, cemented by ferruginous matter. The spot on which they are found has once evidently been the bed of an ancient lake or pond. It is now a beautiful valley of a mile or more in width by four miles in length, surrounded by low hills. On the south side a small branch drains the superfluous water into the Little Hocking. In digging wells for domestic use in this tract, beds of sand, gravel and plastic clay are passed to the depth of thirty feet, containing imbedded branches of trees, leaves and fragments of wood of recent and living species. Similar valleys and levels are found in the uplands of the western part of the county, lying between the headwaters of the creeks, and are a kind of table-land. From the frequency of these flat lands between the headwaters of the Little Hocking and the south branch of Wolf Creek, it is quite possible that at some remote period the waters of Wolf Creek were discharged into the Ohio River instead of the Muskingum. This opinion is strengthened from the fact that the head branches of the South Fork now rise within two miles of the Ohio, and run northerly, parallel with and opposite to the course of the Muskingum for twelve miles, and joins that river twenty miles

from its mouth. The remains of its ancient beds would form pools and ponds of standing water, furnishing fit residences for the fresh water shells, whose fossil remains are now found there. Great changes evidently have been made in the direction of all our water courses before they found their present levels."

The valley floor at Layman is not quite as large as that at Barlow, but it did not carry as large a stream. Several fields in this old valley floor show still, under cultivation, a black valley soil and the writer was informed by Mr. J. A. Gage, of Layman, that at one place there is a deep muck from which much decayed wood has been taken and the waters issuing therefrom have a very disagreeable odor.

The old floor at Fleming is still smaller than the others and probably carried a smaller stream. The full depths of the silt deposits that cover these floors was not determined as all the wells examined were very shallow. The bordering hills associated with these old valleys were very low and well graded and usually carried very deep soils which they often retain at present, where not exposed to the erosion of the more recent cycle.

Not directly in this divide but associated with the Wolf Creek basin is another abandoned valley floor near Watertown. This floor lies about two miles northeast of the town and about a mile east of the South Fork of Wolf Creek. Rainbow Creek heads on this floor. Whether all or only a part of the stream which occupied this Rainbow Creek valley drained over this floor is as yet undetermined. If there were other cols on the Muskingum below Lowell and the reversed Rainbow Creek carried a section of the present Muskingum, they will require very careful detailed work to determine, as the erosion of the valley of the Muskingum has been so great in this portion that almost every trace of such cols has been lost. There are some indications in the character of the divides which would seem to locate one such below the mouth of Bear Run. If this should be certainly located it would follow that both Cat Run and Bear Run drained through Rainbow Creek reversed and over the old Watertown valley floor. The location of this col is not indicated on the map as it was not considered sufficiently well established.

In the divide separating the waters of Wolf Creek from the Muskingum, just south of Roxbury, there is a very low col which while it presents few features characteristic of most of the old valley remnants, still it seems quite certain that it represents the location of an old abandoned valley. The divide at this point is so narrow and the amount of erosion of the large streams on each side is so great (about 150 feet), that nearly all the old valley characters have been lost from excessive erosion.

In the divide separating the lower waters of the Hocking from those of the Little Hocking there is a well preserved valley floor (Figures 1 and 3, Plate V) which has been sectioned in several places by the cuts on the Baltimore and Ohio Southwestern railroad. The best section is but a few rods west of Torch station where the cut is about twenty-five feet deep and very near the center of the old valley and in the present crest line. The section shows above the tracks, about fifteen feet of very fine clay, scattered through which are some small decayed pebbles. Except for the absence of foreign material this clay resembles very much a glacial till. No lamination was observed and it was thought to be a very deep residual soil. Above this clay is a layer of from two to three feet of river gravel composed mostly of small material varying from a quarter of an inch to four inches in size and mostly flattish or lenticular in form. Its local origin from the carboniferous sandstones and shales is very evident. The sandstone pebbles are more nearly equiaxial than the pebbles of the shales. All of this gravel is so thoroughly decayed that good sized pebbles can be easily crushed between the fingers. The section did not show any well marked evidence of shingling, but was very certainly stream-made and stream-laid. Above the gravel is about a foot of rather red clay soil and above that some six to seven feet of loëss-like silt. The rock is not revealed in the bottom of the cut so that the exact depth of the filling was not determined. However it is thought not to be very deep below the railroad track to the rock, judging from other sections to the east and west, which do not show so much clay but do cut into the rock. In some of these cuts the gravel lies directly upon a decayed rock surface without the thick clay beneath.

PLATE V.



1. Preglacial Valley at Torch.
2. Preglacial Valley at Tupper's Plains.
3. From the Valley of the Little Hocking looking towards Torch, down the Preglacial Valley. Ohio River on the left in the distance.

One of these sections about a mile east of Torch shows about eight feet of a sandy clay graduating into the much decayed underlying rock and overlain with about two feet of gravel and this with about five to six feet of the loëss-like silt.

Both east and west of Torch the old valley floor is deeply cut by recent erosion into many very picturesque ravines and gorges. This is especially true on the west. The railroad follows up one of these ravines from the valley of the Hocking onto the old valley floor making a grade of about 125 feet in about two miles. This old floor extends westward to the Hocking and crosses the Hocking valley at Coolville. A cut on the pike in the main street of the village shows a fine section of the gravels in which the shingling to the southwest is very marked.

From Coolville the old valley is a very conspicuous feature in the topography as it extends southwestward past Tupper's Plains (Figure 2, Plate V) and into the basin of Shade River. Between Coolville and Tupper's Plains the old valley floor is deeply cut by a small tributary of the Hocking. At the Plains the old floor forms a part of the divide between this tributary and the East Fork of Shade River. A few wells sunk in the valley penetrate from twenty to thirty feet of clay silts to a water bearing sand or gravel layer.

Two other remnants of old valley floors may be referred to, though somewhat beyond the exact limits of the major topic of this report. One of these lies between the headwaters of Rush Run, a tributary of Federal Creek, and the Hocking; the other on the divide separating the middle fork of Shade River from the Hocking and about a mile south of Guysville. These are of importance in connection with the drainage changes of Federal Creek and the lower part of the Hocking below Athens.

RESTORATION OF THE OLD DRAINAGE SYSTEM.

With the general features of the region, the position of the old eroded cols, which cross the present valleys, and the positions of the remnants of the old valley floors, thus very briefly presented, it seems possible to trace with a considerable degree of certainty the old drainage system. This is represented on the map in red. This reconstruction is based on many detailed

observations of elevations and gradients of the old valley floors, and measurements of valley widths and amounts of erosion, which it is not possible to present in a sketch of this kind.

It will be seen by a glance at the map (Plate I) that the old system coincides with the present drainage along most of the smaller streams. Middle Island Creek and the Little Muskingum were the main headwater branches.

Tributary to Middle Island Creek was a small stream which headed at the New Martinsville col and flowed along the present course of the Ohio as far as Newport. The northward deflection of the old drainage at the mouth of Bull Creek was probably caused by the great strength of the ridge separating the latter from the Little Kanawha basin already referred to. Below the mouth of the Little Muskingum the Duck Creek tributary entered. This was probably smaller than the stream in the present Duck Creek valley. The next tributary was that of a stream which carried the drainage of the section of the Muskingum below Lowell and probably much of that of the headwaters of the present Duck Creek. The Little Kanawha was the next stream to enter the main line which followed along the present Ohio. Just at Parkersburg the Little Kanawha is deflected somewhat to the west of its former line of discharge, the old outlet being blocked with deep clay deposits. Below Parkersburg the old stream followed the present Ohio as far as the mouth of the Little Hocking. Here it received a branch almost, if not quite, as large as itself. This branch comprised several elements. The first one on the east was composed of the drainage from the head water region of the present South Fork of Wolf Creek which crossed the old valley floor at Fleming into the present valley of the East Fork of the Little Hocking. The middle element was made up of the Meigs Creek, Olive Creek and Big Run drainage and the section of the Muskingum above Lowell and below the Meigs Creek col. These waters entered the mouth of Wolf Creek and followed down the East Fork reversed and through the old valley at Barlow into the East Fork of Little Hocking.

The western element included the present basin of Wolf Creek and that section of the Muskingum between the north

Morgan county line and the Meigs Creek col. These latter waters crossed into the Wolf Creek valley through the gap south of Roxbury and thence southward through the old valley at Layman into the Little Hocking.

Below the mouth of the Little Hocking the old stream passed through the old valley floor at Torch, crossed the Hocking at Coolville and thence through the old valley at Tupper's Plains into the basin of Shade River. At Coolville it receives a short tributary, along the line of the Hocking which headed at the col below the mouth of Federal Creek.

Along the line of the present Middle Fork of Shade River the old stream received the waters from the section of the Hocking below the Athens col, including also those of the Federal Creek basin. These waters crossed the ridge through the gap south of Guysville. Concerning the further course of this old river it may be stated that since the work was completed which forms the basis of this report, much more field work has been done and it is known that the old river passed westward across southern Ohio and found its way into the Scioto. A more detailed report is now in preparation covering the entire history of this old valley. The normal characters of this old system are shown on the map Plate VI, which presents the old drainage separated from the present. It is noticeable that this old normal drainage conforms very closely to the slopes of the old upland surface.

THEORETICAL CONSIDERATIONS.

Within the limits of this paper it is not possible to discuss at length the probable factors involved in the production of the modifications of drainage from this old restored system to the new or present form. However, it may not be out of place to offer a few suggestions of a theoretical nature with the hope that they may be helpful in the further study of the phenomena themselves. The first and most natural question that arises is, if the restoration, as worked out, truly represents the conditions of drainage prior to the present, what produced the change? The answer to this question may not be found in the study of so limited a field and the phenomena therein presented. From the work previously done in:

adjacent regions it appears that the drainage modifications therein observed were intimately associated with the phenomena of the glacial period. The blocking of the northern discharge of the Monongahela and upper waters of the Ohio by the advancing ice or its extensive deposits turned the waters of the present upper Ohio region over the New Martinsville col into this basin. In a similar way the waters of the Muskingum which originally discharged westward past Newark and into the Scioto were deflected southward over the old col on the north Morgan county line. The conditions in the case of the Hocking are not so clear and at once suggest that there were other factors present besides the simple introduction of these large streams at particular points. For if the waters of the Hocking were set over the Athens col, due to the damming action of the ice or its deposits, on some northward flowing stream, it would seem as though it would have followed down the Middle Fork of Shade River branch of the old drainage and would not have crossed the col below the mouth of Federal Creek. As this region is far beyond the direct action of the ice and the only glacial deposits of note are the gravel trains found in the valleys of the Ohio, Muskingum and Hocking it at once becomes evident that the modifications wholly within the region must have been produced in some other way than by the direct action of the ice or its deposits. Such for example are the modifications of the lower Muskingum within Washington county. If the waters which headed at the north Morgan county line col were flowing over the gap south of Roxbury and through the old valley at Layman at the time the Muskingum waters first crossed this col it would seem that the larger stream would have followed the more direct and open line of the old drainage than to have turned to the north over the Meigs Creek col and again over the Lowell col. It seems necessary to assume one of two possible explanations. First, that there was some obstruction to the old direct line or that the modifications antedate the introduction of the Muskingum waters and that when the waters came over the col they followed the drainage they discovered already established, which was practically coincident with the present system. Of these two explanations the last seems best to fit the facts

as they appear in this and neighboring districts. If then the modifications were not produced by the glacial floods which were poured over the cols into the basin, but antedate the advent of these larger streams, some modifying cause must be found which could have produced the changes under the action of the old drainage itself. The necessary factor seems to be supplied in the silt deposits which occupy the remnants of the old valleys. These silts often exceed thirty-five feet in thickness. They must have been deposited under exceptional slack water conditions. It is believed that their deposition on the floors of the old valleys so choked up the old drainage that it was compelled to follow new lines which were often over the low cols in the divides and that these new lines were well established when the glacial waters were poured into the basin. The limits of this paper will not permit the full discussion of the problem, but it is hoped that sufficient has been said to show the very great interest that is involved in the study of the geographic geology of the state and to stimulate further research along these lines by members of the Ohio State Academy and others.

HISTORY OF THE LITTLE MIAMI RIVER.

BY J. A. BOWNOCKER, D. SC.

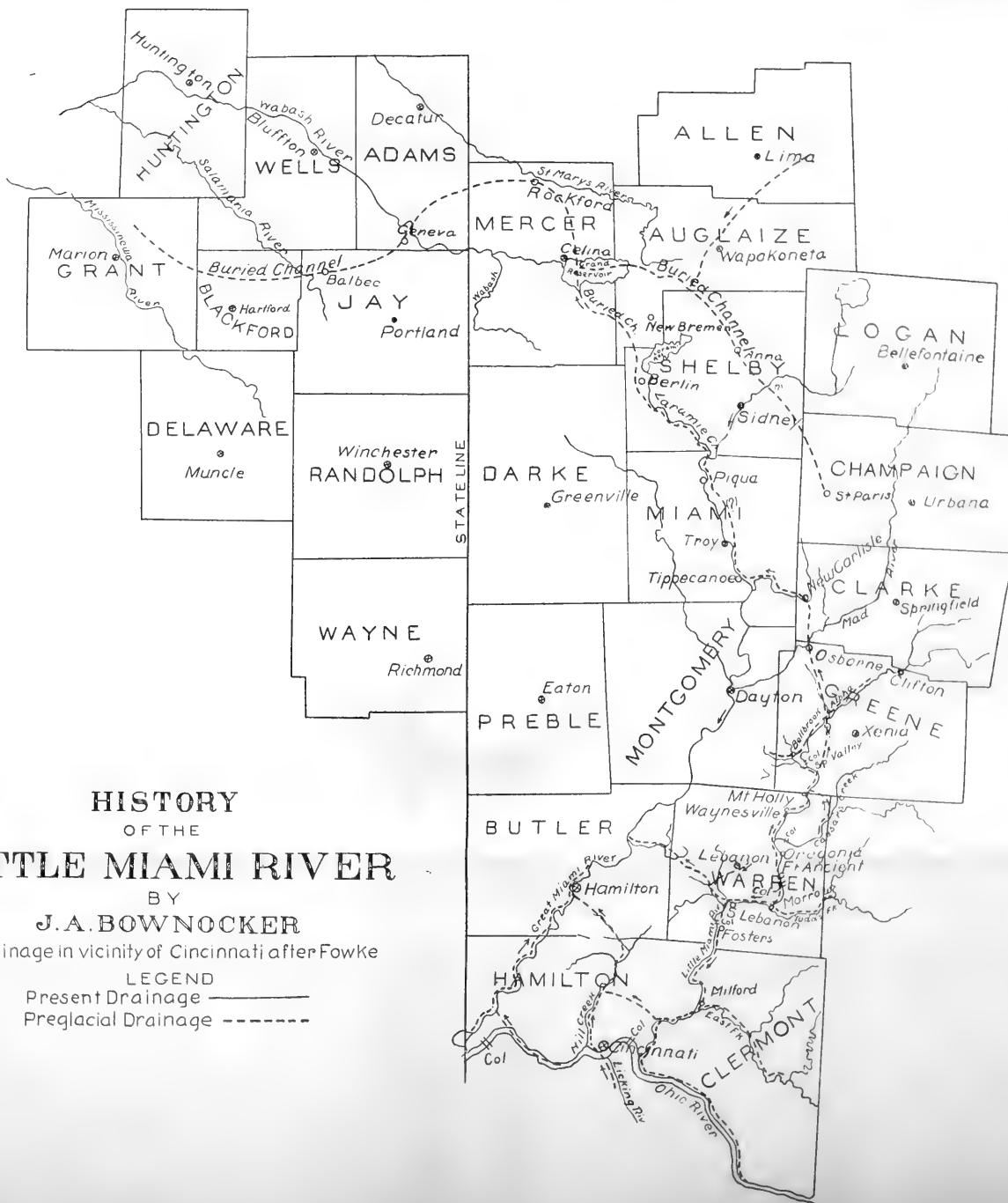
The headwaters of the Little Miami river lie on the glacial plains of western Madison and eastern Clarke counties. The two chief tributaries, known respectively as the East and North branches, unite about two miles north of Clifton to form the Little Miami proper. The valleys of these branches are narrow, but increase in width and depth to the south, though nothing but drift is seen until just north of Clifton where the Niagara limestone appears in the bluffs to the west.

At Clifton the river bids adieu to these commonplace surroundings. Flowing directly over the Niagara limestone, it forms a series of rapids and cascades, and then enters the gorge, which is 80 feet deep, but at the narrowest point not more than one-fourth of that in width. Down stream the gorge widens and at the same time the bluffs become less precipitous. Soon a narrow flood plain appears, and farther down a strip of farm land is found. At Jacobis mill the valley becomes conspicuous. The valley from this place to Clifton may be compared to a greatly elongated V with the apex at Clifton. Everywhere the bluffs are of limestone, making certain that the gorge and valley have been cut from rock, and not from drift as above Clifton.

South from Jacobis the valley widens comparatively rapidly, owing to the stream having left the hard Niagara limestone and entered the much more easily eroded Hudson series, consisting of shales and thin bedded limestones. Nowhere below the north margin of the latter foundation was the stream found directly on rock, but everywhere on a mantle of drift which is of variable but usually unknown depth. At Trebines station a few miles west of Xenia a well located 50 yards from the river was sunk to a depth of 49 feet without penetrating rock.

At Alpha the valley expands greatly, though the only tributary there uniting with the Miami is Beaver Creek—a very small stream in a very large valley of which more will be said

OGAN



HISTORY OF THE LITTLE MIAMI RIVER

BY
J.A. BOWNOCKER

Drainage in vicinity of Cincinnati after Fowke

LEGEND
 Present Drainage ———
 Preglacial Drainage - - - - -



hereafter. About one mile south of Alpha, the valley again contracts, there having a width of perhaps one-tenth of a mile. At this point the valley lies about 75 feet below the top of the bluffs which are steep and composed of rock. Two miles farther down, the valley has again expanded and has a width of one-half mile. From the latter point to Bellbrook there are several variations in the width of the valley. These result largely from the entrance of tributaries and in part from the irregularities in the deposits of drift, and perhaps also from variations in the durability of the rock.

Just east of Bellbrook and north of the point at which the Miami turns abruptly to the east, there is a marked change in the width of the valley. Here the rock bluffs extend so close to the river that the flood plain on one side is only 85 yards wide, while on the opposite side there is scarcely room for a wagon road. A cross section of the valley here is shown in the following figure.

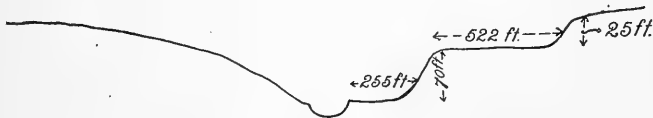


Fig. 1 Cross Section of Miami at Col just above mouth of Sugar Creek

Of special interest is the terrace east of the stream. It is in rock and has a pronounced slope *up* stream. From this point the valley widens, rather slowly up stream and rapidly down. The constriction in the valley and the expansion in both directions, the terrace sloping *up* stream, and the abrupt bend in the river just below, make certain the existence of a col at this place.

At the point where the Miami bends sharply to the east it is joined by Sugar creek which, though the smaller stream, flows through the larger valley. While connecting these two streams one mile north of this place there is an abandoned valley. The following sketch will indicate these relations.

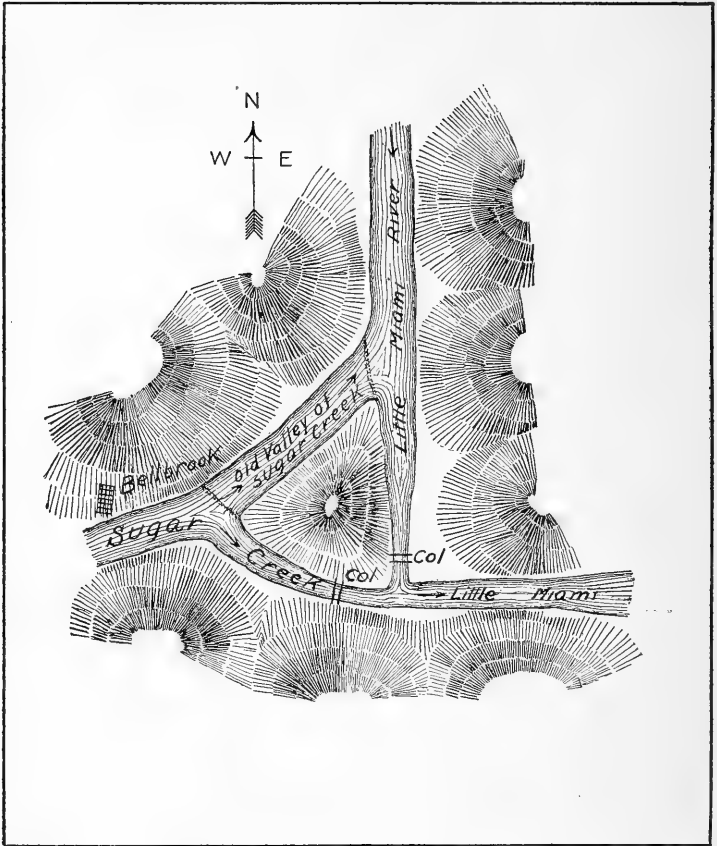


FIG. 2.

Opposite Bellbrook, Sugar creek flows through a valley nearly one-half mile wide. From this place it narrows down stream, reaching the minimum width a few hundred yards before it unites with the Miami. From this point the valley expands rapidly in both directions, and here is located another col. On the east side of this valley is a terrace standing about 70 feet above the creek.

As already stated there is an abandoned valley connecting Sugar creek with the little Miami about one mile north of the point at which the two streams now unite. This abandoned

valley is about one-half mile wide, and so corresponds to the present valley of Sugar Creek at Bellbrook. Similarly it harmonizes with the Miami at the place of junction with that stream. These relations show plainly that Sugar Creek formerly flowed through this old valley, and thence northward in the valley of the present Miami.

The Miami valley below the point of junction with Sugar creek was occupied by a stream which flowed east to Spring Valley where it united with another stream which will be discussed later.

Now the question how was the change from these conditions to the present produced? The answer is not difficult to find. It is one of the many changes produced by the great ice-sheet which formerly covered the northern half of the continent. The existence of a terminal moraine across the valley at Alpha shows that the ice front once stood at that place. This effectually blocked the course of the north flowing Sugar creek. The waters were ponded in front of the ice forming a long and narrow but deep lake. The waters rose higher and higher until they overflowed the divides, thus starting the streams in their present courses. The rapid flowing silt laden waters soon lowered the divides thus draining the lake, but not until its bed had been rapidly silted with drift. After the withdrawal of the glacier the streams found it easier to continue in their new channels than they did to clear out the drift deposits and resume their preglacial courses.

From the point of junction of Sugar creek and the Miami, the latter flows east to Spring Valley and thence making a sharp turn runs due south for a few miles. The valley widens until just opposite Mt. Holly where it is a mile or more in width, not being exceeded in this respect by any part of the valley except just above Cincinnati. Everywhere in this section of the river there is a heavy mantle of drift. About ten years ago a deep well was sunk at Spring Valley, and according to the best evidence now obtainable 170 feet of drift were found. This well it should be noted was on the north side of the valley in the angle made by the sharp bend in the stream. More recently two deep wells

were sunk at Waynesville, but these were at the foot of the hills and only about thirty feet of drift were found.

From the great width opposite Mt. Holly, the valley contracts rapidly to the south. At Waynesville it is only four-tenths of a mile wide, while at Oregonia 6 miles farther down it is less than one-fourth mile in width. The valley continues to contract until a point is reached about three-fourths of a mile south of Ft. Ancient. At this place, locally known as the "Narrows", the bluffs of limestone extend directly down to the river, there being scarcely room for the railroad tracks. No rock, other than drift, was observed in the channel at this point, nor could the depth of drift be ascertained.

Below the "Narrows" the valley widens gradually, but does not become prominent until Morrow is reached. The relations at the "Narrows" indicate the existence of a col at that place. At Morrow where the river turns abruptly to the west it receives Todd's Fork, an important tributary from the east, and immediately below the point of junction there is a marked increase in the width of the valley. This sudden change must be due to Todd's Fork; and the wide valley below the place of junction, to the preglacial work of Todd's Fork and not to the much younger stream, the Little Miami.

From Morrow to South Lebanon the valley continues without noted change; but just west of the last named place the river, making a sharp bend, flows due south, and immediately the valley begins to narrow. The change is so rapid that just north of Fosters the valley has become a gorge, there being barely room for the railroad on one side of the river and the public road on the other. After retaining this character for a fraction of a mile the valley widens gradually and continues without abrupt change for a number of miles to the south. Another col exists at the narrows immediately north of Fosters.

Now the question—how shall we interpret the drainage phenomena observed from Spring Valley to Fosters? The answer to this is found in the location of the cols and the character of the valleys. From the col at Ft. Ancient a stream flowed north to Spring Valley where it received an important tributary from the west as already described. From the same col probably a

small stream flowed south uniting at Morrow with Todd's Fork, a much larger stream. It is to the controlling influence of the latter that the present Miami makes its abrupt bend at Morrow. From Morrow the preglacial Todd's Fork continued west to South Lebanon in the valley now occupied by the Little Miami. Just west of the last named village a small stream, having its headwaters near Fosters, flowed north and then northwest through the present valley of Muddy creek and soon united with the ancient Todd's Fork, which from South Lebanon flowed northwest through the valley of Turtle creek, and thence into the valley of the present Great Miami at Middletown. From the col at Fosters a stream flowed south through the valley now occupied by the Little Miami.

The change from these early conditions to the present is not difficult to explain. The margin of the ice sheet, known as the early Wisconsin, crossed the old valley just west of South Lebanon and also the valley of the present Miami between Oregonia and Waynesville. This completely blocked the old courses of these streams, and, ponding the waters in front of the ice, formed small lakes. One of these lay between the ice front and the col near Ft. Ancient. Gradually the waters in this small lake rose higher and higher until they crossed the col and started on their southerly course. While this was happening a much larger lake was forming in the Todd's Fork valley. This lake extended from the margin of the ice west of South Lebanon up the valley of Todd's Fork beyond Morrow. These waters rose until they overflowed the col at Fosters which they soon lowered. The level of the waters fell proportionately and soon the lake disappeared, but not until its bed had been much clogged with drift. The thickness of the latter is not known. At King's Mills the shot tower well passed through 62 feet of drift without reaching rock. While this bed was being deposited the floor of the lake near Ft. Ancient was likewise being silted, and the same is true of the old valley west of Lebanon. The clogging of the latter was rendered more complete by the moraine which crosses the valley at that place. When finally the ice withdrew the preglacial courses which were so filled with drift that the streams were compelled to continue in their new channels.

From Fosters south the valley widens fairly regularly to a short distance below Milford. Everywhere the stream flows over drift. At Loveland a well 35 feet deep passed through two thin ledges of limestone, thus showing that the drift at that place is not deep. Below Loveland the quantity of drift increases. At Miamisville the gravel forms a terrace 62 feet high on which the village is located. Just below Camp Denison the Miami has abandoned its old course, and now occupies a channel farther east which is separated from its former valley by a knoll of limestone. Just south of this place is the town Milford, which, in the language of Dr. Orton, "stands on an island of blue limestone" and is surrounded on all sides by deep channels of erosion. The old valley of the river lies to the north and east of the town. These changes may be the result of the heavy deposits of drift which clog the valley in this vicinity.

A mile and one-half south of Milford another marked change occurs in the character of the valley. At that point East Fork of the Miami unites with the river, and immediately there is a decided increase in the width of the Miami valley. East Fork has in places a valley a mile or more in width, and lies 200 feet below the general upland. The valley of the Miami below the mouth of East Fork is comparable with the valley of the latter, but not with the valley of the Miami above the point of junction. These relations indicate that the Miami valley below the place of junction is really a continuation of the valley of East Fork, and that the breadth of the former is really due to the work of East Fork long before the present Miami was born. In those early days a tributary whose headwaters were near Fosters flowed south through the valley of the present Miami, and united with the waters of East Fork where this stream now unites with the Miami.

From this place to the junction with the Ohio the Miami valley is everywhere prominent. At Newton, four miles below Milford, it is more than a mile in width and it is several times wider than the Ohio just below the point of junction of the two rivers. These relations suggest important drainage modifications in the vicinity of Cincinnati, though it is no part of the purpose of this article to discuss these.

Having now traced the several streams from which the Little Miami was formed, and shown in what manner these were united to make the present river, let us consider further those parts of the preglacial streams which are not a part of the Miami. Let us first return to the mouth of Turtle Creek and examine that portion of Todds Fork which lies between the point last named and Middletown. The old valley through which this stream flowed is very conspicuous, and has long been known. It was first mapped by Dr. Orton and published with his article on Warren county in volume three of the Ohio Survey.¹ The width of the valley varies from about a quarter mile to more than a mile, the latter width being found near Middletown. The valley is so flat that the old canal which extended from Middletown to Lebanon was without locks. The depth of drift in the valley is not known. Two wells have been found in which the rock is reported to have been struck at a depth of about twenty feet. This shallow depth may be due to an old island now buried, or more probably to a slab of limestone having been dropped in the old valley by the ice sheet and then covered with drift.

Two or three miles west of the mouth of Turtle Creek a branch valley leaves the main one. This extends north and east passing the city of Lebanon, where two deep wells only a few hundred yards apart showed depths of drift of 126 and 256 feet. Just west of this city the wells which supply the place with water showed only 90 feet of drift, but these were located at the extreme side of the valley. Beyond Lebanon this old valley can be followed to the Little Miami with which it unites a mile or two above Oregonia. The bed of this section of the valley, however, is not flat. There is a rapid rise east from Lebanon to a point about one mile from the Little Miami, where the valley stands 190 feet above the adjacent river and 65 feet below the table-land in which the valley is cut. From this place the valley slopes rapidly to the Miami. The width of the valley at the summit is between an eighth and a quarter mile. Only twice in this tributary valley is rock shown in its bed; once at

¹Geol. Sur. of Ohio, Vol. III, p. 382.

Lebanon where the course of the stream has been changed by man and only a few hundred feet from where one of the deep wells was sunk; and the other perhaps a half mile from the point at which the valley unites with the Little Miami. This tributary valley may be explained in two ways: (1) It may have been occupied by two streams, one flowing into that part of the ancestral Miami which flowed from Ft. Ancient to the north, and the other to the southwest past Lebanon and thence into the abandoned channel which constituted a part of the preglacial course of Todd's Fork. These streams must have been so situated that their headwaters tapped the divide at the same point, thus producing the present continuous valley. (2) The other method by which this valley may have been formed was by an old stream flowing from the present Little Miami past Lebanon and thence into the main valley farther south. To this theory there are two objections: (1) The stream occupying the adjacent portion of the ancestral Miami flowed north. Under such conditions it is difficult to understand how there could be such a cross stream; (2) the rock in the valley a half mile from the Miami and above the level of the latter is also against this theory.

Caesar's Creek, which unites with the Miami between Oregonia and Waynesville, flows through a narrow valley in its lower course, but two or three miles above its mouth the valley is at least a half mile wide. The divide between this stream and the Miami is everywhere of rock except opposite Mt. Holly where it is very low and composed of drift. In fact this divide is a part of the Wisconsin moraine which skirts the east side of the valley at this place. The gorge-like character of Caesar's Creek near its mouth, the expansion of the valley a few miles up stream, and the low divide composed of drift leads to the conclusion that Caesar's Creek is part of the reversed stream, which once united with the ancestral Miami opposite Mt. Holly. This interpretation it may be added is in harmony with the great width of the Miami at the latter point.

Now the question—what became of that branch of the ancestral Miami which we have traced as far north as Spring Valley? This question cannot be answered as definitely as we might wish. But there seems to be only one course possible

and that was northwest towards Alpha. In any other direction a wall of limestone is encountered. The territory between Spring Valley and Alpha was once the margin of a great ice sheet and when this receded it left a morainic deposit which not only prevented the northward flow of the stream but entirely obscured the old channel. From Alpha its course is plainer, because from that place an old valley a mile wide in places can be readily followed northwest by Osborn where it is crossed by the Mad river, and thence on past New Carlisle to the Great Miami at Tippecanoe. The lower part of this old valley is occupied by a small stream, Beaver Creek, which is insignificant when compared to the valley through which it flows. The other end of the valley is occupied by Honey Creek, likewise a stream which grossly misfits its valley.

At two points only was the depth of drift in this old valley learned. At Osborn there are 207 feet and at New Carlisle 300 feet. Nowhere in the valley was bed rock seen. From these relations it appears not unreasonable to conclude that the old stream which has been traced to Spring Valley continued northwest past Alpha, Osborn and New Carlisle, and reached the valley of the present Great Miami near Tippecanoe. The stream could not have continued north far in this valley, however, for between Troy and Piqua the river flows in a very shallow channel on a bed of limestone. Neither could it have continued west of the Great Miami because there a solid wall of rock is found. To the suggestion that the stream may have turned south at Tippecanoe and flowed through the present valley of the Great Miami there is the objection that the Great Miami itself is regarded by some as a reversed stream. There appears then only one course for it to have taken, that is north along the east side of the Great Miami to just above Piqua where there is a great expansion of the valley and where the drift is more than 124 feet deep. But the old river could not have followed this valley far, because it contracts rapidly and a few miles up stream flows over rock again. About two miles north of Piqua there unites with the Miami, Laramie Creek, a sluggish stream that drains Laramie reservoir situated a few miles to the northwest. This stream everywhere flows over a

mantle of drift and in a deep valley cut out of the same material. The valley is narrow near its outlet but expands up stream, and near the station, Dawson, is fully a half mile wide. A large portion of this valley is undulating, and the irregularities found suggest that it is an old valley filled, rather than a young valley cut out of the drift. It seems to the writer that this valley is preglacial and that the old stream may have flowed through it to the vicinity of Berlin and there have entered the buried channel which has been traced to that place.

The channel to which reference has just been made was studied during the summer of 1898, and the report published in the *American Geologist* for March of the following year. During the summer of 1899 the work was continued and the mapping of the valley extended. These channels are shown on the map which accompanies this report. As may be there seen, they lie in Champaign, Shelby, Auglaize, Allen and Mercer counties, Ohio, and in Adams, Jay, Blackford and Grant counties, Indiana.

It must be borne in mind that all surface indications of these channels have been destroyed by the great ice invasions. So completely have they been filled that the present streams in places flow at right angles to the preglacial ones. In fact the course of one of the old channels in eastern Shelby county is now the site of a watershed separating the drainage of Lake Erie from that of the Ohio river.

Our knowledge of the location of these channels is due entirely to the driller for oil and gas; and progress in mapping these is likewise dependent upon him. All that we can do is to patiently follow the drill as it moves from section to section, and tabulate the facts which it discloses. Wherever this work ceases there also the work of mapping the old channel discontinues. For the facts relating to the greater portion of these channels reference must be made to the article in the *American Geologist* already referred to. It is proper here to discuss such additions only as have been made since that article was published.

Work during the past summer has been along two lines:
(1) Tracing a tributary of the main channel in Auglaize and

Allen counties; (2) following the channel westward in Indiana. These points will be considered in order. In Washington township, Auglaize county, Ohio, near the Shelby county line, a well in section 23 shows 298 feet of drift; while in section 22 immediately to the west there are 76 feet only. In section 14 due north from 23 a well showed 300 feet of drift without striking rock. The depth of drift outside the channel in this locality cannot be stated since no wells have been drilled there.

In Wapakoneta two wells have been sunk, one on the east side of the city and the other on the west. The former disclosed 125 feet of drift and the latter 90 feet. One mile north of the last well 130 feet are found. One and one-half miles northeast of Wapakoneta in section 16 two wells disclose depths of drift of 398 and 400 feet, with a mile and one-half northwest only 68 feet are found. This shows a drop in the rock floor of 332 feet in the surface distance just given.

The next point at which the channel is struck is in section 34, Duchouquet township. These wells are near the village of Cridersville and just south of the Allen county line. Two wells there disclose depths of drift of 400 and 486 feet; while within a mile either east or west of these the depth is less than 130 feet. From Cridersville the channel runs northeast into Perry township, Allen county. In the northeast corner of section 25 there are 394 feet of drift, while one-fourth mile due south from this there are only 166 feet, and one-half mile northwest only 123 feet. Obviously the channel is here very narrow. To the northeast in section 20 there are 350 feet, but beyond this the drill discloses no marked variations in depth of drift, and so the channel could not be followed farther. The apparent shallowing of this channel to the northeast indicates that the flow of water was to the southwest.

In German township, Allen county, from three to five miles northwest of Lima, several comparatively deep drives are found. In section 15 there are 235 feet; in section 16 there are 262 feet; in section 8 there are 214 feet. But these depths of drift are intermingled with very much shallower ones, so that their interpretation is not easy. Possibly they may result from several deep but very narrow canons.

It may not be improper to say a few words here concerning the continuation of the channel which was mapped last year as far as Anna, Shelby county. Southeast from this village no deep wells have been drilled and so the continuation of the channel cannot be shown with certainty. It may be recalled, however that at the town St. Paris, Champaign county, a drill passed through 530 feet of drift without reaching rock, while east and west of this place the drift is comparatively shallow. The distance of St. Paris from Anna is more than 20 miles and the writer is loth to connect these two points without records at intermediate places. However south from Anna the drift shallows and at Sidney the limestone appears in the river bed. East also from Anna the drift becomes thinner, as is shown by the deep well at Quincy. While these points are not conclusive they indicate that the channel cannot extend either south or east from Anna, while the great depth to the southeast indicates that it extends in that direction and that the channel at St. Paris is a continuation of the one traced as far as Anna.

A few words remain to be said concerning the channel in Indiana. In the report published a year ago, and to which reference has already been made, the channel was traced across Jay and Adams counties into Harrison township, Blackford county. It enters this township in section 20 and passes through sections 26, 35, 34 and 33. The maximum depth of drift reported is 430 feet, while outside the channel the drift is very shallow, not more than 50 feet in places. Near the southwestern corner of this township the channel curves to the northwest and enters Washington township, where depths of drift of 438 and 440 feet were found in sections 20 and 17. Many other deep drives are reported in this locality so that the channel can be definitely located. Continuing in the northwesterly course the channel passes from Blackford county and enters Monroe township, Grant county, where, in the southeast quarter of section 12, 430 feet of drift were found. The channel can be traced through sections 12, 13, 11, 10, 3 and 4 of this township, and then through sections 33, 32, 31 and 30 of Van Buren township, Grant county. In the latter township the depth of drift appears smaller and according to M. W. Page of the Ohio Oil Com-

pany does not exceed 300 feet. From this township the channel enters Washington township and continuing in the northwesterly course can be traced to its center, where in the southeast quarter of section 15, 348 feet of drift are found. Beyond this point the channel cannot be traced at present.

SOME OBSERVATIONS ON THE PREGLACIAL DRAINAGE OF WAYNE AND ADJACENT COUNTIES.

By J. H. TODD, M. D.

In presenting this paper to the Academy I simply wish to lay before you—for your criticism—the results of careful observations on the present drainage system of Wayne and associate counties, together with the relation it sustains to pre-glacial channels, and to a topography modified by glacial forces.

The associate counties are Medina, Ashland, Richland, Knox and Holmes; but even parts of these (with all of Holmes) must be excluded from any associate activity in the *initial* forces that determined the pre-glacial drainage lines. Although later, and before the glacier's advent, they became potent factors in establishing an outlet for the waters, their hills were not in existence when the first lines of drainage were cut; and these first lines are still marked features in our landscape.

These counties rest on the Waverly capping of the north-east face, or incline, of that island or low mountain chain known as the "Cincinnati Arch." Here the arch, owing to its hood of hard Waverly, is least eroded; and, although in Kentucky it presents in intaglio, and at Cincinnati only in slight relief, here the Waverly stands out in bold headlands forming a crescent of highest hills in the State, which decline rapidly to the bed of Lake Erie, and show the original topography, scarred by the original drainage lines.

In studying the Waverly group of rocks in this part of the Island, I find that they dip away rapidly on the west to the oil regions, and on the north under the bed of Lake Erie, while on the east they decline more gradually into the synclinal trough of the Allegheny coal basin; thus constituting a water-shed in three directions. Prof. Newberry says (Vol. I Geological Survey) "It will be noticed that the direction of the drainage streams, which follow the strike of the strata on either side, indicates that it once formed a water-shed that gave the initial bearing to their flow."

MAP AND SCALE

OF
PRESENT AND PAST
DRAINAGE
OF
WAYNE AND ASSOCIATE
COUNTIES
IN OHIO
Compiled from field notes
by
J.H. TO



Scale

3 2 1 0 1 2 3

Stouffville

Wesley

HURON

SPEARS

LETOM

Bepl

Milan

NORWALK

EAST TOWNSHIP

Pontiac

Harland

U R

OLENA

Stuven

North Fairfield

Wine Haven

Plymouth

Shiloh

Redland

London

Bumps

544 AL
Stately

W. River

R T C H L A

Spring Mills

60
Cresline

544 AL
Olliane

5

Oliver's Grove

Stearns

LEXINGTON

Geneville

RELSUNN

St. Domingo

Williamsport

Wheatport

Wheatport

Pulaski

Wheatport

Wheatport

MAP AND SCALE

OF
**PRESENT AND PREGLACIAL
DRAINAGE**

**WAYNE AND ASSOCIATE COUNTYS.
IN OHIO**
Compiled from field notes & drawn
by **J. H. TODD**

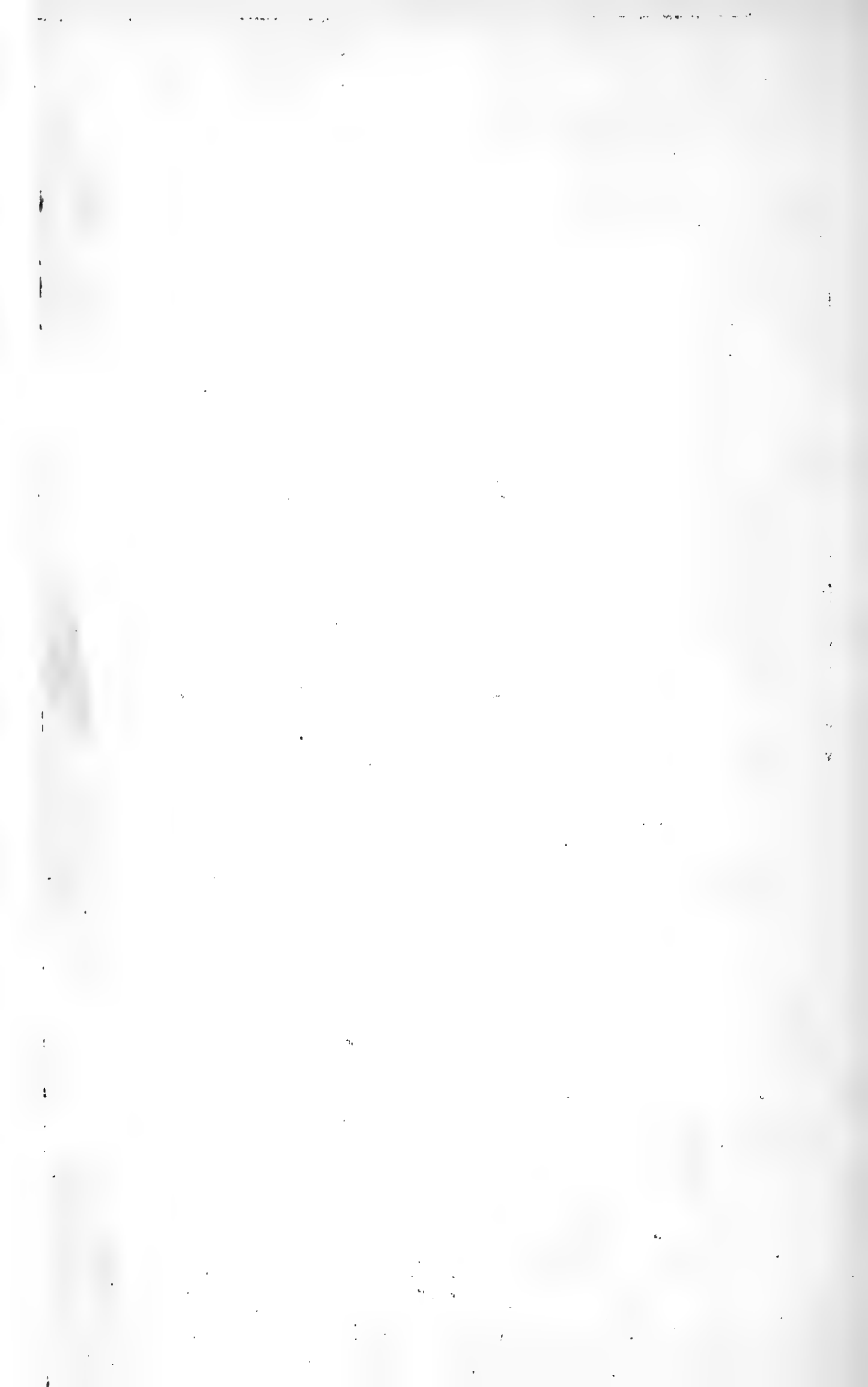
PRESENT DRAINAGE
PREGLACIAL DRAINAGE

LINE OF RIVER ELEVATIONS
INCREASING DATA
WRIGHT'S GLACIAL LINE

LEGEND

CHARTERED
GLACIER
D.D. 1810





Any one walking as I have walked, from Wooster by Hayesville and Mansfield to Bellville; and then crossing the profile from Ashland to Loudonville: will see this fact demonstrated to conviction.

In the first tramp (Wooster to Belleville) you cross all the streams that drain the eastern face of the plateau; and the elevations, as determined by barometer, may be instructive. Wooster University stands 522 feet above Lake Erie. Killbuck Valley 332, Jefferson, on rock summitt of plateau, 600, the flood plain of Muddy Fork 432, and the divide between this and the Jerome Fork 650, while its flood plain is 450. Hayesville, on the summit of the divide between the Jerome and the Black Forks, 700, and the flood plain of the Black Fork at Mifflin is 500, the depot at Mansfield 581, and the plateau south of the city is 800, and above Bellville 900. In the cross section from Ashland to Loudonville the divide between the Jerome and the Black Forks, independent of glacial deposits, is almost a level plane, with only a gradual descent of rock strata of about 50 feet.

The valleys in which the streams run average about three-fourths of a mile, and the rock floor averages about 150 feet below the present bed of the streams, while the rivulets and creeks that form the streams, start from the rock with the dip of the rock, and only mar the strike of the strata by erosion as they proceed.

The above presents a picture of the extreme eastern face of the plateau, showing the uniformity of elevations between streams, and the gentle dip of the plateau to the north and east, as well as the depth to which it was eroded by pre-glacial streams. Prof. Newberry further says: "A current from the south swept the eastern shore of our ancient Atlantis that floated the trunks of tree-ferns and branches of lepidodendron to Sandusky." This *current* gave the *initial* direction to a pre-glacial stream that, in after time, carried the waters not only of the Waverly but of the virgin coal hills as well, to the great channel through the bed of Lake Erie.

The crescent of the highest hills spoken of, that bound the elevations, and head the present streams, presents one horn resting on Medina county, the other on Knox, while the center

includes the Savannah Lakes in Ashland county. It forms the rim of a bowl or hydrographic basin, and its pinnacles of highest hills show as the zig-zag wanderings of a worm fence.

The rivulets and creeks dovetail and intertwine like the locking of fingers; while all along the crest are to be found, between the exposures of native rock, the remains of old lakes, gravel knolls, cat swamps, sink holes, and millions of boulders, the largest two lying near Lodi and Ashland, with an estimated weight of 300 and 350 tons respectively.

The elevations of this rim above Lake Erie are, Wadsworth 700 feet. But Wadsworth is underlaid with coal, and is therefore east of our pre-glacial channel, *which must run exactly between the Coal Measure hills and the Waverly capped Island.*

Seville is on carboniferous conglomerate, and is situated west of the valley of the river Styx, which drains the coal fields north and west of Wadsworth. It is just on the edge of the Coal Measures, and its elevation is 403 feet above Lake Erie, while drillings in the vicinity show 300 feet of drift. This makes a rapid decline of near 600 feet in six miles to the rock bottom of the Seville valley, and the surface decline continues west into a broad valley, where we are justified in assuming the same amount of drift with a lower well head, although no drillings have been made in the center of the valley.

On the west side of this valley $1\frac{1}{2}$ miles east of Leroy, and southwest of Chippewa Lake, a drilled well shows 149 feet to rock, and going north east to a point $4\frac{1}{2}$ miles due south of Medina village, and northeast of Chippewa Lake, a drill was sunk 190 feet and no rock was struck, but $\frac{1}{4}$ miles north, *Waverly* rock was struck at 125 feet. While $1\frac{1}{4}$ miles south, rock was struck in Carboniferous conglomerate at 42 feet, showing a north-east channel through Chippewa Lake on the edge of the conglomerate.

Following this line to a well three miles due east of Medina, near the head of Rocky river, I find 140 feet of blue clay above 60 feet of white sand; the well was abandoned at 200 feet without reaching rock, as sand ran up the pipe to water level. This well head is 180 feet below Medina and it makes the bottom of this drill hole 133 feet above Lake Erie.

This is not conclusive, but it shows no rock bottom at a level lower than Wooster and Orrville, and provides an outlet for the waters of Wayne county to Rocky river, and thence to the lake *between the Coal Measures and the Waverly*.

Ascending from this well to Medina village the elevation is 513 feet above Lake Erie, and crossing the divide between Rocky and Black rivers I find the surface elevation at Lodi to be only 282 feet; thence up to West Salem the register gives 575; at Polk 640; above Ashland 650; at Savannah lakes 700; north of Mansfield 862; and by the registered grades of 892, 912, 932 and 952 I am on the Belleville hills, and ascending to the south of Independence I find myself on one of the highest pinnacles in the State, about 1000 feet above Lake Erie.

Note the graded ascent of the crest that divides the waters, or rather note the descent, and remember that this decline in elevation means the gradual dip of a plateau, the face of which presents north and east.

The streams that drain this basin all trend east or southeast, toward one central axis, and this axis was primarily Prof. Newberry's current from the south that swept around this headland to Sandusky; and next, during the putting down of the Coals, the forecasts of these channels supplied fresh water to the coal marshes in the Allegheny basin: and lastly, after the Coal Measures were elevated to their present level, the axis channel became the trough to carry the waters from both the Coal and Waverly hills to the great pre-glacial river that ran through what is now the basin of Lake Erie.

This large hydrographic basin is now made up of six smaller ones; the Clear Fork, Rocky Fork, Black Fork, Jerome Fork, and Muddy Fork, of the Mohecan river; and the mysterious basin of Killbuck from Wooster to Burbank, where a glacial dam breaks its association with Black river, and fills a scallop or "Water-wier" in the Waverly, below the present surface of Lake Erie. These streams all run in broad valleys, with flood plains near a mile wide; they are separated by high table lands which showed—before the glacier's advent—evenly bedded rock strata, but now they are crushed like a ship in arctic ice. The bed and trend of these streams conspire to impress you—not

so much with their individuality—as that they are parts of a whole, converging to a common axis of drainage, and this axis is the trough between the Coal hills and the Waverly from Loudonville to Lake Erie. The P. F. W. & C. R. R. follows this trough from Loudonville to Wooster, and its record of levels will tell us the grade of descent. Mansfield is 578 feet above the Lake, Lucas 518, Perrysville 433, Loudonville 412, Lakeville 378, Shreve 352 and Wooster 342 above Lake Erie, making a decline of 236 feet between Mansfield and Wooster or about 6 feet to the mile.

This old waterway is clearly defined from Loudonville to Wooster, and from there is easily traced by Orrville and Chippewa Lake to Rocky river; that portion between Loudonville and Wooster is bounded by high and rocky hills of Waverly on the northwest, and Carboniferous conglomerate on the southeast; and the channel ran the entire distance, exactly between these too widely different geologic formations. It is filled to varying depths with gravel, and sand, and clay; its surface presenting a broad and fertile valley, with soft undulations between kames, kettle holes, and cranberry marshes.

Its rock floor, however, is of greater interest to the student of preglacial water ways, and, beginning at Loudonville, a drilled well shows this rock floor to be 150 feet below the village, making our starting point 262 feet above Lake Erie. Next, near the bridge over Lake Fork, where a preglacial channel comes in from Mohecanville, the rock floor is determined by the chain of lakelets that marks its course; their depth being about 130 feet, and the surface elevation here being 375 feet gives the rock bottom 245 feet above Lake Erie. Applying the same rule at Odel's Lake, through which the axial channel passes, I find rock at 228 feet; and at Big Prairie with a surface elevation of 390 feet, a drilled well shows 176 feet of drift, making the floor 214 feet above Lake Erie.

Near Alligewi (Custaloga) Junction between Big Prairie and Shreve, where the precursor of the Lake Fork, that tore out a channel 10 miles long, $1\frac{1}{2}$ miles wide and 400 feet deep—counting from hill tops—thus creating the "Big Meadow" of the Indian and the "Big Prairie" of the Pioneer, entered the axial channel by

Brown's Lake, the surface is very deceiving. The drift seems piled in without order—now rising into hills 500 feet above the lake, and resembling a divide, and now sinking to the plains of the prairie—but a well was drilled here on the plane, at the Brown farm, to water at 170 feet—no rock encountered—and as the well head's elevation was 380 feet, it shows the rock floor to be less than 210 feet above Lake Erie.

Two miles from this, at Shreve, the elevation is 352 feet, and many wells have been driven to water—the only object sought—which is found in white sand under blue clay at from 60 to 105 feet. So I am safe in assuming the rock floor to be less than 200 feet, as the continuance of a channel is unquestioned.

Still, if the channel at Shreve should be regarded as a tributary from the coal hills of Holmes county—and here such a preglacial channel does come in—it would not modify the facts given above, nor embarrass my water-way to Wooster, as there is another way for the waters to proceed. A channel which was possibly used during the later history of the coal beds, when changes of level were common, and shiftings of coal into Waverly, and Waverly back into coal, were frequent, is traceable west of the Shreve hills—in which is found a small pocket of No. 7 coal—and it returns to the axial channel through the preglacial channel at Millbrook.

A very little digging would now turn the Lake Fork into Killbuck. So little that the A. & W. R. R. were afraid to run their track from the clay plant in the Big Prairie to Millbrook through this valley, for their engineer assured them that their track would be flooded if they cut half a mile through the gravel barrier that divides the Big Prairie from the Millbrook valley, as the flood plain of Big Prairie is 150 feet above that of Killbuck. This channel will be more fully studied in the future.

On the Troutman farm, near Millbrook, and where the above old channel comes in, a well was drilled on a gravel knoll elevated 376 feet, to the depth of 185 feet, but no rock struck; four furlongs east on the Webb farm, a well was driven to water at 100 feet and no rock encountered; while two furlongs a little south of east, and one furlong from the hill, rock was struck at

40 feet. These drillings were all on Sec. 6, Franklin township, Wayne county.

It would seem that between Shreve and Wooster, where the widening channel from Millersburgh enters the axial channel, the rock floor has been deepened as well as widened and a preglacial lake, tripod in shape, formed.

The spread of the rugged inclosing hills, the great flood plane known to the pioneers as the Killbuck swamps, and which to them became a lake at each "spring flood", all go to prove this. The basin would be 10 miles long from Wooster to Shreve and 8 toward Millersburgh, with a width of from $1\frac{1}{2}$ to 3 miles; over this plane the Killbuck Creek then crept from hill to hill, and back again like the doublings of a snake. The Indian chief, Killbuck, made himself noted by killing a deer with an arrow from his bow that, on its errand of death, crossed the creek three times.

One drilling in the center of this lake, $1\frac{1}{2}$ miles south of Wooster, and 5 miles from the cross section wells, with a well head of 330 feet, shows 185 feet to rock and 480 feet to Berea sand (which here has a thickness of 27 feet); this makes the rock bed of the channel only 145 feet above Lake Erie, and to this must all other levels conform, unless the lake character of a basin with a deeper bottom than the main channel can be proved. This brings me to the city of Wooster, and from here to Orrville I have a rough road to travel, but the preglacial water came here, and there was but one way for it to go out, and I must find that way *under* the high gravel hills between here and Orrville. On the south of Wooster is Madison Hill, on which is located the Ohio Experiment Station, with its quarry of elegant Coal Measure sandstone; and $1\frac{3}{4}$ miles north of it across Apple Creek valley, on a terrace of which is located South and East Wooster, Wooster University is planted on a hill of naked Waverly shale 522 feet above Lake Erie. Madison Hill has about the same elevation, and between them, but near 200 feet below them, sparkles the crystal water of Apple Creek. No drillings have been made in the center of the channel to the rock floor—so its elevation cannot be proven here—but many drillings have been made for water, which is found in white sand

at from 95 to 105 feet. One well was drilled to rock on the side of the channel, at the foot of College Hill and showed 120 feet to shale; while six furlongs east, across the Apple Creek, at the foot of Madison Hill, rock was found at 45 feet and the channel runs between these two wells.

From this throat at Wooster the axial channel proceeds almost due east for a distance of 8 miles to a point $2\frac{1}{2}$ miles southwest of Orrville, near which the C. A. & C. R. R. enters and follows it in a northeast direction to Orrville. It is bounded by the same type of Coal Measure hills on the southeast, and Waverly on the northwest as at Wooster, but the trough is filled with drumlins of varying heights. At Honeytown, three miles east of Wooster, the Apple Creek enters it through a preglacial channel from the coal hills on the southeast; but it is so deflected by glacial *debris* that it turns on itself and follows the axial channel back to Wooster and thence to the Killbuck.

Near Honeytown I can give you a better record of rock floor; one-half mile east of that hamlet on the Mock farm—Sec. 7, East Union Tp.—a well was drilled to the depth of 185 feet and no rock found. The well head has an elevation of 345 feet and shows the rock floor to be, at most, less than 160 feet above Lake Erie. In the N. E. $\frac{1}{4}$ Sec. 2, East Union Tp., two and one-fourth miles southwest of Orrville, near the C. A. & C. R. R., a well was drilled through sand, gravel, and yellow clay, above 50 feet of blue clay, soft as mud, and the well was abandoned as hopeless in this "blue soap" at 110 feet, without striking rock, while one-half mile away in the S. E. $\frac{1}{4}$ of same Sec. hard sand rock was struck at 3 feet, but drilling was continued in the rock until at the depth of 50 feet a flowing well was struck which yields ten gallons of pure water per minute. This well was on the side of the channel. This would seem to throw a little light on the origin of the many flowing wells about Apple Creek, Shreve, Fredericksburgh, and along some of the preglacial waterways of Ashland county.

But I leave this in the satisfaction I feel in being able to demonstrate a deep preglacial channel under these hills that connects the axial channel with the broad valley of swamps that lie north and east of Orrville where it is joined by the out-

put of the dismal swamps bordering Newman's Creek, which seems to open—as a wedge—the coal measure hills of Baughman Tp. to drain them.

Of course I cannot demonstrate the elevations of the rock floor to these mysterious swamps, for no drillings have been made in these marshes to their bottom, that I am apprised of; but no geologist who has examined them has ever doubted the existence of a preglacial channel here. His only question has been, "To where does it go?" And I think I can prove to you, at least by circumstantial evidence, that the channel proceeds through these swamps north, and after taking in the waters of the Red Run region, goes northwest diagonally across Milton Tp. south of Sterling and east of Creston, where, after reversing or rather doing away with the necessity of a Chippewa Creek, it took up the waters of Killbuck's head from Wayne Tp. and carried them to Chippewa Lake to be forwarded to Rocky River.

One proof of this is found in the fact that two and one-half miles southeast of Sterling, in Milton Tp., an Artesian well, in the line of the channel, has for thirty years filled a three inch pipe with pure water from a depth of 80 feet, and no rock was encountered in its drilling. And second, when the A. & G. W. R. R. was building from Sterling to Creston, some fifty years ago, a section of the track sank out of sight, went down in the night to stay, and they had to change the line and use the wood from an acre of heavy oak timber to steady it in the new place. The third item of proof is that several wells have been sunk in the line of the channel east of Creston to 160 feet and no rock struck. These wells are in valleys some 50 feet lower than Creston village, as I am informed. I am also informed by a prominent member of the U. S. Geological Survey that "a well at Sterling has about 400 feet of drift." I have been unable to locate this well unless it be one situated about one mile northwest of Sterling, near the Medina county line, which reveals great depth of drift, but the exact thickness I could not secure. Yet enough was secured to demonstrate a rock floor very nearly on a level with the surface of Lake Erie, or about the same elevation, as I will show in the Black River

channel, only 10 miles west, over the horse-back divide at Lodi.

Such a channel in width and depth, *could not have been produced by drainage from the north*, for, it is only 12 miles to the rock crest above Medina city, and but six miles to the north and south divide between Chatham and Lafayette townships.

It was on the foot hills of the east face of this divide that the two wells—noted in the early part of this paper—were drilled to rock, at the respective depths of 149 and 125 feet; they are $4\frac{3}{4}$ miles apart, and, joining them with the Medina city foot hill, $4\frac{1}{4}$ miles north, they mark the eastern extension of the Waverly as a surface rock, from Le Roy to Medina, a distance of nine miles. Opposed to this headland of Waverly I find the declining face of the last projection of the Coal Measures from Sharon to Seville, where the quarries of Carboniferous conglomerate are worked from the western face of the hill, and it was between these diverse and opposing faces that the primitive channel ran into that of Rocky river.

I must now search for a cause of sufficient magnitude to convert the drainage system described, into that of the present; a conversion that has created a new topography for a large part of the State of Ohio.

When the glacier passed from the soft shale bed it had plowed out for Lake Erie to lie in, it met two mountainous obstacles of greater, and yet unequal resistance; viz: the Coal Measure hills and the Waverly plateau, each still rising to the height of 700 feet, with the pre-glacial channel, over which now runs the Rocky river exactly between them; seven miles east of Rocky river, opened the wide mouth of the Cuyahoga, that drained the northwest face of the Coal Measures: a cross section of these, from east to west, through the center of Cuyahoga county shows (according to Prof. Newberry in Vol. I, Geological Survey) the pre-glacial bed of Rocky river to be 3 miles wide and that of the Cuyahoga $4\frac{1}{2}$ miles, with the intervening Coal Measure projection only 7 miles. Now 14 miles west of Rocky river comes down across the Waverly the broad trough over which now flows Black river, and all these wide pre-glacial channels worn down into the Erie shale, below the Lake's present

level, making three broad and deep breaches between the prime obstacles barring the glacier's even progress. Huge as it was its course was modified.

Striae on the hills of Summit county are directed *south-west*, while on the pure Waverly of Richland and Ashland counties they are *southeast*; these scorings if *projected* would meet in the Killbuck valley. How could such scorings be produced? Is it not plain to anyone with operative intelligence, and a mind unbiased by pre-conceptions, that the broad inclined plane from Mansfield to Wooster, facing the high range of hills bordering the Tuscarawas valley from Massillon to Akron, would of necessity influence the ice-front, when a lower plane was there, and lead you to expect and search for just such glacial scratchings? Here were two forces acting the one against the other, and together they directed a lobe of the glacier that had entered the inviting depression created by the three open channels across Cuyahoga, eastern Lorain, western Summit, Medina and Wayne counties until it was stranded as a bow on the hard high hills of Holmes county, just before it reached the continental divide of the Coal Measures; this bow a little more than subtends the south front of Wayne county, the bowstring being about 30 miles long, while the central projection is about 8 miles to Millersburg, with the Killbuck valley as a fixed arrow in the bent bow,

This lobe of the glacier seems to have become detached from the main body just where the Coal Measures end below Loudonville in Ashland county, for the main mountain of ice slid on south over the smoother face of the Waverly that skirts the Coal Measures to below Newark, before it was deflected—a distance of 40 miles. Now, it was this arrested lobe of the glacier, that brought the load of material that changed the entire topography of the hydrographic basin described in this paper; from Cleveland to Millersburg, and from Massillon to Mansfield, its burden of *Life in Death* was put down, giving a new physiognomy and a new physiology to the landscape; and the remodeled features, with their fresh expressions, made the face of this valley a thing a beauty to the eye and a blessing to the nation; the angular hills and gorge-like valleys, were rounded

up into gentle swells, and smoothed out into graceful undulations, and the food in the "glacier's grist" was so digested and assimilated that hill and dale rejoiced in verdure unsurpassed, and there was left as our inheritance, as fine a grazing and wheat-growing section as the sun shines on.

But our old water-ways were obliterated, filled with drift to hundreds of feet above their holding, and new drainage channels must be created; a few of which, together with their mode of creation I will attempt to describe. The Clear Fork of the Mohecan, followed, in part, the old channel to near Perrysville, but was here obstructed in its course to the Black Fork gorge by drift; the obliterated channel being now distinguished by two small lakes—or kettle holes between the high gravel knolls that turned the waters. The deflected stream then cut a new channel southeast to the Mohecan, its newness being demonstrated by numerous falls, the most picturesque being Lyons Falls, where the stream cuts down into the crumbling red sandstone of the Waverly immediately below the Carboniferous conglomerate of an outlying coal hill, revealing many and beautiful casts of fossil. The Black Fork was blocked by morainic material where the Killbuck lobe of the glacier became fixed on the Loudonville hills; but it found a col a mile below the village, where the diverted Clear Fork rejoined it, and, uniting their forces they cut a narrow gorge through hills that now stand 425 feet above the rock bottomed and rock banked Mohecan. Here a mountain of sand stone and shale is cut in two as you would cut a loaf of bread. The next col is at Lake Fork where, because their old channel in the Big Prairie was walled up by a glacial dam now 180 feet high, the Muddy and Jerome Forks of the Mohecan were compelled to mingle their waters and tear down a low breach in the hills at Fort Tyler into a gorge 200 feet deep, and 3 miles long, through a divide, to gain—at Rochester a pre-glacial channel coming down from Mohecanville.

This channel of waters—now called Lake Fork—followed to above Lakeville, where they were again staggered out of their course by the hill like obstructions of glacial debris that here stopped transit in the axial trough, and, they must a second time cut a way through high conglomerate hills for 7 miles to join

the new channel of the united Black and Clear Forks, 5 miles below Loudonville, and create the Big Mohecan.

We now come to the mysterious Killbuck, the preglacial heralds of which entered the axial channel at Wooster, but its mystery is explained by the lately discovered fact, that it was not through its *entire course* that it so entered pre-glacial times—even from the north,— and its channel from the south will be discussed later.

Late investigation has developed a new feature in the Killbuck and Black river valleys, one that throws much light on the enigma of pre-glacial drainage in this region, and these newly observed facts make it necessary that I repeat a few salient points of my paper, and introduce additional detail.

I must especially recall to your mind the picture of an island in a Devonian sea; and this island made up of a fold of Silurian and Devonian rock, capped with deeply eroded Waverly. The head of this island was near the mouth of the Black river trough that drained this face of the Waverly; and its sides are now practically bounded by an imaginary line running through Norwalk, New Haven, Galion and Mt. Gilead—on the west, and on the southeast and northeast, by the Coal Measure conglomerate from Independence, by Loudonville, Wooster, Orrville and Rocky river from head to mouth.

It must be remembered that this island has never been entirely submerged since the elevation of the Waverly. Its surface constituted a plateau with only rounded and eroded edges, as determined by the strike of the strata, while the waters drained from it—owing to difference in *temperature* and *quality*—assisted greatly in developing into *permanency* a current along its sides.—from south to north—and around its head. This current was maintained during the putting down of the Coals and *instituted* the axial channel for all pre-glacial drainage in this region. On the west and north we had the progenitors of the Huron, Vermilion, Black and Rocky rivers; on the southeast and east we had the *initial* channels of the Clear, Rocky, Black, Jerome and Muddy Forks of the Mohecan river, and a portion of Killbuck channel, pouring their floods into this common current; and this, through all Carboniferous and subsequent time, until the gla-

cier's burden blocked the way. What a game of shuttle-cock must have been played between the *debris* of their floods, and the deposits in the coal marshes, from the frequent oscillations of land and sea during this æon of time; and how this shifting of *debris* and growth must have modified the course of the current at different times! And when we think of the corrosive influence of the atmosphere, and the erosiv power of the streams, we will not wonder at the great width and depth of the main drainage troughs noted above, nor at the occasional dove-tailings of the Waverly and the Coal Measures conglomerate that throws a shadow over the course of the mutual outlet for their waters.

Furthermore, not only was this water way obscured, but the entire face of the plateau was transmuted. Erosion had so marred its features, and glacial drift so deformed them, that my first examination was faulty and I must add to, and explain, the elevations noted in the early part of the paper. The line of highest hills there noted marks the present divide between Lake Erie and the Ohio river, but not the pre-glacial divide marking the crest of the Waverly. I found it to be south, and east of this line of hills. Entering Wayne county south of West Salem, it passes across Congress township about two miles south of Congress village, and crosses the Killbuck one mile north of Cedar Valley (now Overton) and entering Wayne township it intersects a north and south divide from Burbank to Wooster in such a manner as to almost present the picture of a turkey's foot, the central toe—the continuance of the continental divide—extending across Wayne township to Green and ending at Smithville. The right toe, being represented by a range of hills that run southeast to Wooster, where Wooster University is located on the extreme front, 172 feet above the city's square. From these two points the descent of the Waverly is very rapid until it disappears under the Coal Measures. The elevations of these spurs are, above Wooster 640 feet, above Smithville 700 feet, and the rock is badly crushed. The projection of the third toe is disgraced by a line of high elevations running from the heel at Cedar Valley, northeast across Canaan township, and almost paralleling the middle division of Killbuck valley—to

east of Burbank—where it was connected with the divide separating the Black from the Rocky river, and shows that a north and south pre-glacial divide in the plateau did exist from Medina to Wooster; and where it was crossed by the continental divide above Cedar valley, the Killbuck gorge was bisected.

Here the hills banking the Killbuck are less than 80 rods apart, although nearly 200 feet high, and the stream runs on a rock bottom.

From this point, and from all the northeast face of Congress Tp. the collected waters were carried into one channel, that of the Black River, at Lodi, and thence to the Lake. Drilled wells west of Burbank show 100 feet to rock; in the Harrisville swamps 90 feet, and its bottom is studded with innumerable boulders. Southwest of Lodi rock is found at 120 feet, and two miles northwest of Lodi on the Little Black River, the drill passed through 285 feet of drift before reaching rock, and the well head is 45 feet below Lodi; two miles north of this, where the valley is 20 feet lower, no rock was struck at 270 feet, and one mile northeast rock was not reached at 217 feet, but $1\frac{1}{4}$ miles east of the line of these wells, with well heads 45 feet above Lodi, rock was reached at from 200 to 204 feet and the ascent is very rapid from here to the crest of the divide between Black and Rocky Rivers, which follows the line between Chatham and Lafayette townships. Many other wells have been drilled in this region of which I have the records, but these are enough to show that the preglacial trough over which the Black River now winds its torturous course was many feet lower than the present level of Lake Erie. The next observation of interest made here is connected with the unique Killbuck, which now drains the northeast angle formed by the crossing of the divides near Cedar Valley.

Bisecting this angle was found a preglacial channel passing northeast through the Jackson swamp to join the axial channel near Creston. The three heads of the present Killbuck, after uniting, follow in part this old channel across Canaan Tp. to its northeast corner and there, turning abruptly west, the stream cuts its way for seven miles through the divide to the trough of Black River, where it again turns at an acute angle and pro-

ceeds southeast to Wooster, passing, after traveling 24 miles, within one mile of the springs that mark its head.

The explanation is this: When the great mass of morainic material which formed the hills between Creston and Sterling was piled into, and over the water-way, then as low as the Lake's present level, of course this channel was obliterated, as well as the one coming from Canaan Tp., now represented by the head of Killbuck. The dammed up waters of the Killbuck channel formed a lake at Jackson, and the obstructed waters in the axial channel created the larger lake from Orrville to Easton. Now these lakes must have an outlet, and the waters of the eastern one, now represented by Orrville swamps, Chippewa Creek, and the subterranean passage near Sterling, where fish came up when the railroad went down, cut its way by a low col in the coal measures at Warwick and gave birth to the Tuscarawas River.

The other, or Old Hickory Lake, forced a way directly across the north and south divide, creating a broad and rocky channel for Killbuck to Burbank, but the Black River trough was also blocked by a series of kames running east and west and forming the south border of a Lake imprisoned between Burbank and Lodi, now known as the Harrisville Swamp. So the Killbuck waters must search for a new way out, and being joined by the embarrassed waters of the northeast face of Congress Tp. enough force was generated to cut a narrow path through the continental divide near Cedar Valley, and so the Killbuck river was completed and sent on its way to join the Tuscarawas at Coshocton.

This completes the preglacial and present drainage of the northwest half of the hydrographic basin. The southeast half shows a rim made up of hills as high, and hard, and irregular, as those on the west and north, but of different material. The first were of Waverly, while these are composed of all the factors of the coal measures. Each of the seven numbers of the coals are represented, while limestone, and sandstone, iron ore, and chert are found as capstones to the rim of the bowl through all of Holmes county. The line of the divide starts near Independence and Bellville in Richland county, and passes through

the southwest corner of Hanover Tp., Ashland county, touching the northeast corner of Knox county, and crosses the Mohican four miles south of its junction with the Clear Fork and near its union with the Lake Fork. From here it runs northeast into Knox Tp., Holmes county, and crossing an enigmatical north and south divide that turns Black Creek to the east, it continues in a northeast direction across the township and enters Monroe Tp. at its northwest corner, then bending southeast it traverses the township nearly midway between Paint Valley and Welcome, and has for its crest the Blue Stone, of which the Millersburgh court house is built, and the red sandstone known as Killbuck red sandstone. From here, after crossing the southwest corner of Hardy Tp. it enters the north corner of Killbuck Tp. and crossing the Killbuck River 4 miles below Millersburg, locates a narrowing in the Killbuck channel, supposed to be a col, just where that stream turns to the southwest to be joined to the Black Creek. From here this divide enters in an easterly direction the northwest corner of Mechanic Tp. and crosses the township in zigzags until it approaches the northeast corner where it turns abruptly northeast to Santillo P. O., then east through a stone-quarry region and on to a point two miles south of Berlin, where it again turns northeast and passes north of New Carlisle, where a new turn directs it to the limestone ridge above Weinsburgh. It here leaves the county of Holmes in worm-fence progression, possibly to Dundee, or in some other way to assimilate with the confining walls of the mysterious Tuscarawas.

I have not had the privilege of tracing it, nor determining the location of the col in the Big Sugar Creek, whence the waters were carried in preglacial times from the Newmans Creek channel north of Orrville.

But this I have determined, that a spur of the divide passes from near Weinsburgh by Mt. Eaton to Kidron, inclosing a territory that sent its waters to Kidron, and thence to the Apple Creek channel. Along this old water way, Artesian wells are secured from white sand at from 75 to 80 feet. This valley is followed by the new Camp Railroad from Kidron to Honeytown. It is no easy matter to determine the exact crest of the

divide, but the character and quality of the earth together with the strike of the rock strata, determines the trend of the rivulets that make up the creeks, and the creeks continue in the same general course until a ravine has been reached cutting into strata of lower geologic formation; here a new direction may be given, which is again modified by elevation and strike of strata. Unlike Wayne county, the strike of the strata in Holmes county is very irregular. We used all these points in following the line of divide, spending five days between Loudonville, Nashville, Napoleon, Oxford, Millersburgh and Holmesville, and the prime thing noticed, as obscuring the investigation, was the influence of the *glacial moraine* on the direction of the rivulets. The morainic material from Stark to Ashland county is abundant on an irregular line from two to four miles north of the crest of highest hills and gradually thins out to the crest, creating an intervening *border plain* where the rivulets seem to struggle to find a way out, and then, shuddering back, make crow-feet markings on the summit, or they huddle together, forming little pools, or they spread out to form peat swamps, like the notable one north of Berlin where the Ohio Ground Sloth (*Megalonis Jeffersonii*) was found.

Any one will recognize these important facts who will critically examine the line of the terminal moraine as platted by Prof. G. F. Wright.

I say important because they must be used in questionable cases, as the Sugar Creek and upper Tuscarawas regions.

This brings me to the preglacial channels that drained the Carboniferous side of the completed hydrographic basin and were tributary to the common water way. The first on the west was a small channel coming in just south of Loudonville and one mile north of the present confluence of the Clear and Black forks; it drained the higher hills of Hanover township and is crossed by the new bed of the Clear Fork. Drakes Valley from Nashville to Lakeville marks the line of the second.

The third in order drained the limestone highlands of Ripley and enters the main channel just west of Shreve. A well on the D. E. Foltz farm shows 91 feet to water but no rock. We are now at the south exposure of the Limestone ridge of

Ripley township and all its waters were directed by the dip of the rock to the Paint Valley channel, which started near Nashville and enters the Killbuck channel near Holmesville.

The next and principal tributary is the great Killbuck channel, in which the waters are now reversed. We located the col in this river 4 miles south of Millersburgh, but later observations reveal many facts pointing out Oxford as the site of the col, and that the Black Creek gorge sent its waters to Wooster. In driving from Nashville to Napoleon by a route west of the common, I found a range of hills starting from the east and west divide in Knox township that had not been considered in the first investigation, and although this discovery does not do away with the significance of the line of high hills there noted yet it does constrain me to believe that this divide was surrounded by a range of higher hills, and that the waters of Black Creek were included by them. This line continues almost parallel with the Mohican River to old Fort Fizzle, west of Napoleon, and from here is directed to the "Summit Ridge" in Richland township, and only separated from it by a strait so narrow that it seemed like a col. As the summit ridge is continuous to Oxford and forms the dividing ridge between Wolf Creek and Black Creek; and also because there is a line of high hills on the south side of Killbuck Valley that connects with, and is continuous with the line of hills in Killbuck township where I located the col, I fear that the former location of the col only noted the crossing of a line of hills, and that the true col was at Oxford. But leaving this for future investigation, when I will note the observations by barometer, I return to the sixth channel, a small one that comes in, between coal hills, two miles south of Millersburg from a fissure directed to Berlin. The eighth comes in from Salt Creek township, between Holmesville and the Holmes county infirmary. It is now occupied in part by Martins Creek. A drilled well here shows 196 feet to rock. The eighth in order is probably of more importance to the people of Wayne county than all the others combined, for it furnishes a series of flowing wells of the purest water. It drained a large portion of Salt Creek and Paint Creek townships in both Wayne and Holmes counties. I have only traced

the channel a short distance into Holmes county, where it is now represented by Dry Run, passing down a fissure between coal hills southwest of the south branch of Salt Creek, and entering the Big Salt Creek valley near the tile factory below Fredericksburgh; here it is joined by a small channel from the limestone hills of Wayne county. At this point is located the col in the Big Salt Creek, and from here the stream goes tearing over a rocky bed and between rock hills to Holmesville five miles distant. From this col the old channel passes almost due north to old Edinburgh, where it is joined by the preglacial channel coming in from Kidron by Apple Creek. It then proceeds in a northwest direction along the valley of the Apple Creek to Honeytown where it enters the main channel to the lake by Orrville.

This valley is one-half mile wide and is filled with drift from Honeytown to Fredericksburgh and Kidron, and flowing wells are secured on every farm in its course, except near Honeytown where the dam in the great channel is complete. The obstructing glacial hills rise to 200 feet above the plane and no rock is found below the flood plane at 185 feet, and Apple Creek is turned, like the Killbuck at Burbank, almost at right angles back to Wooster. In all the flowing wells water is found on blue boulder clay and in white sand. Fredericksburgh wells are about 100 feet deep, Apple Creek 120 and rock is reached at Apple Creek at 186 feet.

This completes the description of the channels tributary to the central channel, as far as the one represented by the Big Sugar Creek. And here I must call your attention to a feature in the location of these channels which will be better understood by referring to the map accompanying this paper, viz., all the channels that enter the axial channel from the coal measures enter it through fissures or gorges between coal hills; and this fact must help us in determining the original course of the channels now occupied by Sugar Creek, Newmans Creek, and Chipewa Creek; the waters now in them trend out, but we think this evidence shows that in preglacial times they flowed in.

First, as to Sugar Creek, in which the col is not located, it will be observed that it now passes up a ravine, between coal

hills, from a point in the axial channel that is more than 110 feet below its present bed; and second, that the rivulets from the innumerable springs that line its border, through all of Sugar Creek township to Stark county, have their primal direction with the strike of the strata, which is contrary to the present course of the stream.

Now the law of the other channels and coal hill fissures being applied to this would show the stream to be reversed. Nearly the same features with the same expressions are found in Newmans Creek for six miles across Baughman township, with this addition, the old dismal swamp of which this stream is the remains was shaped like an Indian arrow head, the point driven into the coal hills as far as the Stark County line, and along its sides coal banks facing each other, and all entered by drifts. The shoulders of the dart on the north and south are represented by short preglacial channels entering from the hills, while the stem is pictured by the mouth of the swamp as it entered the Orrville glacial lake. There is neither coal nor conglomerate under the swamp, but its margin is marked all around by conglomerate, and the environing hills are coal from the base of the dart to its point. The mines on its opposite sides, across the shaft of the arrow, are but half a mile apart, while at the barbs the hills are two miles apart, and the stem at its neck is half a mile broad, but it widens to near three miles where it enters the lake. It seems plain that this dismal swamp or "Shades of Death," as the pioneers called it, marked the line of a preglacial channel tending north and west.

The direction of the next preglacial channel was northwest from the coal hills to the axial channel, and is now indicated by Patton Lake, Fox Lake and Red Run, all located end to end in the Tamarack swamp, which is a marsh on the side of a hill.

The next channel, that through which the Chippewa Creek now flows to form the head of the Tuscarawas River, is from a scientific point of view the most important of all, for it has of late been a mooted question where the Chippewa Lake and the Sterling channels sent their waters in preglacial times.

The old supposition was that they went out by the Chippewa Creek channel to the Tuscarawas and thence to the Ohio River. But a later conception sent them by Warwick and New Portage to the Cuyahoga River and thence to the great Lake Erie channel, but in both of these the reckoning was made without considering the existence of the axial channel described, or the force of the Orrville Lake.

My first objection to them is that I have found another way through which the waters could proceed, and that the Chippewa channel passes over Carboniferous conglomerate that was once covered with coal. In other words, it shows a breach in coal hills that is not consistent with their formation, but which is in accordance with the idea presented above, that the dammed up waters of the Orrville Lake selected the point of least resistance to force their way through their prison walls, viz., the V-shaped fissure still recognizable in the coal hills on the sides of this channel. In sections 26 and 25 of Chippewa township coal mines are operated less than a mile apart with the Chippewa Creek channel between them, making the strait too narrow for the volume of water to pass. It would be like passing a two-inch ball through an inch augur-hole. But as it is not the outlet we are contending for, but only for the general trend of the main channel between the Waverly and Carboniferous, and its tributaries from the hills of widely separated geologic periods. I will wait for further developments before I will change my present thinking, that these waters went from the Orrville Lake across the Chippewa channel, receiving it as a tributary from section 26, through Chippewa Lake to Rocky River and thence to the great preglacial channel in Lake Erie.

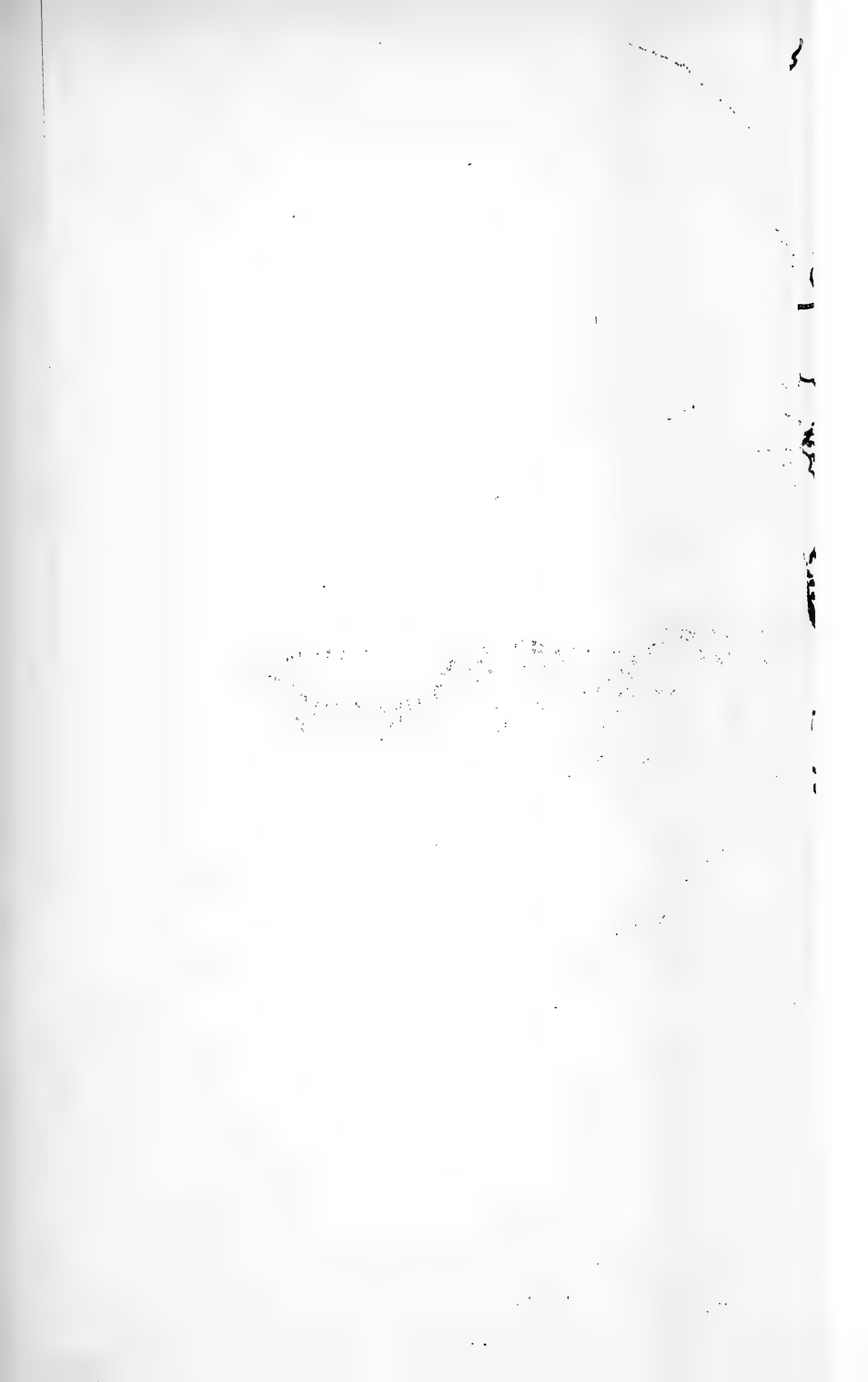
PREGLACIAL DRAINAGE CONDITIONS IN THE VICINITY OF CINCINNATI.

BY GERARD FOWKE.

At the winter meeting of the Ohio Academy of Science, in 1897, I offered a paper upon the above subject. This was published as a Bulletin of the Scientific Laboratories of Denison University, in volume XI. Recently the opportunity has been afforded by the Academy, through the McMillan fund, for further exploration of the region. Some discoveries resulted which considerably modify so much of that article as relates to the section below Cincinnati.

In order that the reader may arrive at a correct understanding of the matter herein presented, it will be necessary to utilize such portions of the report already published as refer to the territory east of the Great Miami river, and acknowledgment is hereby made to the Denison University for permission so to do.

The initial point of this part of the Ohio was near Manchester, at the col (A). A few miles below, Cabin creek entered, and at Maysville it was joined by Limestone creek. For distinction, the name of the latter is given to the stream. At short intervals below, other tributaries put in, each marked by a large area of bottom land. Between them the valley is somewhat narrower. This is because gravels and silt cover the low points at the junction of the streams, where the combined valleys are widest. These features continue to the mouth of the Little Miami. The distance between the hills bordering this tributary is very much greater than the width of the main valley at any place above; and the shrunken stream which winds its devious way from side to side of the included level, seems entirely inadequate to the task of carving out such a basin. Immediately below this, at Dayton, Kentucky, opposite the upper end of Cincinnati, the Ohio contracts almost at once to a narrow channel, very much less than that of the Little Miami. It is evident that a col (B) at this point formerly deflected the waters of old Limestone to the northward. On passing through this gap, the Ohio



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is seen to flow between extensive bottom lands on which stand the cities of Cincinnati, Newport and Covington. Here it receives the Licking from the south and Mill creek from the north; the latter, like the Little Miami, coming through a valley in which it seems almost lost as it meanders aimlessly back and forth. Then the Ohio passes into a very diminished space at Sedamsville, where it flows on rock bottom. This is the site of another col (C); and from here the hills gradually recede to North Bend. Three miles below North Bend was another col (D); a little farther down the Ohio suddenly debouches into a very broad valley where it receives the Great Miami. Like the two streams observed above here, the latter seems utterly incompetent to the excavation of the trough which it occupies.

This valley holds its width to the mouth of the Kentucky, varying somewhat from the average in different parts, as it does elsewhere. One noticeable feature along this stretch is that nearly all the tributary streams have a direction opposite the current of the river; that is, in going down the main stream one is looking toward the sources of those which flow into it. There are also several abrupt bends; in these the outer side of the curve is at the foot of the steep hills or cliffs, while on the other side are wide bottom lands. At Sugar creek the river makes an acute turn to the west, which course it holds past Carrolton, where it receives the Kentucky. From this town it rapidly narrows until it reaches Madison (E). Here was the last col above Louisville. The valley contracts until on the Indiana side the water washes the solid rock, while on the Kentucky side there is a strip of level land only wide enough to afford room for a single warehouse.

Two miles below Madison, the river turns again toward the south through a gorge which gradually expands until it opens into the basin in which Louisville is situated.

The interpretation of these facts is about as follows:

When old Limestone was deflected northward by the col at (B) it entered the depression lying north and east of Cincinnati. Here it received a considerable tributary from the east by way of the present East Fork. The united streams flowed west, and reached Mill creek valley at the point (G) in the vicin-

ity of Carthage. A short ravine joined them, from the hills where the Little Miami discharges, but that river was not then in existence, being a post-glacial stream.

It will be perceived that when old Limestone turned northward, it was separated from the Licking only by the col at (B). Between this col and the one at Sedamsville (C) the Licking flowed north into Mill creek valley where it continued its northerly course. Receiving old Limestone at (G) it passed on and entered the valley of the Great Miami at Hamilton.

From the west side of the col at (C) a ravine extended to North Bend. The hill behind this village, though apparently continuous with the blue limestone formations on either side, is composed of glacial material. This fact was first disclosed when the railroad which passes through here undertook to make a tunnel; it was found that the limestone was absent. Consequently only a cut was needed. This cut is in the lowest part of the deposit; the higher hills to the eastward are also composed of drift. This proves that the ravine from (C) formerly turned to the north at this point, reached the Great Miami valley at Cleves, and there turned west along the present course of the river.

The wide valley below the col (D) has an interesting history. It is continuous from Hamilton to the mouth of the Kentucky river. This fact, in connection with the rapid narrowing of the Ohio between Carrolton and Madison, together with the certain evidence of a col at the latter place, proves beyond question that this ancient bed was eroded by the Kentucky river. In other words, that stream, instead of following the present Ohio as it does now, or flowing across Indiana, turned to the east and north to join the Licking at Hamilton. There is no other channel through which it could have gone. The hills in every other direction, except at the gorge below Madison, are unbroken. From Lawrenceburg it extended almost due north through the valley now partially occupied by the Whitewater and Dry Run, to the point (H). Here it turned east, and at (I) reached the Great Miami, following that valley to Hamilton. From Hamilton northward the old river bed is filled with drift and has not been traced. There can be no doubt, however,

that it joined old Kanawha north of Dayton—probably in the neighborhood of Piqua.

The lower part of the Great Miami requires a few words of explanation. There was a col at (F), just south of the village of Miami. North of this Taylor's creek flowed north and emptied into the Kentucky at (I). South of the col (F), a small ravine joined the creek that flowed through the gap at North Bend, at a point somewhere near Valley Junction (K).

Having thus traced the former rivers and their tributaries, and located the cols, so far as they are essential to the problem, we are in a position to follow the steps by which the Ohio was established.

The Great Kanawha held its way across Ohio until the glacier had advanced to that part of its valley which extended farthest to the northward. For a time the waters may have skirted the ice-front and recovered their natural channel farther down; but presently the valley was completely closed and the imprisoned waters found no escape until they had reached the level of the col at Madison (E).

At this stage began the readjustment of drainage channels. The principal stream at this time was, of course, the Kanawha. How far it may have extended toward the north or the northwest, we have no means of knowing; but it was probably first reached by the glacier at some place west of Ohio. Shut off by this agent from its natural outlet, it turned back into the old Kentucky, wherever their confluence may have been; followed that channel past Hamilton, Lawrenceburg and Carrolton and was impounded by the col at Madison (E). If we may judge from the nearly uniform level of the hills on either side of the river there, up to the very edge of the cliffs which descend steeply to the water, this point in the old watershed was but little lower than any other along the crest. Whatever its elevation, the Kanawha was compelled to rise to its level. As a result, a lake was formed which reached well up toward the headwaters of every stream between the Kentucky river and the Cumberland mountains on the south and to the eastern part of Ohio on the north. It had to reach the level not of the bottom of the gap, but of the highest flood of the torrents which poured

through the gap. The mythical "Lake Ohio," which is currently believed to have resulted from a blocking of the Ohio river by the glacier, would be insignificant by comparison—admitting, for the sake of comparison, that it ever existed as so frequently described. The area of the real lake, created by the Madison dam, can be ascertained only by carrying the level at which it stood at its outlet, up the Kentucky, Great Miami, Licking, Big Sandy, Kanawha, and across central Ohio toward the headwaters of the Tuscarawas. Until this level is ascertained we cannot know how much of the country was submerged, or how many of the existing high areas were drowned. Neither have we any means at present of knowing how long these conditions prevailed. They may have lasted until the col had worn low enough to drain off most of the accumulated water. On the other hand, the advancing ice may have pushed this water in front of it, and maintained a constantly diminishing lake until its most southern limit was reached. If we may suppose the former supposition to be the correct one, then a new river was established; following the Kanawha as far as the mouth of the Licking-Kentucky, and that stream, reversed, from there toward the south and west.

In time, the encroaching ice covered the site of its junction with these two rivers, and Kanawha was again deprived of an outlet. A second lake was formed, including the basin of the Kanawha and all its tributaries east of the Licking. It increased in area and depth until it surmounted the col at (A); flowing over this divide, its waters would follow old Limestone to its junction with the Licking at the point (G), thence north to Hamilton, and so find their way to the Kentucky.

The glacier reached Hamilton, and for the third time a lake was formed. Both Kanawha and Licking were now shut off; the water rose over the col at (C). The Kanawha reached this by following old Limestone as before to (G), and thence down the Mill creek valley. Pushing through the gap at North Bend, and past Cleves, they reached the Kentucky along the bed now occupied by the Great Miami below that village.

When the ice came to the hills about Cincinnati, the mouth of old Limestone at (G) was obliterated, and for the fourth time

Kanawha was backed up into a lake which rose until it overflowed the col at (B). Joining Licking again, the two followed their last channel as far as North Bend and probably out past Cleves; but there is a possibility that before the col at (B) was removed the ice had advanced far enough to reach the hill below North Bend and obstruct that outlet. In this case the new lake would have included Licking as well as Kanawha, and had to rise to the level of the col at (D) before it could have begun to drain off. If, however, the col at (B) was worn down in time for the water above it to escape past Cleves, then, when the ice had advanced across the valley below Cleves, a fifth lake covered the upper Ohio valley before the col at (D) was eroded and the present drainage to the mouth of the Great Miami established. It is possible there was still a sixth lake, though if so it was of less extent and shorter duration than any of the others, and was due to a projection or loop of the glacier pushing out of Miami valley as a dam to the new Ohio—which name is now applicable to the river for the first time—until its waters broke through a ravine back of Petersburg, Kentucky. The depression thus formed is usually spoken of as “an abandoned channel of the Ohio,” but it was occupied only while torrents from melting ice were far above existing flood plains. It furnishes about the only evidence, by the way, that the glacier ever reached the Kentucky hills.

The theory advanced here in regard to the succession of glacial lakes is based entirely on the assumption that the col at Madison (E) was broken down sufficiently to drain the first one formed, and upon the further assumption that the ice reached each necessary point for the formation of a lake, in the order here given. There seems to be no doubt regarding the first and most extensive one; the existence of the others depends upon the strength of the col at (E) and the relative periods of time at which the subsidiary streams were blocked. It is not necessary to presume a constant forward motion of the glacier; its advance may have been frequently interrupted, or there may even have been an occasional recession without in the least invalidating the argument. The effect would be the same in the end, whether there was a continuous progressive motion, or

an intermittent action. Even if there was more than one glacial period, the sequence of events would not be greatly different from the series here described. The work was begun by the one which first blocked the Kanawha, and was completed by the one which extended farthest south.

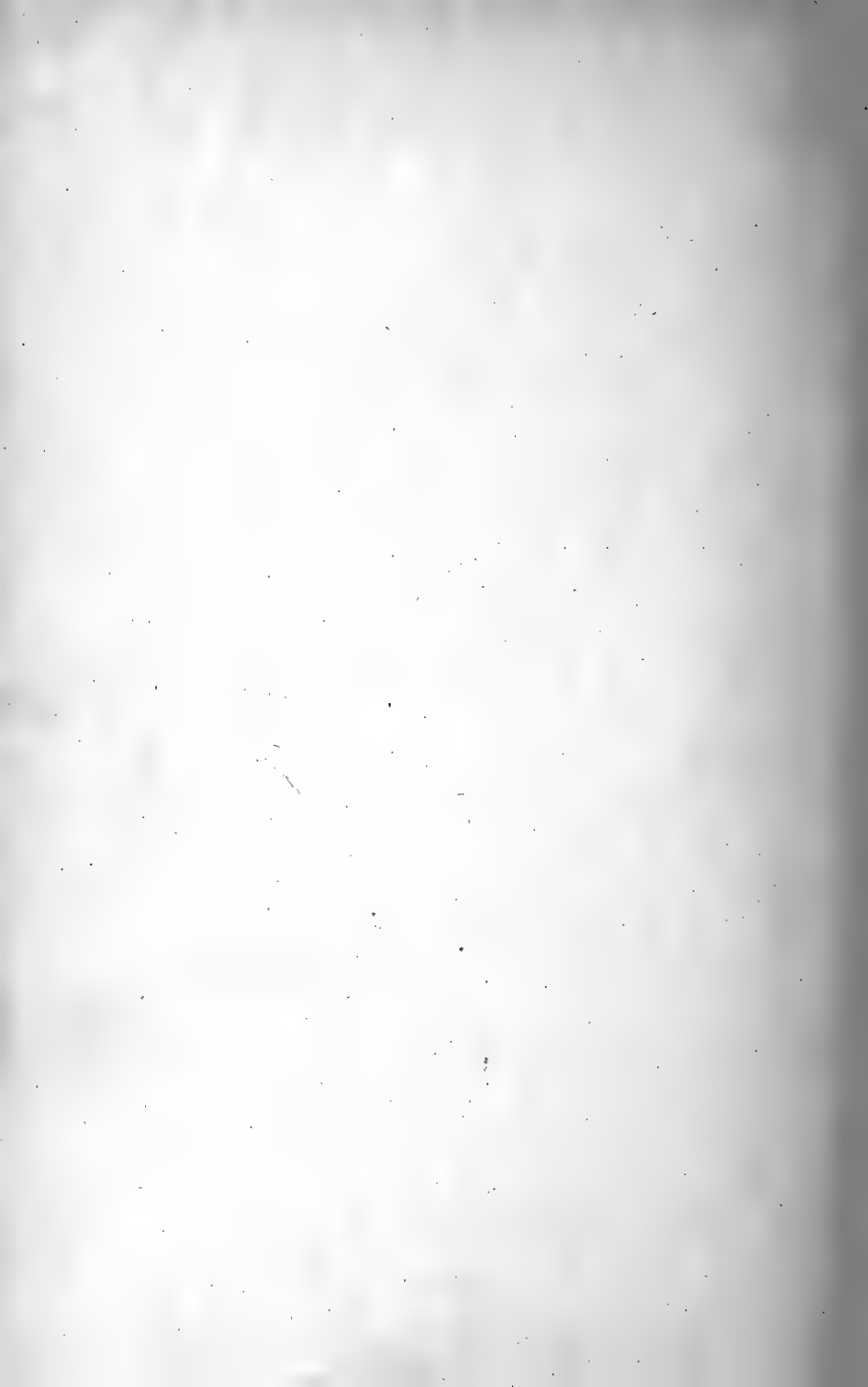
When the ice retreated, the drift which it left behind shut the rivers and creeks off from their former ways, and they were left as we now find them. The channel of old Limestone has been partially taken possession of by the Little Miami and its East Fork; the part between these streams and its former mouth at (G) is deserted. Licking turns west at Covington, and its ancient valley from Cincinnati to Hamilton has been preempted by the insignificant Mill creek. The Whitewater, a post-glacial stream, and the mouth of the Great Miami use a fragment of the old Kentucky river valley in Ohio, but the part between (I) and (H) is abandoned. The Miami utilizes that portion of its channel between Hamilton and the point (I), where Taylor's creek formerly emptied; but the immense gravel deposits which were left here deflected the new river toward the east. It followed a small ravine for a short distance, then broke over a low place in the divide between this ravine and Taylor's creek, filled the latter to the col (F), tore this out, and at Cleves fell into the creek which came through the hill at North Bend; it went with that creek to the drift filled valley of the old Kentucky near Valley Junction, through which it has eroded its devious way to the Ohio.

A large creek entered the old Kentucky at the town of Harrison; the Whitewater crossed this to reach the ancient valley, leaving an island of Silurian rock between the former and recent beds, just as the Great Miami did at the gravel deposits at (I).

The old streams herein described flowed through valleys which were eroded to a considerable depth below the waters which now go through them. While the new channels were forming the old ones were being filled with sediments of mud-laden torrents and debris from masses of floating ice. The streams of today have not had time to clear out these deposits, so they remain as the bottom lands on either side of

the river. As such they must continue to exist until a greater elevation above sea level of the interior region permits the Ohio and Mississippi to scour their channels deeper than the present grade lines will allow them to do.

The extensive drift deposits south of Cincinnati have not yet been accounted for in a satisfactory manner. Professor Wright says that the great masses of conglomerate two miles below Aurora, Indiana, are the terminal moraine. Only a casual inspection is needed to show that this assertion is entirely unfounded. There are similar deposits farther down, and at a much greater altitude, which he has overlooked, or at least not mentioned. A careful examination of this entire territory is required in order to determine the limit of the ice sheet; to ascertain what part it may have taken in the surface changes below Lawrenceburg to estimate the relative elevation of the hills at Madison and those where these deposits are found; and to discover the probable causes which led to the gravel deposits upon the high lands in Boone county, Kentucky.



Ohio State Academy of Science

Special Papers No. 4.

The Fishes of Ohio

BY

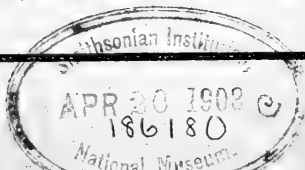
RAYMOND C. OSBURN, M. Sc.



Published by the Academy of Science
with the Emerson McMillin
Research Fund.



May, 1901



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MAY, 1901.

COLUMBUS :
PRESS OF SPAHR & GLENN,
1901.

NOTE.

The investigations upon which this paper is based were made under two grants of fifty dollars each from the Emerson McMillin Research Fund, and the results are now published by the further aid of the same fund.

F. M. WEBSTER,

H. C. BEARDSLEE,

WILLIAM R. LAZENBY,

Trustees.

DEDICATION.

*To the memory of my dear friend and teacher, the late
Professor David Simons Kellicott.*

THE FISHES OF OHIO.

An Authenticated List, with Especial Reference to Occurrence
and Distribution.

INTRODUCTION.

THE purpose of this work is to bring together the results of the investigations on the fishes of Ohio, which have from time to time been made in various localities within the state, and to compile an authenticated list of the fishes of Ohio, which shall include only such species as have been definitely reported for the state by some collector. An attempt has also been made to show the distribution in the state, of each species, by citing all the records of occurrence which could be obtained. The results show that many species are so widely distributed and so abundant that they have been taken by every collector in the state; some are widely distributed, but nowhere common; others have been taken commonly in one or two localities, but not elsewhere; and still others are so rare that only single individuals have been recorded.

Before proceeding with the list it may be of interest to glance at the work of some of the collectors of Ohio fishes, as shown by their publications.

The work in the Ohio Valley was begun by C. S. Rafinesque, in a paper dated at Louisville, Kentucky, July 20, 1818. This paper was followed by a number of others in rapid succession, and in December, 1819, to November, 1820, Rafinesque published in a series of articles in the "Western Review and Miscellaneous Magazine," his "Ichthyologia Ohiensis," which, as Dr. Call says, "laid the literary foundation of American Ichthyological Science." As Rafinesque's paper covered the Ohio River System, it is not definitely known how many species he took within the limits of Ohio, but he mentions about twenty-five

species as occurring in the streams of the state, Muskingum, Hocking and Miami Rivers and the Ohio River "as far as Pittsburgh." Rafinesque makes mention of one hundred and eleven species as occurring in the Ohio and its tributaries, but of this number, as Dr. Jordan says, "upwards of forty-three are either spurious or redundant." Of the one hundred and thirty-four native species now recorded for Ohio, Rafinesque described thirty-four. Further comment on Rafinesque's work is unnecessary, as it has been reviewed by various later writers, especially by Dr. Jordan. Dr. R. E. Call has recently published an edition of the *Ichthyologia Ohiensis* in the original text, accompanied by a biographical sketch.

The first paper to appear, dealing entirely with the fishes of the state, was that by Dr. Jared P. Kirtland, published in the Second Annual Report of the Geological Survey of Ohio, and bearing date of November 1, 1838, at Cincinnati. In this paper Dr. Kirtland gave a list of seventy-two species belonging to Ohio. Of this number, at least twelve are redundant. In the "Family Visitor," of 1850, however, Kirtland gave a corrected list, in which seven doubtful species of his former list were omitted, and two other species added, thus reducing his list to sixty-seven species, of which number at least sixty-one are good. Kirtland published other papers on Ohio fishes, his most important work being "Descriptions of the Fishes of Lake Erie, the Ohio River and their Tributaries," which appeared in the "Boston Journal of Natural History," as a serial, in 1840-46. Eight species of our present list were described by Dr. Kirtland, and his careful work resulted in many valuable contributions to ichthyological knowledge.

The next work of importance on Ohio fishes was that of Mr. John H. Klippart, of the State Fish Commission, published in the first and second annual reports of the commission. The first report, for the years 1875-76, contains descriptions of twenty-five species "copied and arranged from the manuscript of Prof. D. S. Jordan, by his assistant, Chas. H. Gilbert," with comments and notes by Klippart, and with plates of nineteen species drawn by Miss Josephine Klippart. The same report also contains a list of one hundred and eighty-five species of fishes "supposed to occur

in Indiana, and therefore in Ohio." In regard to this, Klippart remarks, "Messrs. Jordan and Gilbert's Catalogue of the Fishes of Indiana is here given, under the belief that the same species of fishes found in Indiana south of the watershed may be found in the waters of Ohio." The list contains many species not recorded for Ohio after the lapse of a quarter of a century, and some that, owing to peculiarities of distribution, probably never will be taken. The second report contains descriptions of twenty-four species "arranged from manuscript of Prof. D. S. Jordan, by his assistant, Mr. Ernest Copeland," with plates of sixteen species. As a whole the reports contain much that is good.

By far the most important paper on Ohio fishes is that by Prof. David Starr Jordan, published in the fourth volume of the Report on the Geology of Ohio, entitled a "Report on the Fishes of Ohio," and bearing date of December 10, 1878. Dr. Jordan was at that time connected with Butler University, in Indiana, and his services in the preparation of the report were engaged by Prof. J. S. Newberry, the State Geologist of Ohio. This report contains, besides the synonymy and many valuable notes in regard to habits, careful descriptions of a hundred and sixty-five species of fishes supposed to occur in Ohio. Of this number, nine have since proved to be redundant, while three others have been reduced to varietal rank. Of the remaining number described, more than fifty had not at that time been taken within the limits of the state, but were included because their range was such as made their occurrence within the state probable. Many of these have since been noted, but at the time of publication of Jordan's Report only about one hundred species had been recorded for the state.

Following Jordan's Report, in more recent years have appeared a number of papers dealing with investigations more local in their nature, but all contributing materially to our knowledge of the occurrence and distribution of Ohio species. The first of these of which I have any knowledge, appeared in the Journal of the Cincinnati Society of Natural History, for July-October, 1888, under the title, "Contributions to the Ichthyology of Ohio, No. 1," by Dr. J. A. Henshall, and gave a list, with occurrence notes, of seventy species noted in Hamilton County.

This was followed in January, 1889, by a second paper, more general in its nature, adding forty species noted at various points in the state, and making a state list of a hundred and ten species noted by himself. Localities were given for all the species mentioned.

In 1892 appeared "A Descriptive List of the fishes of Lorain County, Ohio," as "Laboratory Bulletin No. 2," of Oberlin College, by Mr. L. M. McCormick. This list includes eighty-eight species "resting upon specimens preserved in the museum," with brief descriptions, and notes on occurrence and habits, and with plates of eighteen species.

In 1893, Dr. Philip H. Kirsch, at that time Fish Commissioner of Indiana, investigated the Maumee River and its tributaries, under the direction of the U. S. Commission of Fish and Fisheries. Kirsch's paper, "Report upon Investigations in the Maumee River Basin During the Summer of 1893" (Bull. U. S. Fish Com., 1894), includes a list of eighty-seven species of fishes, with descriptions of the streams and lakes of the system, and many interesting notes. The report includes the unpublished notes of a small collection of fishes made in Defiance County by Prof. S. E. Meek, in 1887. Although the investigations covered portions of the Maumee Basin in Indiana and Michigan as well as in Ohio, the occurrences for each locality are definitely noted, and eighty-two of the eighty-seven species mentioned by Kirsch are recorded for localities in Ohio.

In the summer of 1897, Mr. E. B. Williamson and the writer investigated the streams of Franklin County, and published the results in a paper entitled "A List of the Fishes of Franklin County, Ohio, with a description of a new species of *Etheostoma*, by R. C. Osburn and E. B. Williamson" (Sixth Annual Proceedings of the Ohio State Academy of Science, 1898). The list includes sixty-nine species, with occurrence notes, and some color notes on the rarer species, together with many breeding dates, and a table showing distribution.

A somewhat similar investigation was carried on in the summer of 1898, by Messrs. J. B. Parker, E. B. Williamson and the writer, and the results appeared in the Seventh Annual Proceedings of the Ohio State Academy of Science, 1899, under the title,

“A Descriptive List of the Fishes of Big Jelloway Creek, Knox County, Ohio.” Many color descriptions of species in high breeding coloration are given, and some interesting breeding and occurrence notes.

Prof. E. B. Williamson has kindly furnished the author with an unpublished list of twenty-six species taken by him in the vicinity of Salem, Columbiana County.

During the summers of 1899 and 1900, aided by a portion of the Emerson McMillin fund of the Ohio Academy of Science, the writer was enabled to investigate some parts of the state not before studied, and, as the general distribution of the food fishes was already quite well known, attention was turned more directly to the smaller and less conspicuous species. As a result of the investigation, several species not previously noted have been added to the list for the state, and a number of rare species recorded for new localities and their range extended, while the knowledge of the distribution of many of the more common species in the state has been considerably furthered. Ten days spent in the vicinity of Ironton, seining in the Ohio River and Ice Creek, a small tributary of the Ohio, and in Johns Creek, a tributary of Symmes Creek, gave some interesting results. The Ohio River, with its tributaries, Wheeling Creek and McMahan Creek, was also seined in the vicinity of Bellaire. The shallow waters of Sandusky Bay were hauled in many places and *Notropis heterodon* was added to the state list. The Huron River, with one of its small tributaries, was seined in the vicinity of Milan, and fifty species, nearly all common, were taken. Ashtabula Creek, in Ashtabula County, was seined, but yielded only a meager list, due to the fact that the stream flows for nearly its whole course over a solid shale bottom. The small streams forming the headwaters of the Wabash River, in Mercer County, yielded a good representative list, forty-nine species being taken. Stillwater and Wolf Creeks, tributaries of the Miami, near Dayton, were hauled, and *Exoglossum maxillingua* taken—a most unexpected find. The Cuyahoga River and its tributary, Breakneck Creek, were seined near Kent, and the Cuyahoga again at Hawkins; Grand River, with its small tributaries, was hauled for some distance above Painesville, and the Chagrin River was

touched at Willoughby ; Chippewa Lake, near Medina ; Summit Lake, at Akron, and Pippin Lake, near Kent, were investigated, and some time was also spent at Buckeye Lake, better known as the Licking Reservoir ; and the North Fork of Licking River, with some of its small tributary streams, was seined near Newark. The results of these investigations will be found embodied in the occurrence notes of the following list.

No attempt was made to collect the parasites of fishes, but in a few cases these were common enough to attract the attention of even the casual observer. In Ashtabula Creek a species of leech was found attacking the catfish. The largest of the leeches were about one and one-half inches in length. They were found usually attached to the lower jaw among the barbels, which in color they closely resembled. Not a catfish was taken in this stream but what bore the evidence of the work of this parasite, and frequently a half dozen leeches would be found on a single small catfish. In the headwaters of the Wabash River, in Mercer County, a species of crustaceous parasite was found in great numbers attacking especially the suckers and minnows. So numerous were they that it was difficult to find individuals of *Catostomus commersonii* and *Campostoma anomalum*, the species most affected, without at least one of these parasites. The points of attack were chiefly the regions immediately behind the pectoral and ventral fins, probably because they were most protected in such position. A Myxosporid parasite attacking *Notropis cornutus* was noted for a number of localities in central and northern Ohio. This species has been partially described by Linton (Psorosperm of *Notropis megalops* [*cornutus*], Linton, Bull. U. S. Fish Com. for 1889 (1891), IX, pp. 459-61, pl. 120, figs. 1-3), from specimens taken by Mr. L. M. McCormick, in Black River, Lorain County, September 1, 1890, and again on October 5, 1891; and Gurley mentions it with additional notes ("The Myxosporidia or Psorosperms of Fishes," by R. R. Gurley, Report of the Commissioner of Fish and Fisheries for 1892 (1894), 12. Genus et sp. incert., pp. 182-3, pl. 7, figs. 1-3). This Psorosperm has been noted by the writer on *N. cornutus* from Franklin County, and from Licking Reservoir in the Ohio River drainage, and from Huron River, Cuyahoga River, Grand River, and Chagrin River,

tributary to Lake Erie. The species is evidently not, as believed by McCormick, "restricted to a very narrow geographical range." The cysts formed by this parasite reproducing in the subcutaneous tissue may reach a diameter of one-third inch, and as many as eleven cysts have been noted on a single fish. It would seem that in some cases they must inevitably cause the death of the host.

Specimens of all the species of fishes recorded by Kellicott, Williamson, Parker and the writer are deposited in the museum of the Ohio State University.

In the preparation of this paper free use has been made of the works of the various writers on Ohio fishes, of "The Fishes of North and Middle America" (Bulletin 47, U. S. National Museum), by Drs. David Starr Jordan and Barton W. Evermann; of Dr. O. P. Hay's "Lampreys and Fishes of Indiana" (19th Annual Geol. Rept. of Ind.), and of the reports and bulletins of the U. S. Commission of Fish and Fisheries. The classification is that adopted by Jordan and Evermann in Bulletin 47, U. S. Natl. Mus. The keys for the separation of families, genera and species have, for the most part, been taken from the same work, but modified and abridged to meet the requirements of the more limited scope of this paper. The descriptions have been drawn largely from the same source, but as far as possible these have been verified for Ohio specimens, and modified as occasion demanded to make them apply more closely to the species as found in Ohio.

While it is not the purpose to discuss in this paper the general anatomy of the fish, such as may be found in any good laboratory guide on zoology, a few hints to the beginner in regard to methods of procedure and to some particular points of structure may here find a place. The teeth in some species are borne on nearly all parts of the mouth and pharynx—premaxillaries, maxillaries, mandibles, vomer, palatines, tongue, hyoid apparatus, pterygoids and pharyngeals, but may be wanting from any or all of them. The examination of all but the last mentioned can usually be satisfactorily made through the open mouth by using a blunt dissecting needle or the head of a pin as a "feeler." It is the determination of the number and arrange-

ment of the lower pharyngeal teeth that constitutes the particular "bête noire" of the uninitiated, but this must be mastered or many identifications will be impossible. The lower pharyngeal bones form the fifth pair of gill arches and usually bear teeth on their inner surfaces, and to examine these it is necessary to remove the bones. This is most easily done in the case of the minnows and other small species by lifting the opercle and inserting a small hook behind the gills. In the sunfish and suckers and other larger forms it is best to run a scalpel around them before attempting to remove them. The teeth when removed are usually covered, more or less, with broken tissues, which can be removed by cleaning carefully with a fine-pointed needle, or with a soft brush under water. In case the teeth have been broken off, as frequently happens, the bases can be distinguished. A good hand lens is essential. In native minnows the pharyngeal teeth are in one or two rows, and their number and arrangement is expressed by a formula—thus 1,4-4, 2, meaning that on one side the small, inner row consists of one tooth, and on the opposite of two, while the teeth of the outer row are the same on both sides. The fins are composed of stout spines, or soft rays or of both. In the fin formula the number of spines is expressed by Roman characters, and the rays by the Arabic figures. Thus the formula, "D. X, 14," indicates that the dorsal fin is composed of ten spines and fourteen rays. If the dorsal fin were in two parts the formula would read "D. X-14." In counting the number of rays the undeveloped rudimentary ones are not usually considered except in the case of the catfish. A little allowance may be made for variation in number of rays. In small specimens where the rays are not always easy to count, a good way to determine the number is to draw the point of a pin forward over the fin near the base of the rays. A good lens is also useful. The dorsal fin is usually referred to in descriptions as simply the dorsal, and other fins in like manner. They are further abbreviated by using D., A., C., V. and P. to stand for dorsal, anal, caudal, ventral and pectoral fins respectively. The scales are counted along the lateral line (a longitudinal row of scales each with a small pore in most fishes) from behind the opercle to the base of the caudal fin, and the transverse rows are counted from the front.

of the dorsal fin to the lateral line and from the lateral line to the middle of the belly. Thus the formula, "6-45-4," means that there are forty-five scales in a longitudinal row, and that there are six rows above the lateral line and four below it. If the lateral line were absent the formula would read, "45-10." Variations, sometimes considerable, may be looked for in the scale formula. The gill membranes (free folds of skin below the opercles, supported by one or more branchiostegal rays) may be "connected," that is, united together in a fold below the "isthmus" or space between the throat and breast, they may be "joined to the isthmus" along their lower edges, or they may be "free" from the isthmus and from each other. The pre-maxillaries are "protractile" when they are separated in front from the skin of the forehead by a transverse groove, and "not protractile" when such transverse groove is incomplete or wanting. In some fishes, as in the bass and many sunfishes there is a "supplemental maxillary" bone lying along the upper side of the maxillary. In taking body measurements the depth is taken at the deepest place, and the head is measured from point of snout to the end of the opercle, except that in sunfishes the soft flap is not measured. Depth and length of head are compared with the length of the whole body exclusive of the caudal fin. Thus, "head 4" means that the length of the head is contained four times in the length of the body. The eye is measured to the full width of the orbit.

The writer desires to express his gratitude to the Department of Zoology of the Ohio State University for the use of a seine and other collecting apparatus, to Prof. Herbert Osborn for kindly advice and assistance in many ways, and to the Trustees of the Ohio State Academy of Science for pecuniary aid, through the Emerson McMillin fund, in carrying on the work of seining. Special acknowledgment is also due to Messrs. J. S. Hine, W. R. Rhoades, Chas. Carter, F. L. Landacre, J. H. Pumphrey, S. E. Rasor, Chas. Osburn, and others, who by kindly assistance in various ways have so materially aided in the pursuit of the work.

THE FISHES OF OHIO.*

- A. Body long and slender, eel-like ; skin smooth and slippery, wholly devoid of scales ; no paired fins ; no lower jaw ; the mouth placed in or near the center of a large, circular and sucker-like disc ; a single median nostril ; skeleton cartilaginous.—
Class : MARSIPOBRANCHII (Cyclostomes).

- AA. Body variously developed, scales usually but not always present ; paired fins present ; lower jaw always present ; nostrils never median.—

Class : PISCES (True Fishes).

Class : MARSIPOBRANCHII.

Order : HYPEROARTII.

Family : PETROMYZONIDÆ (Lampreys).

Key to Genera.

- A. Sucker large, and furnished with numerous teeth which are in rows radiating from the mouth ; horny plate above the mouth short and provided with 2 or 3 teeth, which are placed close together.— ICHTHYOMYZON.
- AA. Sucker relatively small, and with few teeth ; mouth overhung with a crescent-shaped, horny plate, which terminates at each end in a distinct tooth ; tongue-armed in front with a crescentic, serrated, horny plate.— LAMPETRA.

Genus : ICHTHYOMYZON.

Ichthyomyzon concolor (Kirtland). SILVER LAMPREY.

Sucking disk large, moderately fringed ; teeth strong and nearly uniform ; two teeth on supraoral plate ; seven in the transverse row below mouth, the remaining teeth arranged in about four concentric circles. Dorsal fin arising midway from snout to end of tail, broadly notched, continuous with caudal ; anal fin also continuous with caudal. About fifty-two muscular grooves between gills and vent. General color bluish, sometimes blotched with black ; a dark blue spot above each gill opening. Length about 12 inches.

This species appears to be distributed throughout the state, though nowhere very common. It ascends small brooks in spring to breed. McCormick mentions finding females with ripe eggs on May 22, in Vermillion river. The breeding date must be considerably earlier in central Ohio, as Messrs. Parker, Williamson and the writer took young larvæ a couple of inches long in Big Jelloway creek, Knox County, during the latter part of May, 1898. On the same date a large larva seven inches long was taken, so the species must continue in the larval stage something

*It has been thought best to include here also the Lampreys (*Marsipobranchii*) of Ohio, for the reason that, in the popular idea, a lamprey is a "fish."

more than a year. One large larva, seven inches in length, showed the following colors: dull yellow, pigmented above with fine, brown specks, giving to the back a brownish cast; this is interrupted in the mid-dorsal line, leaving a yellow, vertebral line; fins yellowish, brightest at base. Young larvæ, two and one-half inches long, were light olive brown, with fine brown specks above; dark around base of anal fin. Eyes very slightly developed. The young larvæ were taken from a mass of sand and mud seined from the bottom of Sawmill Run.

The species was first taken by Dr. Kirtland in Big Miami river, and described by him. He afterward recorded it from the Mahoning and Scioto rivers. Vermillion river, McCormick, 1892; Big Jelloway creek, Parker, Williamson and Osburn, 1898; Henshall mentions one which passed through a hydrant in Cincinnati; and Dr. Jordan says, "I have obtained several specimens with Perch from Lake Erie, both external, feeding on the Perch, and internal, having been devoured by the fish."

Genus: LAMPETRA..

Lampetra wilderi (Gage). SMALL BLACK LAMPREY;
BROOK LAMPREY.

Sucking disk smaller than in the preceding, the fringes longer. Dorsal fin arising midway from snout to end of tail, not continuous with caudal except during breeding season, when it is deeply notched. Below the mouth is a transverse row of blunt, horny teeth, 5 to 9 in number. On each side of the disk is a plate with three bicuspid teeth; supraoral plate with a tooth at either end; remaining teeth few and weak. About 65 muscular grooves between gills and vent. Color bluish black, lighter on disk and belly. Length 6 to 9 inches.

Although from its range we might expect this species to occur throughout the state, it has, I believe, been recorded for but one locality. Mr. J. B. Parker has observed it to be common on the ripples of small tributaries of Big Jelloway creek, in Knox County, about the middle of April. Four specimens were captured at one dip of an insect net, and specimens taken by him are in the State University collection. The *Ammocetes bicolor*, or Blind Lamprey, which Kirtland records from the Mahoning river may have been the larva of either this or the preceding species, as the immature forms are so similar as to be almost indistinguishable.

Class : PISCES.

Sub-Class : TELEOSTOMI (True Fishes).

Artificial Key to the Families of Fishes.

I. VENTRAL FINS PRESENT—ABDOMINAL.

- A. Back with an adipose fin behind the single, rayed dorsal fin.
- B. Head with barbels about mouth and nostrils, body scaleless; a single spine in each pectoral and in dorsal fin.— SILURIDÆ.
- BB. Head without barbels; body scaled.
- C. Dorsal, anal and ventral fins each with a small but distinct spine; scales ctenoid.— PERCOPSIDÆ.
- CC. Dorsal, anal, and ventrals without distinct spine; scales not ctenoid.— SALMONIDÆ.
- AA. Back without adipose fin.
- D. Dorsal fin single, composed of rays, and not preceded by a series of free spines.
- E. Tail evidently strongly heterocercal.
- F. Body naked; snout with a spatulate blade; mouth wide, without barbels.— POLYODONTIDÆ.
- FF. Body with scales or bony plates or shields.
- G. Body with 5 series of bony shields; mouth inferior, toothless, preceded by four barbels.— ACIPENSERIDÆ.
- GG. Body scaly.
- H. Scales cycloid; a broad, bony, gular plate; dorsal fin many rayed.— AMIIDÆ.
- HH. Scales ganoid; no gular plate; dorsal fin short.— LEPISOSTEIDÆ.
- EE. Tail not evidently heterocercal.
- I. Gill membranes broadly joined to the isthmus; head naked; no teeth in jaws.
- J. Lower pharyngeal teeth very numerous, in one row like the teeth of a comb.— CATOSTOMIDÆ.
- JJ. Lower pharyngeal teeth few, fewer than 8, in 1 to 3 rows.— CYPRINIDÆ.
- II. Gill membranes free, not attached to the isthmus.
- K. Head scaly, more or less.
- L. Upper jaw not protractile, its lateral margins formed by the maxillaries.
- M. Jaws depressed, prolonged; lateral line present.— LUCIIDÆ.
- MM. Jaws short; no lateral line.— UMBRIDÆ.
- LL. Upper jaw protractile, its margin formed by premaxillaries alone; no lateral line.— POECILIIDÆ.
- KK. Head naked.
- N. Lateral line well developed; mouth large, teeth all pointed, some of them canine.— HIODONTIDÆ.
- NN. Lateral line wanting.
- O. Mouth small, inferior, toothless; stomach gizzard-like.— DOROSOMATIDÆ.
- OO. Mouth moderate, terminal; stomach not gizzard-like.— CLUPEIDÆ.

- DD. Dorsal fin not as in D.
 P. Dorsal fin single, preceded by free spines; body scaleless.—
GASTEROSTEIDÆ.
 PP. Dorsal fins, two; the first small, composed entirely of spines; body very
 slender, covered with scales.—
ATHERINIDÆ.

II. VENTRAL FINS PRESENT—THORACIC OR SUB-JUGULAR.

- A. Body covered with scales.
 B. Rays of the ventral fins, I, 5.
 C. Lateral line extending on caudal fin to tip of middle rays.—SCIAENIDÆ.
 CC. Lateral line not extending beyond base of caudal fin.
 D. Pseudobranchiæ or false gills on under side of opercles well developed; head scaled forward to between nostrils.—SERRANIDÆ.
 DD. Pseudobranchiæ wanting or covered by skin.
 E. Anal spines, 3 to 10; body more or less deep and compressed.—
CENTRARCHIDÆ.
 EE. Anal spines, 1 or 2; body usually elongate.—
PERCIDÆ.
 BB. Rays of the ventral fins not I, 5.
 F. Dorsal fin single, with 3 or 4 spines.—
APHREDODERIDÆ.
 FF. Dorsal fin divided into 2 distinct parts, spines wanting.—
GADIDÆ.
 AA. Body naked; dorsal fin with 6 or 7 spines.—
COTTIDÆ.

III. VENTRAL FINS ENTIRELY WANTING.

- A. Body long and snake-like; skin covered with long imbedded scales at right angles to each other; lower jaw projecting.—
ANGUILLIDÆ.

Series: GANOIDEI.

CHONDROGANOIDEA (THE CARTILAGINOUS GANOIDS).

Order: SELACHOSTOMI.

Family: POLYDONTIDÆ.

Genus: POLYODON.

Polyodon spathula (Walbaum). PADDLE-FISH; SPOON-BILL CAT.

A very peculiar looking fish, recognizable at once by its long, paddle-shaped snout, which is about $\frac{1}{3}$ the length of the body and is thin and flexible. The eyes are small and placed near the base of the snout; opercular flap long, reaching back as far as to the ventral fins. Caudal fin large, forked, the lobes about equal. Color olivaceous, paler below. This singular fish attains a length of 5 or 6 feet, but is of little or no economic importance.

Taken in the Ohio and Muskingum rivers, Kirtland; "one was taken in a pound net (in Lake Erie) near Vermillion in 1874," McCormick; "common in the Ohio river," Henshall, 1888.

Order: CHONDROSTEI.

Family: ACIPENSERIDÆ.

Key to Genera.

- A. Spiracles present; snout subconic; rows of bony shields distinct throughout; the tail not depressed nor mailed.— ACIPENSER.
- AA. Spiracles obsolete; snout subspatulate; rows of bony shields confluent behind dorsal so that the depressed tail is completely mailed.— SCAPHIRHYNCHUS.

Genus: ACIPENSER.

Acipenser rubicundus Le Sueur. LAKE STURGEON;
OHIO STURGEON; ROCK STURGEON.

Body elongate, terete, tapering towards snout and tail. Snout long and slender in young, becoming more blunt with age. Body covered with large, rough, strongly hooked shields, which become smoother with age. Color dark olive above, sides paler or reddish, with sometimes irregular dark spots. Length 6 feet.

This species occurs both in Lake Erie and the Ohio river. Those from the Ohio, formerly considered as belonging to a separate species, *A. maculosus*, are now regarded as the young of *A. rubicundus*.— “The Ohio river as far as Pittsburg,” Rafinesque (Rafinesque made six species out of this and *Scaphirhynchus platyrhynchus*, which he included in the same genus); Lake Erie and Ohio river, Kirtland; Lorain County, very common, McCormick, 1892; abundant in the Ohio river, Henshall, 1888; Lake Erie (west end), Kirsch, 1893.

Genus: SCAPHIRHYNCHUS.

Scaphirhynchus platyrhynchus (Rafinesque).
SHOVELNOSE STURGEON.

Body slender, head broad, becoming suddenly broader just behind the eyes. Snout flat and pointed. The body tapers gradually backward from the head to the tail, the upper lobe of which ends in a long, slender filament. Body protected by five rows of bony shields, which are keeled and hooked. Color olive, paler below. Length 5 feet.

“Very common in the Ohio, but seldom reaching as high as Pittsburg,” Rafinesque; “common in the waters of the Ohio,” Kirtland; “common in the Ohio,” Henshall, 1888.

HOLOSTEI (THE BONY GANOIDS).

Order: RHOMBOGANOIDEA.

Family: LEPISOSTEIDÆ.

Genus: LEPISOSTEUS.

Key to Species.

- A. Large teeth of upper jaw in 1 row on each side.
 B. Beak long and slender, snout more than twice the length of head.— *osseus*.
 BB. Beak shorter and broader, little longer than the rest of the head.— *platostomus*.
 AA. Large teeth of upper jaw in 2 rows on each side; beak short and broad, not longer than rest of head.— *tristechus*.

Lepisosteus osseus (Linnaeus). COMMON GAR PIKE;
 BILLFISH; GAR.

Snout at least twice as long as the rest of the head, and quite slender, its least width being contained 15 or 20 times in its length. Color olivaceous above, paler below. Young with round, black spots on vertical fins and posterior part of body, these becoming less distinct with age. Very young with black, lateral band. Length 5 feet.

A voracious, good-for-nothing fish, but interesting to the naturalist on account of its structure and habits. A common and widely distributed species, being found in Lake Erie and Ohio river, and in all the larger streams of the state. They are very common in the Scioto river below Columbus, where the river in summer is rotten with filth from the sewers of the city. They have a peculiar habit of lying motionless in schools at the top of the water. Dr. Kirtland records the species for the state as "found in most of the larger tributaries of the Ohio;" Lorain County, Lake and lower part of larger streams," McCormick, 1892; Ohio river and Lake Erie, Henshall, 1889; Maumee river, Blanchard river, Auglaize river, Hoaglin creek and Beaver creek, Kirsch, 1893; Scioto river at Columbus, Williamson and Osburn, 1897; Ohio river at Ironton, John's Creek at Waterloo, Huron river at Milan, and Sandusky Bay, R. C. Osburn, 1899; Ohio River at Bellaire, R. C. Osburn, 1900.

Lepisosteus platostomus Rafinesque. SHORT-NOSED GAR.

Distinguished from *L. osseus* chiefly by the snout, which is only a little longer than the rest of the head—never more than $1\frac{3}{4}$ times the length of

the head. The snout is also comparatively broader than in *L. osseus*, its least width being contained only 5 or 6 times in its length. Coloration much as in *L. osseus*.

Rare in Lake Erie and its tributaries, more common in the Ohio and its tributary rivers. Ohio, Miami and Scioto rivers, Rafinesque; Maumee river at Toledo, "a single specimen," Kirsch, 1893; Lorain county, "very rare," McCormick, 1892; Sandusky Bay, one specimen, and Ohio river at Ironton, R. C. Osburn, 1899.

Lepisosteus tristoechus (Bloch and Schneider). ALLIGATOR GAR.

Snout shorter than in either of the preceding members of this genus, being usually shorter than the head. It is also comparatively much broader, its least width being contained in its length $3\frac{1}{2}$ times. Length 8 or 10 feet. "A huge, muscular, voracious fish, useless as food, remarkable for its armature of enameled scales."

This species is included on the authority of Dr. Kirtland, who says (Rept. on the Zool. of Ohio, 1838): "A specimen is to be seen in the Cincinnati Museum, said to have been taken within the bounds of our state." Jordan and Evermann (Bull. 47, U. S. Natl. Mus.) give its range as far as Cincinnati, whether on added evidence I do not know.

Order: CYCLOGANOIDEA.

Family: AMIIDÆ.

Genus: AMIA.

Amia calva Linnaeus. DOGFISH; BOWFIN; GRINDLE.

Head $3\frac{3}{4}$ in length; depth 4 to $4\frac{1}{2}$; D. 48; A. 10 to 12; V. 7; scales in lateral line 67; lateral line nearly median, directed slightly upward at either end. Color dark olive or blackish, paler below; lower jaw usually with round, dark spots; fins somewhat mottled. Male with a round, black spot at base of caudal above, surrounded by a yellowish or orange shade. Length, male 18 inches; female 2 feet.

Lake Erie, Kirtland; Lake Erie and Ohio river, Jordan; Lorain County, "Rare, once in a great while one is brought in from the pounds, and I have taken one in Black river," McCormick, 1892; Lake Erie, Henshall; one specimen from the Maumee river at Toledo, Kirsch, 1893; Huron river and Sandusky Bay, R. C. Osburn, 1899.

Series: TELEOSTEI.*Order:* NEMATOGNATHI.*Family:* SILURIDÆ (The Catfishes).*Key to Genera.*

- A. Adipose fin, with its posterior margin free.
- B. Premaxillary band of teeth truncate behind; not produced backward at the outer angles.
- C. Supraoccipital bone continued backward from the nape, its notched tip receiving the bone at base of dorsal spine, so that a continuous bony bridge is formed under the skin; caudal fin forked.— ICTALURUS.
- CC. Supraoccipital not reaching as far as dorsal fin, the bony bridge more or less incomplete.— AMEIURUS.
- BB. Premaxillary band of teeth with a lateral backward extension on each side; lower jaw projecting.— LEPTOPS.
- AA. Adipose fin keel-like, adnate to the back.
- B. Band of teeth in upper jaw, with a backward extension at its outer posterior angle as in *Leptops*.— NOTURUS.
- BB. Band of teeth in upper jaw without backward extension, as in *Ameiurus*.— SCHILBEODES.

Genus: ICTALURUS.*Key to Species.*

- A. Anal fin very long, its rays 32 to 35.— *furcatus*.
- AA. Anal fin shorter, its rays about 26.— *punctatus*.

Ictalurus furcatus (Le Sueur). CHUCKLE-HEADED CAT.

Head $4\frac{1}{2}$; depth 4 in adults to $5\frac{1}{2}$ in young. Anal fin long, of 32 to 35 rays. Eye small, wholly anterior, the middle of the head being behind its posterior margin. Humeral spine not reaching middle of pectoral spine. Color silvery, sometimes spotted with darker. Sometimes reaching a weight of over 40 pounds.

"I have seen one or two specimens taken at Cincinnati," Jordan; "common in the Ohio river," Henshall, 1888. Not recorded elsewhere in the State.

Ictalurus punctatus (Rafinesque). CHANNEL CAT; BLUE CAT; WHITE CAT; LADY CAT.

Head 4; depth 5; anal fin of 25 to 30 rays, usually 27 in Ohio specimens. Eye large, the middle point of the length of the head being near its posterior margin. Barbels long, those of the maxillary reaching beyond gill opening. Humeral process long, more than $\frac{1}{2}$ the length of pectoral spine. Color light olivaceous, becoming silvery or pale on sides and belly; the sides usually with distinct round, dark spots, these becoming less distinct with age. Young specimens usually have a gaunt, faded-out, "consumptive" look. It reaches a weight of about 25 pounds.

Distributed throughout the state, but more abundant in the Ohio and tributaries. Rafinesque records it under the name *Pimelodus* (*Silurus*) *maculatus*, "as far as Pittsburg." Kirtland mentions it under the name *Pimelobus coeruleus*, as "common to the Ohio and lake waters," and as *P. pallidus*, "common in the Ohio at Cincinnati." The latter is identical with the former. Abundant in Ohio and Little Miami rivers, Henshall, 1888; Lorain County, common, McCormick, 1892; Maumee river at Toledo and Grand Rapids, Kirsch, 1893; Muskingum river at McConnellsville, Prof. D. S. Kellicott, 1895; Franklin County, "common in all larger streams, especially in Big Walnut creek," Williamson and Osburn, 1897; Ohio river and Ice creek at Ironton, Wabash river at Celina, R. C. Osburn, 1899; Chippewa lake, Ohio river at Bellaire, R. C. Osburn, 1900.

Genus: AMEIURUS.

Key to Species.

- | | | |
|-----|--|-------------------|
| A. | Caudal fin forked.— | <i>lacustris</i> |
| AA. | Caudal fin not forked. | |
| B. | Anal fin long, of 24 to 27 rays (counting rudiments).— | <i>nata'is.</i> |
| BB. | Anal fin shorter, of 17 to 22 rays. | |
| C. | Lower jaw projecting. Anal rays 20.— | <i>vulgaris.</i> |
| CC. | Lower jaw not projecting. | |
| D. | Pectoral spines long, 2 to 2½ in head; anal rays 20 to 23.— | <i>nebulosus.</i> |
| DD. | Pectoral spines shorter, 2½ to 3 in head; anal rays 17 to 19.— | <i>melas.</i> |

Ameiurus lacustris (Walbaum). MISSISSIPPI CAT; GREAT FORK-TAILED CAT.

Head 4, low, broad and depressed, its upper surface quite flat, its width $\frac{5}{8}$ its length. Depth 5; D. I-5; A. 25 to 32, base of the fin as long as head. Humeral process short, only a little over $\frac{1}{3}$ the length of pectoral spine. Body stouter than in the preceding genus. Caudal fin deeply forked. Color dark olivaceous or slate, growing darker with age; belly pale, no dark spots on sides. Our largest catfish, said to reach a weight of 150 pounds or more.

In Ohio this species is well distributed, being found in the lake, Ohio river and larger streams. Kirtland does not record this species, probably confusing it with his *Pimelobus coeruleus* (*Ictalurus punctatus*). Common in the Ohio river, Henshall, 1888; Lorain County, common in the lake and lower parts of the rivers, McCormick, 1892; Franklin County, two specimens taken in Big Darby creek; one of these, a female weighing $4\frac{1}{2}$ pounds, contained eggs, June 21, 1897, Williamson and Osburn.

Ameiurus natalis (Le Sueur). YELLOW CAT.

Head broad and short; upper jaw slightly projecting. Body stoutish; the back low, not arched. Anal fin long, its base contained in length of body $3\frac{1}{2}$ to $3\frac{1}{4}$ times; its rays 24 to 27. Color usually brownish or yellowish, sometimes black; belly pale or yellowish. Length about a foot. Ohio specimens seem to fall into the nominal variety *cupreus*, as indicated by the longer upper jaw.

This is a common species in most parts of Ohio, occurring in nearly all streams and lakes. "The yellow catfish I have only seen in the Cincinnati markets, where it is comparatively rare," Kirtland; Lake Erie, Henshall, 1889; Lorain County, "common in the ponds, streams and lake," McCormick, 1892; Maumee river at Antwerp, Defiance, Grand Rapids and Waterville, Tiffin river at Brunersburg, Sugar creek at Lima, Lost creek at Lima, Blanchard river at Findlay and Ottawa, Beaver creek at Grand Rapids, "seemingly scarce at all of these points," Kirsch, 1893; Franklin County, Scioto river, Olentangy river, Big Walnut, Little Walnut and Darby creeks, and Hell Branch, Williamson and Osburn, 1897; Ohio river at Ironton, John's creek at Waterloo, Huron river at Milan, Ashtabula creek at Ashtabula, Wabash river at Celina, Stillwater and Wolf creeks at Dayton, North Fork of Licking river at Newark, R. C. Osburn, 1899; Chippewa lake, Summit lake, Licking reservoir, R. C. Osburn, 1900.

Ameiurus vulgaris (Thompson). LONG-JAWED CATFISH.

Head $3\frac{1}{2}$ to 4, a little longer than broad, considerably narrowed forward when viewed from above, lower jaw distinctly projecting. Body somewhat elongate and compressed, the back somewhat elevated. Anal rays 20. Color dark brownish or black, becoming white rather abruptly on the belly. Length 18 inches.

The Long Jawed Catfish is not common in Ohio, but seems to be widely distributed. Jordan mentions it as "taken in Lake Erie and occasionally in the Ohio"; Henshall in 1889 records it for Lake Erie; Lorain County, "Martin's run, only one recorded," McCormick, 1892; two specimens from the Ohio canal at Columbus, Williamson and Osburn, 1897; Pippin lake, R. C. Osburn, 1900.

Ameiurus nebulosus (Le Sueur). COMMON BULL-HEAD;
HORNED POUT.

Head broad and flattened, upper jaw noticeably the longer. Body rather elongate, depth 4 to 4½. Anal fin with 20 to 22 rays, its base contained 4 times in length of body. Humeral process more than ½ the length of the rather long pectoral spine. Color dark brown or brownish yellow, usually somewhat clouded, sometimes nearly black. Length 18 inches.

A very common species in the lake and its tributaries, less common in the Ohio river drainage, but found in all larger streams. "Occasionally seen in the Cincinnati markets," Kirtland; Lake Erie, Henshall, 1889; Lorain County, "common in all streams," McCormick, 1892; Maumee river at Cecil and Waterville, Fish creek at Edgerton, St. Mary's river at St. Mary's, Gordon and Lost creeks near Cecil, Tiffin river at West Unity and Brunersburg, Auglaize river at Wapakoneta, Cloverdale, Oakwood and Defiance, Sugar creek at Cloverdale and Lima, Lost creek at Lima, Blanchard river at Findlay and Cloverdale, Hoaglin creek at Oakland, Kirsch, 1893; Franklin County, Scioto river, Olentangy river, Mason's run, Big Walnut, Little Walnut, Big Darby and Alum creeks, Williamson & Osburn, 1897; Huron river at Milan, Sandusky Bay, Ashtabula creek at Ashtabula, R. C. Osburn, 1899; Pippin lake, Summit lake, R. C. Osburn, 1900.

Ameiurus melas (Rafinesque). BLACK BULL-HEAD.

Body stout, short and deep, back high, the profile nearly straight to base of dorsal fin. Head broad, rounded in front, jaws about equal. Pectoral spine short, its length contained 2½ to 3 times in length of head. Anal fin short and deep, its base 4½ to 5 in length of body, rays 17 to 19, the light colored rays contrasting sharply with the dark membranes. Color almost black, sometimes brownish or yellowish, the belly pale or yellowish. This species shares with the three next preceding the name of Bull-head, the ordinary fisherman not drawing very fine distinctions in regard to species.

The Black Bull-head is the most abundant species of catfish in the state, found in nearly all streams and ponds of whatever size, and especially in the Ohio river drainage. It is less abundant in the lake drainage. It is a mud loving species and is less likely to be found in clear, swift streams than in muddy, stagnant bayous. *A. xanthocephalus* Rafinesque is now recorded as synonymous.

with *A. melas*. Recorded by Kirtland as *A. xanthocephalus*, and by Jordan as *A. melas* and *xanthocephalus*. "Very common in Ohio and Little Miami rivers and Mill creek," Henshall, 1888; Lorain County, "common in all streams and ponds," McCormick, 1892; Maumee river at Cecil and St. Mary's river at Rockford, Kirsch, 1893; Franklin County, in nearly all streams, Williamson and Osburn, 1897; Big Jelloway creek at Howard, Parker, Williamson and Osburn, 1898; Ohio river at Ironton, Huron river at Milan, Wabash river at Celina, Stillwater and Wolf creeks at Dayton, North Fork of Licking river at Newark, R. C. Osburn, 1899; Sandusky, Prof. D. S. Kellicott, Williamson and Osburn, 1896; Niggermill run at Salem, E. B. Williamson, 1900; Sandusky bay at "Black Channel," Breakneck creek and Cuyahoga river near Kent, and Licking reservoir, R. C. Osburn, 1900; June 22 is given as a breeding date by Williamson and Osburn.

Genus: LEPTOPS.

Leptops olivaris (Rafinesque). MUD CAT.

Body slender, depressed forward, the head extremely flat, the lower jaw the longer. Dorsal spine very weak, only $\frac{1}{2}$ the height of the fin; caudal fin slightly emarginate; anal short, its base about $\frac{1}{4}$ the length of body, its rays 12 to 15. Yellowish, much mottled with brown and greenish, whitish below. Size large, reaching a weight of 50 to 75 pounds.

Jordan says, "This species abounds in the Ohio river and its larger tributaries," but it is probably common nowhere in Ohio except in the southwestern part of the state. Henshall records it for White Oak creek and the Ohio river, 1889; and in 1892 McCormick mentions the occurrence in Lake Erie, Lorain County, as "quite rare; I have seen but one specimen fresh, though I have noticed heads on the beach."

Genus: NOTURUS.

Noturus flavus Rafinesque. YELLOW STONE CAT.

Head broad and flat, much depressed, 4 in length of body. Body terete, tail compressed. Soft dorsal fin keel-like, separated from caudal by a deep notch. Dorsal spine very short, only $\frac{1}{2}$ as long as pectoral spine; caudal rounded; anal short, its rays about 16. Brownish yellow, varying into bluish or blackish. Length 1 foot.

Widely distributed and generally common in suitable localities. It is found most abundantly on stony ripples of the larger streams, and on sandy and gravelly bottoms of rivers and lakes. "Occasionally found beneath stones in the Mahoning river," Kirtland; "much more abundant in the Ohio and its immediate tributaries than in the streams of the interior," Jordan; "abundant in Little Miami river, Mill creek and nearly all streams" (Hamilton County), Henshall, 1888; Lorain County, "larger streams and the lake," McCormick, 1892; Maumee river at Defiance, Grand Rapids and Waterville, Fish creek at Edgerton, St. Mary's river at Rockford, Auglaize river at Cloverdale and Defiance, Blanchard river at Ottawa, Hoaglin creek at Oakland, and Blanchard river and Sugar creek at Cloverdale, Kirsch, 1893; Franklin County, "abundant in all larger streams, Scioto and Olentangy rivers, Big Walnut, Little Walnut, Alum, Big and Little Darby creeks, Black Lick and Hell Branch," Williamson and Osburn, 1897; Knox County, Big Jelloway creek, Parker, Williamson and Osburn, 1898; John's creek at Waterloo, Huron river at Milan, North Fork of Licking river at Newark, R. C. Osburn, 1899; Lake Erie at Sandusky, frequently thrown up dead on the beach by the waves; not noticed in Sandusky bay, Wheeling creek at Bridgeport, Ohio river at Bellaire, R. C. Osburn, 1900.

Genus: SCHILBEODES.

Key to Species.

- A. Pectoral spine entire or grooved behind, never retrorsely serrate; adipose fin high and continuous, not separated by a notch from the caudal.— *gyrinus.*
- AA. Pectoral spine distinctly serrate behind.
- B. Adipose fin nearly or quite free from caudal; color nearly plain brownish, saddle-like blotches faint, everywhere pigmented with fine dots; anterior edge of pectoral spine retrorsely serrate.— *e'utherus.*
- BB. Adipose fin not quite free from caudal; color much variegated, back with distinct saddle-like blotches; pectoral spine strong, its anterior edge with few serrations.— *mirus.*

Schilbeodes gyrinus (Mitchill). CHUBBY STONE CAT;
TADPOLE CAT.

Head large, broad and depressed, $3\frac{1}{2}$ to 4 in length; mouth wide, jaws about equal. Body short and stout, pot-bellied, shaped much like a tadpole. Caudal peduncle comparatively long and compressed. Pectoral spine not serrated behind, but grooved instead. Anal fin with 13 rays. Soft dorsal

continuous with caudal, scarcely notched. Color yellowish brown or brownish olive, nearly uniform; a distinct narrow, black line along lateral line. Length 5 inches.

Rather irregularly distributed, but common in suitable localities. Dr. Jordan (Ohio Rept.) says of this species and *S. miurus* that "their habits are similar, they are usually found together and are about equally abundant in Ohio," but in the writer's experience *S. miurus* has been found much more generally distributed, occurring in the open water of streams, usually on gravelly or stony bottom, while *gyrinus* seems to prefer the quiet of lakes and ponds, and in the course of several years collecting the two species have never been taken together. *S. gyrinus* was observed by Prof. D. S. Kellicott, Mr. E. B. Williamson and the writer to be common among the decaying vegetation in shallow water in Sandusky Bay in 1896; "Ross lake," Henshall, 1889; Lorain County, "Common on mud banks in the lower parts of streams entering the lake," McCormick, 1892; Maumee river at Toledo, St. Mary's river at St. Mary's, "everywhere scarce," Kirsch, 1893; Franklin County, Mason's run and Big Darby creek, rare, Williamson and Osburn, 1897; Sandusky Bay, R. C. Osburn, 1899; Summit lake, Licking reservoir, R. C. Osburn, 1900.

Schilbeodes eleutherus (Jordan).

Head broad and flat, much depressed, narrowed anteriorly, $3\frac{3}{4}$ in body; upper jaw much longer than the lower, which is included. Body much of the same form as that of *S. miurus*, but with the back somewhat higher; depth $4\frac{1}{2}$ in length. Soft dorsal free from caudal, or only very slightly connected. Color nearly uniform brown above, lighter below, flecked everywhere except on middle of belly, with black dots. Distinguished from *S. miurus*, which it most nearly resembles, by the free adipose fin, the longer upper jaw and the absence of distinct, black, saddle-like blotches on the back. Length 4 inches.

I know of but one specimen of this very rare species taken within the limits of the state. This was taken in Big Walnut creek, Franklin County, by Mr. E. B. Williamson and the writer, June 25, 1897.

Schilbeodes miurus (Jordan). CROSS-BARRED STONE CAT.

Head very much depressed, rounded anteriorly, $3\frac{3}{4}$ in length; upper jaw longer but not so much so as in the preceding species. Depth about 5 in length; back scarcely elevated; adipose fin connected with caudal, but more or less deeply notched. Conspicuously mottled with gray and blackish, with 3 or 4 definite black blotches across the back. Length, 4 inches.

A rather common and widely distributed species. Ohio river at Raccoon I., Henshall, 1889; Lorain County, quite rare, Vermillion and Black rivers, McCormick, 1892; Maumee river at Antwerp, St. Joseph river at Edgerton, St. Mary's river at Rockford, Tiffin river at West Unity and Brunersburg, and Auglaize river at Cloverdale, Oakwood and Defiance, "In an old mill race which empties into Tiffin river near West Unity large numbers were caught, common in Hoaglin creek near Oakwood, rather scarce at all other points," Kirsch, 1893; Franklin County, generally common, abundant in Big Walnut, taken also in Scioto river, Olentangy river, Black Lick, Little Walnut, Big Darby and Alum creeks, Williamson and Osburn, 1897; Ohio river at Ironton, John's creek at Waterloo, Sandusky Bay, Ashtabula creek at Ashtabula, Wabash river at Celina, North Fork of Licking river at Newark, R. C. Osburn, 1899; Ohio river at Bellaire, R. C. Osburn, 1900. Females were observed with ripe eggs from June 25 to July 6, 1897, by Mr. Williamson and the writer.

Order: PLECTOSPONDYLI.

Sub-Order: EVENTOGNATHI.

Family: CATOSTOMIDÆ (The Suckers).

Key to Genera.

- A. Dorsal fin elongate, developed rays 25 to 50, air bladder in 2 parts.
- B. Fontanelle present, body ovate, scales large.
- C. Mouth large, more or less terminal, protractile forward; pharyngeal bones and teeth moderate, large species of dark color.— ICTIOBUS.
- CC. Mouth smaller, inferior, protractile downward; pharyngeal bones narrow, the teeth thin and weak; smaller species, pale in color.—
CARPIODES.
- BB. Fontanelle obliterated by union of parietal bones; body elongate; scales rather small; lips thick and papillose.—
CYCLEPTUS.
- AA. Dorsal fin short, 10 to 18 developed rays.
- D. Air bladder in 2 parts.
- E. Lateral line present, complete and continuous; scales small, more than 50 in lateral line.—
CATOSTOMUS.
- EE. Lateral line interrupted or wanting, scales large, less than 50 in lat. line.
- F. Lateral line entirely wanting.—
ERIMYZON.
- FF. Lateral line more or less developed, especially in the adult.—
MINYTREMA.
- DD. Air bladder in 3 parts; scales large; lateral line complete.
- G. Mouth normal, the lower lip entire or merely lobed, the upper lip protractile.
- H. Pharyngeal bones moderate, the teeth compressed, not molar-like, increasing in size gradually downward.—
MOXOSTOMA.
- HH. Pharyngeal bones very strong, the lower teeth very much enlarged, cylindrical and truncate, molar-like.—
PLACOPHARYNX.
- GG. Mouth singular, the upper lip not protractile, greatly enlarged, the lower lip developed as two separate lobes.—
LAGOCHILA.

Genus: ICTIOBUS.

Key to Species.

- A. Mouth large, terminal, protractile forward; lips very thin, lower pharyngeals and teeth weak.—
cyprinella.
- AA. Mouth smaller, more or less inferior, and with thicker lips; pharyngeal bones stronger; the teeth comparatively coarse and large.
- B. Back scarcely elevated, depth 3 to 3¼ in length.—
urus.
- BB. Back elevated and compressed, depth 2½ to 2¾.—
bulbus.

Ictiobus cyprinella (Cuvier and Valenciennes). COMMON BUFFALO FISH;
RED-MOUTHED BUFFALO.

Head very large and thick, 3½ in length; depth 2½ to 3½. Developed rays of dorsal fin 27 to 29; anal 9; ventrals 10. Scales 7-37 to 41-6. Body robust, moderately compressed, the outline somewhat elliptical, but the back rather more curved than the belly. Opercular apparatus very strong, the operculum forming nearly ½ the length of the head. Color dull brownish olive, not silvery, fins dusky. Length nearly 3 feet.

According to Jordan, the Red-mouthed Buffalo Fish abounds in the Ohio river and its larger tributaries, and Henshall reports it "very common in Ohio river." Not reported for any other locality.

Ictiobus urus (Agassiz). . MONGREL BUFFALO; RAZOR-BACKED BUFFALO.

Head very stout, strongly transversely convex, thicker, larger and less pointed than in *I. bubalus*, about 4 in length. Eye about equal to snout, $5\frac{1}{2}$ in head, much smaller than in *I. bubalus*. Mouth large, considerably oblique, approaching that of *I. cyprinella*. Body much less elevated and compressed than in *I. bubalus*, the back not at all carinated; 3 to $3\frac{1}{4}$ in length. D. 30; A. 10; scales 8-41-7. Longest ray of dorsal scarcely $\frac{1}{2}$ the length of base of fin; anal rounded. Colors very dark, fins all black. "Not always separable from *I. cyprinella*, and perhaps not really different."

Ohio river at Cincinnati, Henshall, 1889. Not mentioned by any other collector.

Ictiobus bubalus (Rafinesque). BUFFALO FISH; SMALL-MOUTHED BUFFALO; RAZOR-BACK; SUCKER-MOUTHED BUFFALO.

Head moderate, triangular in outline when viewed from the side, 4 in length, mouth quite small. Body considerably elevated and compressed above; the dorsal region sub-carinate, the belly thicker; depth $2\frac{1}{4}$ to $2\frac{3}{4}$. Highest dorsal ray reaching much beyond middle of fin; D. 29; A. 10; V. 10; scales 8-39-6. Color brownish olive, paler below, the lower fins slightly dusky. Length 30 inches.

Recorded by Rafinesque for the Ohio, "as far as Pittsburg." Also recorded for the state by Kirtland. "Abundant in the Ohio river," Henshall, 1888. Not recorded for any other point of the state.

Genus: CARPIODES.

Key to Species.

- A. Body sub-fusiform, depth about 3 in length. Dorsal with about 30 rays.— *carpio*.
- AA. Body ovate oblong, the back elevated, depth about $2\frac{1}{2}$ in length.
 - B. Lips thin, silvery white, the halves meeting in a wide angle.
 - C. Head large, snout blunt; eye large, $3\frac{1}{2}$ to 4.— *difformis*.
 - CC. Head small and pointed, the snout projecting, eye small, 5 to $5\frac{1}{2}$ in head.— *thompsoni*.
 - BB. Lips full, thick, reddish in life, the halves of lower lip meeting in an acute angle.— *velifer*.

Carpiodes carpio (Rafinesque). BIG CARP SUCKER.

Head comparatively short, 4 to 5 in body. Body more fusiform than in others of the genus, compressed, but not much arched, depth $2\frac{2}{3}$ to 3.

Anterior rays of dorsal short, much thickened and osseous at base, especially in adults, the longest ray a little more than $\frac{1}{2}$ the base of the fin, which consists of 30 rays; caudal moderately forked. Eye medium, anterior, $4\frac{1}{2}$ in head. Muzzle short, but projecting beyond mouth. 36 scales in lateral line.

Limited in its distribution to the Ohio and its larger tributaries. "The commonest species of its genus in the Ohio river, and it is often found in the streams of the interior," Jordan. Very abundant in the Ohio river, Henshall, 1888; Ohio river at Bellaire, R. C. Osburn, 1900.

Carpiodes difformis Cope.

Snout very blunt, the maxillary reaching to front of pupil. Nostrils very near tip of snout. Lips thin, silvery colored in life, the lower Ω -shaped. Head $4\frac{1}{4}$ in body; depth $2\frac{1}{4}$ to $2\frac{3}{4}$, the back considerably elevated. Eye quite large, $3\frac{1}{2}$ to 4 in head. D. 24, its first rays very high; A. 8; V. 9; scales, 6-35-4.

Recorded for the state by Jordan, under the name of *C. cutisanserinus* (Cope), as "abundant in the Ohio." *C. cutisanserinus* is now regarded as identical with *C. difformis*. "Abundant in Ohio river, young common in Little Miami river," Henshall, 1888. Klippart, in his first report, says of this species, that it "abounds in Lake Erie, but this must be a mistake, probably in regard to the species, as *C. difformis* is not, I believe, known to occur in the St. Lawrence System."

Carpiodes thompsoni Agassiz. LAKE CARP.

Body stout, short, the back much elevated, depth $2\frac{1}{2}$ in length. Head small, 4 to $4\frac{1}{2}$ in length, the snout pointed; lips thin, white, meeting at a wide angle. Eye small, 5 to $5\frac{1}{2}$ in head. Tip of lower jaw much in advance of nostrils; maxillary reaching line of orbit. Dorsal of about 27 rays, arising about midway from snout to base of caudal, its anterior rays high, $\frac{2}{3}$ as long as base of fin. A. 7; V. 10; scales rather closely imbricated, 8-39 to 40-6.

"Abundant in Lake Erie. I have examined many specimens from Sandusky Bay," Jordan; Lake Erie, Henshall, 1889; Lorain County, "not very common," McCormick, 1892; Lake Erie at Toledo, Jordan and Evermann (Bull. 47, U. S. Nat'l. Mus.).

***Carpiodes velifer* (Rafinesque). QUILL BACK ; SPEARFISH.**

Head $3\frac{3}{4}$ to 4; lips thick, full, flesh-colored in life, the halves of the lower meeting at an acute angle; muzzle projecting, conic; eye 4 to 5 in head. Back much arched; depth $2\frac{1}{2}$ to 3. Dorsal fin of about 27 rays, the anterior rays very long and filamentous, sometimes as long as the base of the fin. Caudal deeply forked, its lobes slender, the upper lobe the longer. Scales 7-35-5.

Recorded by Rafinesque for the Ohio river as far as Pittsburg. "Quite common in Ohio river, young ones common in Little Miami river and tributaries," Henshall, 1888; Maumee river at Antwerp, Defiance, Grand Rapids and Toledo, Tiffin river at Brunersburg, Auglaize river at Cloverdale, Oakwood and Defiance, Blanchard river at Ottawa and Cloverdale, Hoaglin creek near Oakland, Beaver creek at Grand Rapids, "rather common at all these points," Kirsch, 1893; Scioto river, Scioto Big Run, Mason's Run and Hell Branch, Williamson and Osburn, 1897; Scioto river at Ironton, Wabash river at Celina, Wolf creek near Dayton, North Fork of Licking river at Newark, R. C. Osburn, 1899; Breakneck creek and Cuyahoga river near Kent, Chippewa lake, Wheeling creek at Bridgeport, Ohio river and McMahon's Run at Bellaire, R. C. Osburn, 1900.

***Cycleptus elongatus* (Le Sueur). BLACK HORSE ;
MISSOURI SUCKER.**

Depth 4 to 5; head 6 to $8\frac{1}{2}$; eye small, 6 to 7 in head. D. 30, its longest ray a little longer than head; A. 7 or 8; scales 9-56-7. Color very dark, males in spring almost black. Length $2\frac{1}{2}$ feet.

Apparently confined in this state to the Ohio river. "As far as Pittsburg," Rafinesque. Recorded for the Ohio by Kirtland and by Jordan, and Henshall in 1888 mentions it as "not uncommon in the Ohio river.

Genus: CATOSTOMUS.*Key to Species.*

- A. Head transversely convex above, the orbital rim not elevated, scales in lateral line 60 or more.
 B. Scales in lateral line about 100.— *catostomus.*
 BB. Scales in lateral line 64 to 70.— *commersonii.*
 AA. Head broad, depressed, and transversely convex between the orbits; scales in lateral line, 48 to 55. *nigricans.*

Catostomus catostomus (Forster). NORTHERN SUCKER.

This species can at once be distinguished from the others of the genus occurring in Ohio, by the great number of scales in the lateral line, 95 to 114. About 29 cross rows between dorsal and ventrals. Head broad above, pointed in front; snout a little longer than remainder of head and much overhanging the mouth. Body rather slender and somewhat terete. D. 10; A. 7. Color, above, smoky gray; below, white. Length $2\frac{1}{2}$ feet.

This species is one of northern distribution, probably not occurring in the tributaries of the Ohio. "Quite abundant in Lake Erie," Jordan (Ohio Rept.), 1878; Lake Erie, Henshall, 1889.

Catostomus commersonii (Lacepede). COMMON SUCKER;
FINE-SCALED SUCKER.

Head rather conical, $4\frac{1}{4}$ in length of body, flattish above, but not concave between the eyes. Body moderately stout, terete or sub-terete, becoming heavier at the shoulders with age, depth 4 to 5 in length. D. 11 or 12; scales small, 10-64 to 70-9. Color olivaceous, tending toward blackish on back and lateral line. Length 18 inches.

One of the commonest species in the state, found in abundance in nearly every stream. Recorded for the state by Kirtland for the Big Miami, and small brooks of northern Ohio; "Swarming in every pond and stream in Ohio," Jordan (Ohio Rept.); Hamilton County, "Everywhere abundant," Henshall, 1888; Lorain County, "Very common in all our waters," McCormick, 1892; recorded by Kirsch for nearly every locality seined in the Maumee River System, 1893; taken by Mr. Williamson and myself in every stream in Franklin County, 1897; in every stream of the Big Jelloway Creek System in Knox County, Parker, Williamson and Osburn, 1898; taken by myself in 1899, at the following places: Ohio river and Ice creek at

Ironton, John's creek at Waterloo, Huron river at Milan, Ashtabula creek at Ashtabula, Wabash river at Celina, Stillwater and Wolf creeks near Dayton, and North Fork of Licking river at Newark; and in 1900 in the Cuyahoga river at Hawkins, Breakneck creek near Kent, Chippewa lake, Grand river at Painesville, Chagrin river at Willoughby, Wheeling creek at Bridgeport, Ohio river and McMahon's Run at Bellaire, and Licking reservoir.

Catostomus nigricans Le Sueur. HOG SUCKER; STONE ROLLER.

Head large, concave between the eyes, $4\frac{1}{4}$ in length. Body nearly terete, depth $4\frac{1}{2}$ to 5. D. 10 or 11; scales 48 to 55 in lateral line. Color, olive, becoming brownish on the back, which is crossed by several dark, irregular blotches; belly white. Length 2 feet.

This Sucker is very widely distributed over the state, being found in all suitable localities. Its especial haunts are clear, stony ripples and rock-bottomed pools. Not taken in lakes. Kirtland records it as two species, *Hypentelium macropteron* and *Catostomus nigricans*; "extremely abundant in every running stream in Ohio," Jordan (Ohio Rept.); Hamilton County, "everywhere abundant," Henshall, 1888; Lorain County, McCormick, 1892; Kirsch, 1893, records it for the streams at nearly all points investigated in the Maumee River System, "none taken in the lakes"; Franklin County, Scioto river, Olentangy river, Scioto Big Run, Grant's Run, Big Walnut creek, Rocky Fork, Black Lick, Alum creek, Big and Little Darby creeks and Hell Branch, Williamson and Osburn, 1897; every stream in the Big Jelloway Creek System, Parker, Williamson and Osburn, 1898; Ohio river and Ice creek at Ironton, John's creek at Waterloo, Huron river at Milan, Ashtabula creek at Ashtabula, Wabash river at Celina, Stillwater and Wolf creeks near Dayton and North Fork of Licking river at Newark, R. C. Osburn, 1899; Cuyahoga river at Hawkins, Grand river at Painesville, Chagrin river at Willoughby, Wheeling creek at Bridgeport, Ohio river and McMahon's creek at Bellaire, and the outlet of Licking reservoir into Licking river, R. C. Osburn, 1900.

Genus: ERIMYZON.**Erimyzon sucetta oblongus** (Mitchell). SWEET SUCKER ;
CHUB SUCKER.

Head 4 to $4\frac{1}{4}$ in length ; snout not projecting ; eye $4\frac{1}{4}$ to $4\frac{3}{4}$ in head. Body stout, compressed ; depth in adults about 3, but younger specimens much more slender ; back arched, old specimens becoming quite gibbous at the nape. Lateral line entirely wanting. Scales about 40, closely imbricated and somewhat crowded anteriorly, sometimes showing irregularities of arrangement. Length 10 inches. Color varying with age, in adults brown or brownish olive above, with a tendency to brassy on sides and belly ; younger specimens are plain olivaceous, occasionally bright, "gold-fish yellow" ; very young with a distinct, black lateral band, which breaks up into blotches a little later. Ohio specimens show some variations between the typical *E. sucetta* and the variety *oblongus*, but seem to agree more closely with the variety than with the typical form.

The Chub Sucker, or Sweet Sucker, is widely distributed over the state, but its occurrence is irregular. At some points it is an abundant species, at others rare. "Common in Little Miami and Ohio rivers," Henshall, 1888 ; "not common, I have taken a few in the lower part of Beaver creek," McCormick, 1892 ; Maumee river at Toledo, St. Joseph river at Edgerton, St. Mary's river at St. Mary's, Tiffin river at West Unity, Lost and Gordon creeks near Cecil, Kirsch, 1893 ; Franklin County, Scioto river, Scioto Big Run, Grant's Run, Big Darby, Little Darby and Hell Branch, Osburn and Williamson, 1897 ; Ohio river at Ironton, Wabash river at Celina, Stillwater and Wolf creeks near Dayton, R. C. Osburn, 1899 ; Licking reservoir, E. B. Williamson ; Sandusky Bay, very common in Black Channel, Grand river at Painesville, Chagrin river at Willoughby, Wheeling creek at Bridgeport, and Ohio river and McMahan creek at Bellaire, R. C. Osburn, 1900.

Genus: MINYTREMA.**Minytrema melanops** (Rafinesque). WINTER SUCKER ; SPOTTED SUCKER ;
STRIPED SUCKER.

Head $4\frac{1}{4}$; snout round, a trifle projecting. Body elongate, somewhat terete, back somewhat arched in front of dorsal fin ; depth about 4. D. 12 ; A. 7. Scales about 46. Lateral line wanting in young, present but more or less interrupted in adults. Coloration dusky olive above, each scale with a more or less distinct black spot at its base, these forming rows along the rows of scales. Length about 18 inches.

Not usually a common species, though widely distributed. Recorded by Kirtland, 1838; Hamilton County, Little Miami and tributaries, Henshall, 1888; Lorain County, "Rare, Vermillion river and Beaver creek," McCormick, 1892; Maumee river at Grand Rapids, St. Joseph river at Edgerton, Fish creek at Edgerton, St. Mary's river at St. Mary's and Rockford, Auglaize river at Wapakoneta and Cloverdale, Blanchard river at Findlay, Kirsch, 1893; Franklin County, Scioto river, Olentangy river, Black Lick, Little Walnut and Big Darby, Williamson and Osburn, 1897; Stillwater creek near Dayton, and Wabash river near Celina, R. C. Osburn, 1899. At the latter place, in a series of pools formed by the outlet of St. Mary's reservoir, the species was taken in abundance, the only time I have ever taken more than a few individuals in one locality.

Genus: MOXOSTOMA.

Key to Species.

- A. Dorsal fin of 15 to 18 rays; lower lip V-shaped.— *anisurum.*
 AA. Dorsal fin of less than 15 rays; lower lip truncate behind, not evidently V-shaped.
 B. Head rather large, 4 to nearly 5 in length, snout little projecting.—*aureolum.*
 BB. Head small and conic, about $5\frac{1}{4}$ in length, the snout much projecting beyond the small mouth.— *breviceps.*

Moxostoma anisurum (Rafinesque). WHITE-NOSED SUCKER.

Head short and broad, flattened above, $\frac{3}{5}$ to $\frac{4}{4}$ in length, eye midway in head, 4 to 5 in its length. Body compressed; back high, considerably more arched than in *M. aureolum*; depth $3\frac{1}{2}$ in length. Fins all large. Color bright olivaceous to smoky above, white or silvery on sides and belly. Most easily distinguished from other species of the genus occurring in Ohio, by the long dorsal fin, containing from 15 to 18 rays.

This species is found in both the Lake and Ohio river drainage, but is not usually very common, and is confined to the larger streams. Ohio river, "as far as Pittsburg," Rafinesque. Given by Jordan (Ohio Rept.) as three species—*M. anisurum*, of which he says, "I have seen a few specimens, obtained in the Cincinnati market"; *M. velatum*, "frequently taken in the Ohio river and its tributaries," and *M. carpio*, from Lake Erie and the Ohio at Cincinnati and Marietta. These three are now regarded as synonymous (See Bull. 47, U. S. Natl. Mus.). Hamilton County,

not uncommon in Ohio river, Henshall, 1888; Lorain County, McCormick, 1892; Maumee river at Antwerp, Defiance and Toledo; Tiffin river at West Unity and Brunersburg, Auglaize river at Cloverdale, Oakwood and Defiance; Blanchard river at Ottawa, Hoaglin creek near Oakwood, Beaver creek at Grand Rapids, Kirsch, 1893; Franklin County, Scioto river, Olentangy river and Alum creek, Williamson and Osburn, 1897; Ohio river at Ironton, Huron river at Milan, R. C. Osburn, 1899; Ohio river at Bellaire, Licking reservoir, R. C. Osburn; 1900.

Moxostoma aureolum (Le Sueur). RED-HORSE; MULLET;
WHITE SUCKER.

Head 4 to 5, flattened above; snout slightly projecting; eye $4\frac{3}{4}$ in head. Body rather stout, somewhat compressed; back, little elevated; depth 4 in length. D. 13, or more rarely 12 or 14; A. 7; scales about 45. Color olivaceous above, sides silvery; lower fins reddish, especially during the breeding season.

Until very recent years this has been recorded as two species, the short-headed, small-mouthed form as *M. aureolum*, and the more ordinary form as *M. macrolepidotum duquesnii* (Le Sueur). This matter is cleared up by Jordan and Evermann (Bull. 47, U. S. Natl. Mus.). It is very probable that some collectors have confused the short-headed form with *M. breviceps* (Cope), as I can find no record of *M. breviceps* for Ohio in any paper preceding Bull. 47, U. S. Natl. Mus., in which it is recorded as abundant in some portions of the state. However, as I have no direct evidence of any such error, I include all records for *M. aureolum* and *M. macrolepidotum duquesnii* under *M. aureolum*. Ohio river, "as far as Pittsburg," Rafinesque; recorded for the state by Kirtland as *Catostomus aureolus*, *C. Duquesnii* and *C. erythrus*; Hamilton County, "abundant in all streams explored," Lake Erie, Henshall, 1888-89; Lorain County, McCormick, 1892; Maumee river at Defiance, Grand Rapids and Waterville, St. Mary's river at Rockford, Auglaize river at Oakwood, Sugar creek at Lima, St. Joseph river at Edgerton, west end of Lake Erie, Kirsch, 1893; Franklin County, "abundant, taken in all but the smallest streams," Williamson and Osburn, 1897; Knox County, Big Jelloway creek system, "abundant, the young fry

ascending even the smallest brooks," May 26 given as a breeding date, Parker, Williamson and Osburn, 1898; Ohio river and Ice creek at Ironton, John's creek at Waterloo, Huron river at Milan, Sandusky Bay, Ashtabula creek at Ashtabula, Wabash river at Celina, Stillwater and Wolf creeks near Dayton, North Fork of Licking river at Newark, R. C. Osburn, 1899; Niggermill Run at Salem, E. B. Williamson, 1900; Cuyahoga river at Hawkins, Grand river at Painesville, Chagrin river at Willoughby, Wheeling creek at Bridgeport, Ohio river and McMahan creek at Wheeling, Licking reservoir, R. C. Osburn, 1900.

Moxostoma breviceps (Cope).

Form of a *Coregonus*, with deep, compressed body, small head, and a conic snout, which overhangs the very small mouth. Caudal fin, with the upper lobe falcate, much longer than the lower. Dorsal fin short, high, falcate, the anterior rays $1\frac{1}{3}$ to $1\frac{1}{2}$ times base of fin, the free border much concave. Depth $3\frac{1}{2}$ in length. Head 5 to $5\frac{1}{4}$. D. 12 or 13. Scales 6-45-5. Lower fins bright red.

"Abundant in Lake Erie; our specimens from Sandusky, Toledo and Cincinnati," Jordan and Evermann (Bull. 47, U. S. Natl. Mus.).

Genus: PLACOPHARYNX.

Placopharynx duquesnii (Le Sueur).

Head 4; snout rounded, projecting; lower jaw somewhat oblique when closed; eye $4\frac{1}{2}$ in head. Body rather stout, somewhat compressed, in form like that of *M. aureolum*; D. 13; A. 7 (not 9, as is usually given, in any Ohio specimens I have seen); scales 6-45-6. Lower pharyngeal bones very strong, the lower teeth on these bones very strong and molar-like, little compressed, and having broad grinding surfaces.

This species so closely resembles *M. aureolum* that it can be positively distinguished only by the appearance of the lower pharyngeal teeth, and it has no doubt been much overlooked. Recorded by Jordan (Ohio Rept.) on the strength of a skeleton found by Dr. J. M. Wheaton in the Scioto river at Columbus, one of the very few specimens known at that time. The species has since proved to be well distributed over the state, though not usually abundant. Hamilton County, not rare in the Ohio, Henshall, 1888; Lorain County, Lake Erie, common with other

mullets, McCormick, 1892 ; Franklin County, Scioto river, Olen-tangy river and Big Darby creek, Williamson and Osburn, 1897 ; Ohio river at Ironton, Wabash river at Celina, R. C. Osburn, 1899 ; Ohio river at Bellaire, R. C. Osburn, 1900.

Genus: LAGOCHILA.

Lagochila lacera Jordan and Brayton. HARE-LIP SUCKER ;
CUT-LIPS.

Head short, conical, with lengthened snout, the region between the eyes flattened and with prominent mucous ridges. Cheeks and lower part of head rather swollen. Opercle much reduced, its greatest length scarcely greater than diameter of eye. Head $4\frac{2}{3}$ in length. Eye $4\frac{1}{2}$ in head, 2 in length of snout. Body rather slender, depth $4\frac{2}{3}$. Dorsal fin rather low, its rays 12 ; A. 7 ; V. 9 ; scales 5-45-5. Mouth very singular ; the upper lip is broad and fleshy, not separated from the skin of the forehead by a crease ; at each side of the mouth a sharp fold of skin is formed, which descends to the mid line below, passing under the lower jaw, but is separated from that of the opposite side by a longitudinal crease ; in front of these the fleshy lower lip is split into two large depending lobes.

This species has been recorded for but three localities in the state. Its rare occurrence in the state was first noted by Dr. Jordan in Klippart's "Second Annual Report of the Ohio State Fish Commission for 1877," where he says : "Mr. Klippart finds it very abundant in the Scioto, where it has been overlooked by all the collectors from Rafinesque and Kirtland down," and Mr. Klippart further comments : "The fisherman assured me that he had taken them several years in succession." Twenty years later, the investigations on the fishes of Franklin County, carried on by Mr. Williamson and the writer, and extending over a period of several years, failed to bring to light a single specimen of this species, though the Scioto river was hauled in many places. The species has been taken in the state by Kirsch, in 1893, in the Auglaize river at Cloverdale, and in the Blanchard river at Ottawa.

*Family: CYPRINIDÆ (The Minnows).**Key to Genera.*

- I. (Dorsal fin long, with 2 or 3 spines, and 18 or 20 rays ; introduced species.)
- A. Teeth in 3 rows, 1, 1, 3-3. 1, 1, all molar; 4 barbels.— CYPRINUS.
 AA. Teeth in 1 row, 4-4, molar, but compressed; barbels wanting.— CARASSIUS.)
- II. Dorsal fin short, without developed spine.
- A. Air bladder surrounded by many convolutions of the very long alimentary canal.— CAMPOSTOMA.
 AA. Air bladder above the alimentary canal, not surrounded by convolutions of the intestine.
- B. Alimentary canal more than twice the length of body; teeth in 1 row; peritoneum usually black.
 C. Teeth 5-5 or 4-5; scales minute.— CHROSOMUS.
 CC. Teeth 4-4; scales larger.
 D. A small barbel present at base of maxillary; color silvery.— HYBOGNATHUS.
 DD. Barbel wanting; color olivaceous, little silvery.— PIMEPHALES.
- BB. Alimentary canal less than twice the length of body; peritoneum usually silvery.
- E. Lower jaw normally formed, dentary bones free from each other except at the symphysis.
- F. Teeth in main row 5-5 or 4-5.
 G. Abdomen rounded behind ventral fins, not compressed into a scaleless ridge; anal basis short.
 H. A minute barbel present on maxillary at a little distance above its base.— SEMOTILUS.
 HH. Maxillary without barbel.
 I. Teeth in 2 rows, 2, 4-5, 2.— LEUCISCUS.
 II. Teeth in 1 row, 5-5. Mouth extremely small.— OPSOPHODUS.
- GG. Abdomen compressed behind ventral fins into a sharp, scaleless ridge; anal basis longer.— ABRAMIS.
- FF. Teeth in main row 4-4.
- J. Maxillary without barbel.
 K. No cavernous lymph spaces visible in mandible, sub-opercle and inter-opercle.
 L. First (rudimentary) ray of dorsal detached from the first developed ray and connected to it by a membrane; a conspicuous black spot at base of caudal and dorsal.— CLIOLA.
 LL. First (rudimentary) ray closely attached to first developed ray.— NOTROPIS.
- KK. Mandible, sub-opercle and inter-opercle, with conspicuous, externally visible, cavernous lymph chambers.— ERICYMBA.
- JJ. Maxillary barbel present.
 M. Premaxillaries not protractile, connected to skin of forehead in the median line without a cross groove; teeth 2, 4-4, 2. RHINICHTHYS.
 MM. Premaxillaries protractile, a cross groove separating them from the skin of forehead in front; only 1 tooth in lesser row.— HYBOPISIS.
- EE. Lower jaw singularly formed, the dentary bones parallel and united for their entire length; a conspicuous, fleshy lobe on each side at base.— EXOGLOSSUM.

*Genus: CYPRINUS.***Cyprinus carpio** Linnaeus. THE CARP.

The Carp may be readily distinguished from any of our native *Cyprinidæ* by the presence of four long barbels, and by the very long dorsal fin—about 20 rays—preceded by a stout spine, which is serrated behind. Anal fin short, of about 5 rays, also preceded by a spine. The lower pharyngeal teeth, unlike those of any native American Minnow, are in 3 rows, 1, 1, 3-3, 1, 1. The lateral line is complete. Many varieties have resulted from cultivation. Chief among these are the "Full-scale," in which the body is covered with strong scales, after the formula, 6-40-5; the "Half-scale" or "Mirror," characterized by a few rows of very large scales; and the "Leather Carp," in which the scales are entirely absent.

The Carp was first introduced into the state to stock ponds and lakes, but, escaping from cultivation, has become generally distributed over the state and occurs in streams as well as ponds and lakes. Recorded for the state by Henshall, 1889, in Ross lake and Little Miami river; Lorain County, occasionally taken in the rivers, McCormick, 1892; Maumee river at Toledo (abundant), St. Marys river at Rockford, Tiffin river at West Unity, and west end of Lake Erie (abundant), Kirsch, 1893; Franklin County, "of general distribution throughout the county," Williamson and Osburn, 1897; Knox County, Big Jelloway creek, "very common," Parker, Williamson and Osburn, 1898; very common in Sandusky Bay, R. C. Osburn, 1899; Wheeling creek at Bridgeport, Ohio river at Bellaire, and Licking reservoir, R. C. Osburn, 1900.

*Genus: CARASSIUS.***Carassius auratus** (Linnaeus). GOLDFISH.

The Goldfish may be distinguished from our native Minnows by the very long dorsal fin, preceded by a stout, serrated spine; the anal of 7 rays, with a similar spine. From the Carp it is distinguished by the absence of the barbels about the mouth, and by the teeth, which are 4-4. As in the Carp, cultivation has produced many varieties.

It has escaped from cultivation in some parts of Ohio, and has been reported by Henshall, 1888, as "not rare in the canal basin near Elmwood, Hamilton County.

*Genus: TINCA.***Tinca tinca** (Linnaeus). TENCH.

In the spring of 1898 a freshet carried away the banks of an artificial lake on the grounds of the Ohio State University, at Columbus, and many of the Tench, with which the lake was stocked, escaped into the Olentangy river. In September of the same year specimens were taken at the mouth of the small stream flowing from the lake to the river. Whether the Tench will hold its own in the streams of Ohio yet remains to be seen.

Genus: CAMPOSTOMA.**Campostoma anomalum** (Rafinesque).STONE-ROLLER ;
STEEL-BACKED CHUB ; MAMMY ; DOUGH-BELLY.

This species is most easily distinguished by an examination of the intestine, which is very long and is wound in many convolutions about the air-bladder. This arrangement is peculiar to this genus among all known fishes. Head 4; depth $4\frac{2}{3}$; eye 5 to $5\frac{1}{2}$ in head; D. 8; A. 7; scales 7-48-6; teeth 4-4. Body stoutish. Snout somewhat decurved, mouth inferior. Color brownish, almost black in adult breeding males; sides brassy, irregularly mottled with dark olivaceous or brown; fins usually plain, in breeding males the dorsal is tinged with orange, a black bar through its middle, other fins more or less tinged with orange. Entire dorsum of breeding males covered with tubercles. Young with a dark lateral band extending onto gill covers and between eye and tip of snout. Length 6 to 8 inches.

A very abundant and widely distributed species, generally most abundant in small streams and on ripples of larger ones. First recorded for the state by Kirtland under the name *Exoglossum lesueurianum*; given by Jordan as "extremely abundant in every stream in the state"; Hamilton County, "abundant in every stream explored," Henshall, 1888; Lorain County, "common in most of our streams," McCormick, 1892; Franklin County, "very abundant everywhere," Williamson and Osburn, 1897; Big Jelloway creek system, "apparently the most abundant species," Parker, Williamson and Osburn, 1898; recorded for many places in the Maumee river system (not taken in St. Mary's river) by Kirsch, 1893; Ohio river and Ice creek at Ironton, Huron river at Milan, Ashtabula creek at Ashtabula, Wabash river at Celina, Stillwater and Wolf creeks near Dayton, north fork of Licking river at Newark, R. C. Osburn, 1899; Niggermill Run at Salem, E. B. Williamson, 1900; Cuyahoga river at Kent and Hawkins, Breakneck creek at Kent, Chippewa lake, Summit lake, Grand river at Painesville, Chagrin river at Willoughby, Wheeling creek at Bridgeport, Ohio river and McMahan creek at Bellaire, Licking reservoir, R. C. Osburn, 1900.

*Genus: CHROSOMUS.***Chrosomus erythrogaster** Rafinesque. RED-BELLIED DACE.

Head 4; depth 4; eye $3\frac{1}{2}$. D. 8; A. 8; teeth 5-5; scales 16-85-10. Body rather elongate, the head pointed; mouth small, terminal, somewhat oblique. Lateral line developed backward about as far as the dorsal fin. Color above, brownish; a black vertebral line, bordered on either side by a row of black dots; sides creamy white, bordered above and below with a black band, the lower the wider and extending forward through eye; under parts white, in breeding males entirely suffused with vermilion; fins all bright sulphur yellow, the dorsal with a bright red spot at its base, anteriorly; females and young less brilliantly colored. Length 2 to 3 inches.

The Red-bellied Dace is widely distributed and is generally abundant where found, but it is strictly a "brook species," being confined to small clear streams and spring runs. Recorded for the state by Dr. Kirtland; Lorain County, "I have found them in but one stream, Spring brook," McCormick, 1892; "collected by Prof. Meek in Lost creek, near Defiance," Kirsch, 1893; Franklin County, Grant's Run and Plum Run, tributaries of the Scioto river, in abundance, Williamson and Osburn, 1897; Knox County, Parker's Run, a tributary of Big Jelloway creek, "in considerable numbers," Parker, Williamson and Osburn, 1898; Licking County, occurring in abundance in spring runs tributary to North Fork of Licking river near Newark, R. C. Osburn, 1899; Niggermill Run at Salem, E. B. Williamson, 1900.

*Genus: HYBOGNATHUS.***Hybognathus nuchalis** Agassiz. SILVERY MINNOW.

Head $4\frac{1}{2}$ to 5; depth $4\frac{1}{8}$; eye 4; D. 8; A. 7; teeth 4-4; scales 5-38-4. Body elongate, comparatively slender. Head moderate, the profile evenly curved; upper jaw heavy, lower thin. Scales large and silvery, 12 to 14 in front of dorsal. Lateral line decurved. Intestines very long, 7 to 10 times the length of body. Color olivaceous green above, translucent in life; sides clear silvery; fins plain. Length 4 to 7 inches.

This species seems to be confined to the southwestern part of the state. Jordan, in his Ohio Report, gives it as abundant in small streams flowing into the Ohio river, but Dr. Henshall records it for only White Oak creek and the Ohio river, and in my work at Ironton and Bellaire I failed to find it. This species is not mentioned by any other collector.

Genus: PIMEPHALES.*Key to Species.*

- A. Lateral line more or less incomplete; body very short and stout.— *promelas.*
 AA. Lateral line complete; body moderately elongate.— *notatus.*

Pimephales promelas Rafinesque. FAT-HEAD.

Head 4; depth $3\frac{3}{4}$ to 4; eye 4. D. I, 7; A. 7; scales 7 or 8-43 to 47-5 or 6. Body very short and deep. Head short, everywhere convex, almost globular in adult males. Scales deep, closely imbricated; lateral line incomplete. Color dark olivaceous above, paler below; a dark lateral band and caudal spot; dorsal fin with a dusky shade through it at the middle. Breeding males with the head nearly black, with tubercles on snout and lower jaw. Length $2\frac{1}{2}$ inches.

Recorded by Kirtland. Given by Jordan as most abundant in small streams flowing into the Ohio; Hamilton County, "very abundant everywhere," Henshall, 1888; Lorain County, "not common, but found in most of the streams," McCormick, 1892; Maumee river at Cecil, Lost and Gordon creeks near Cecil, Sugar creek at Lima, Kirsch, 1893; Knox County, Big Jelloway creek, rare, Parker, Williamson and Osburn, 1898; Ohio river at Iron-ton, Wabash river at Celina, Stillwater and Wolf creeks near Dayton, R. C. Osburn, 1899; Niggermill Run at Salem, E. B. Williamson, 1900; Pippin lake, Cuyahoga river at Hawkins, Ohio river at Bellaire, R. C. Osburn, 1900.

Pimephales notatus (Rafinesque). BLUNT-NOSED MINNOW.

Head $4\frac{1}{2}$; depth $4\frac{1}{2}$ to 5; eye 4. D. I, 7 or 8; A. 7; scales 6-45-4, 22 in front of dorsal, much crowded and irregularly arranged anteriorly. Body rather elongate. Head moderate, the snout very blunt and convex; top of head depressed; mouth small, inferior, horizontal. Color olivaceous, sometimes very dark; a black spot at base of dorsal fin in front. Males in breeding season with the head black or nearly so, and with about 16 large tubercles on the snout. Length 4 inches.

This species is much more abundant than the preceding. "Swarms in all the streams of the state," Jordan; Hamilton County, "the most abundant minnow," Henshall, 1888; Lorain County, "very abundant in small streams," McCormick, 1892; Kirsch records it for every stream of the Maumee river system explored in Ohio; Franklin County, "our most abundant minnow,

in great numbers in every stream," Williamson and Osburn, 1897; Knox County, abundant in every stream of the Big Jelloway creek system, Parker, Williamson and Osburn, 1898; Ohio river and Ice creek at Ironton, Huron river at Milan, Sandusky Bay, Ashtabula creek at Ashtabula, Wabash river at Celina, Stillwater and Wolf creeks near Dayton, North Fork of Licking river near Newark, R. C. Osburn, 1899; Niggermill Run at Salem, Mahoning river, E. B. Williamson, 1900; Pippin lake, Chippewa lake, Summit lake, Cuyahoga river at Kent and Hawkins, Breakneck creek at Kent, Grand river at Painesville, Chagrin river at Willoughby, Wheeling creek at Bridgeport, Ohio river and McMahan's creek at Bellaire, Licking reservoir, R. C. Osburn, 1900.

Genus: SEMOTILUS.

Semotilus atromaculatus (Mitchill). HORNED DACE; CHUB.

Head $3\frac{3}{4}$; depth 4; eye 5 to $5\frac{1}{2}$. D. 7; A. 8; scales 9-55 to 60-6, about 30 in front of dorsal; teeth 2, 5-4, 2. Head large and heavy, broad and rounded above; snout broad; mouth broad, oblique; a small barbel on the maxillary some distance above its posterior end, not evident in young specimens. Body stout, arched in front of dorsal. Dorsal inserted behind ventrals. Color dusky olivaceous or bluish above, paler below; sides with a brassy luster; an indistinct lateral band and caudal spot (these markings distinct in young). Dorsal with a black spot at its base anteriorly. Sides of head and lower fins rosy in breeding males. These have also the snout covered with tubercles. Length 10 inches.

A widely distributed species, occurring abundantly in brooks throughout the state, less commonly in the larger streams, and rarely in lakes. In seining up stream the increase in number of individuals of this species as the headwaters are approached is very noticeable. Kirtland, following Rafinesque, recorded it for the state as two species, *S. dorsalis* and *S. cephalus*. Both are synonyms of *S. atromaculatus*. Hamilton County, "abundant in all streams," Henshall, 1888; Lorain County, "abundant in most of the streams," McCormick, 1892; "generally distributed throughout the Maumee river basin," Kirsch, 1893; Franklin County, abundant in all streams, Williamson and Osburn, 1897; Knox County, Big Jelloway creek system, Parker, Williamson

and Osburn, 1898; Ice creek at Ironton, John's creek at Waterloo, Huron river at Milan, Ashtabula creek at Ashtabula, Wabash river at Celina, Stillwater and Wolf creeks near Dayton, North Fork of Licking river at Newark, R. C. Osburn, 1899; Niggermill Run at Salem, Mahoning river, E. B. Williamson, 1900; Sandusky Bay, Cuyahoga river at Kent and Hawkins, Breakneck creek at Kent, Chippewa lake, Grand river at Painesville, Chagrin river at Willoughby, R. C. Osburn, 1900.

Genus: LEUCISCUS.

Leuciscus elongatus (Kirtland). RED-SIDED DACE.

Head 4; depth 5; eye 4 to $4\frac{1}{3}$. D. 8; A. 9; scales 10-70-5; teeth 2, 5-4, 2. Body elongate, compressed; head long, pointed; mouth very large, oblique, the maxillary extending to middle of orbit; lower jaw projecting, with a small knob at its symphysis. Color above varying from a dark bluish to greenish, sides somewhat paler and mottled; a dark vertebral line; along the side is a broad band, bright blood red anteriorly, black posteriorly, the two colors shading into each other imperceptibly at about middle of body; above this band is a narrow brassy band; belly silvery white. In breeding males the belly and lower fins are tinged with rosy; in females and young the bright colors are subdued or wanting. Length 5 inches.

The Red-sided Shiner is certainly one of the most elegant of fishes. It is, generally speaking, a brook species, inhabiting clear deep pools of brooks and spring runs, though Dr. Kirtland, who described the species, records it for Lake Erie. It is found in the tributaries of the Ohio and of the Lake, but has not been noticed in the western part of the state. Mahoning river in Trumbull County, and Lake Erie near Cleveland, Kirtland; Lorain County, "common in Spring brook, but not found elsewhere," McCormick, 1892; Knox County, Little Jelloway creek, Black Run, Parker's Run, Joe Sapp Run, Shadly Run and Doudy creek, tributaries of Big Jelloway creek, common, Parker, Williamson and Osburn, 1898; Wilson's Run, a small tributary of the North Fork of Licking river near Newark, R. C. Osburn, 1899; Niggermill Run at Salem, E. B. Williamson, 1900; a small tributary of the Grand river at Painesville, R. C. Osburn, 1900.

*Genus: OPSOPŒODUS.**Key to Species.*

- A. Lateral line complete or very nearly so; dorsal fin with black blotch on anterior rays, usually none on the posterior.— *emiliæ.*
- AA. Lateral line always incomplete; dorsal usually with a conspicuous black spot on posterior rays.— *megalops.*

Opsopœodus emiliæ Hay.

Head about $4\frac{1}{2}$; depth $4\frac{3}{8}$; eye 3. D. 9; A. 8; scales 5-40-3; teeth 5-5, very slender, strongly hooked, and deeply serrate. Body rather elongate, moderately compressed, not elevated. Head short and slender. Muzzle blunt and rounded. Mouth very small and very oblique, smaller than in any other of our *Cyprinidæ*, with scarcely any lateral cleft. Caudal peduncle long and slender, caudal deeply forked. Breast naked; 16 scales before dorsal. Lateral line complete or very nearly so. Yellowish; sides silvery; scales above dark edged; usually a dark lateral band from snout to caudal, above and below which are series of black dots; anterior rays of dorsal dark, no black spot on the posterior rays.

Given by Jordan and Evermann (Bull. 47) for Lake Erie; "two small specimens from the St. Mary's river at St. Mary's," Kirsch, 1893.

Opsopœodus megalops (Forbes).

Head $4\frac{3}{4}$; depth 4 to 5; eye $2\frac{3}{4}$. D. 7 or 8; A. 7 or 8; scales 5-39-4, 15 before dorsal. Teeth 5-5, hooked and crenate. Lateral line always incomplete, sometimes on 4 or 5 scales only; sometimes extending with interruptions to middle of caudal peduncle. Body slender, fusiform; mouth small, terminal, oblique, so much so in old specimens as to appear almost vertical, the chin projecting beyond mouth, in younger specimens the mouth is less oblique. Top of head covered with prickles in old males. Fins large, caudal deeply forked. Breast partly naked. Yellowish brown, sides silvery; scales above dark-edged. Dorsal fin with a black blotch on 4 anterior rays; a second black blotch usually present on 3 posterior rays. Length $2\frac{1}{3}$ inches.

I have given above the separation of *O. emiliæ* and *O. megalops* as given by Jordan and Evermann (Bull. 47, U. S. Natl. Mus.) They suggest in regard to *O. megalops* that it is "perhaps not a distinct species." A comparative study of these forms confirms this belief. A dozen specimens taken by the writer in the headwaters of the Wabash river at Celina, August, 1899, and two from Summit lake at Akron, July 30, 1900, are referable to *O. megalops* as given above, but so many variations between

O. emilia and *megalops* exist among these specimens that it is possible to establish a graduated series between the two species, and none of the characters given in the above separation are found to be constant. The lateral line in some cases ceases in front of the dorsal fin, and in others is continuous to within two or three scales of the caudal. The second dorsal spot is also subject to great variation, for, while in old males it is distinct, in some cases it is very indistinct or wanting altogether. The fin formulæ and squamation of the breast also vary. Recently, through the kindness of Dr. S. E. Meek, I have been permitted to examine specimens of *O. emilia* from Indian Territory, Arkansas and Illinois, in the Field Columbian Museum at Chicago. These specimens show much the same variation as that given for *O. megalops*. As I have had no opportunity to compare with the type specimens, I hesitate to reduce *O. megalops* to synonymy, although the two species, as determined by Dr. Meek and myself, undoubtedly intergrade.

Genus: ABRAMIS.

Abramis crysoleucas (Mitchill). GOLDEN SHINER;
GOLDEN BREAM; ROACH.

Head $4\frac{1}{2}$; depth 3. D. 8; A. 13; scales 10-46 to 55-3; teeth 5-5. Body strongly compressed, the belly behind ventrals compressed into a sharp keel, over which the scales do not pass. Color, greenish above, the sides silvery, with bright golden reflections. Length about a foot.

The Golden Bream is an abundant resident of the state in suitable localities, being found chiefly in ponds, quiet pools and weedy bayous, apparently more common in the northern part of the state. Given by Rafinesque under the name *Notemigonus auratus* for the Ohio and Miami rivers; recorded by Kirtland under the name *Rutulus crysoleucas*; given by Jordan as "extremely abundant in every pond, lake or bayou"; Hamilton County, "common in Bloody Run and Clear creek," Henshall, 1888; Lorain County, "very common in still waters," McCormick, 1892; Maumee river at Cecil, Grand Rapids, Waterville and Toledo, St. Mary's river at St. Mary's and Rockford, Tiffin river at West Unity, Auglaize river at Oakwood and Defiance, Sugar creek and Lost creek at Lima, Blanchard river at Findlay,

Kirsch, 1893; Franklin County, Scioto river, Scioto Big Run, Big Walnut creek, Mason's Run, Big Darby creek, Hell Branch, Williamson and Osburn, 1897; Knox County, Big Jelloway creek, Parker, Williamson and Osburn, 1898; Sandusky Bay, Ashtabula creek at Ashtabula, Wabash river at Celina, R. C. Osburn, 1899; Niggermill Run at Salem, E. B. Williamson, 1900; Chippewa lake, Licking reservoir, R. C. Osburn, 1900.

Genus: CLIOLA.

Cliola vigilax (Baird and Girard).

Head $4\frac{1}{4}$; depth $4\frac{1}{2}$; eye $3\frac{1}{2}$. D. 8; A. 7; scales 8-42-6, about 28 before dorsal; teeth 4-4, with grinding surface and slight hook. Superficially, much resembling *Pimephales notatus*, but the form is more stout, the mouth more terminal, and the alimentary canal less than twice the length of the body. Caudal peduncle quite deep. Color, greenish, sides pale, darker above, the scales above dark-edged; a dark lateral band ending in a distinct caudal spot; a well defined black spot on anterior rays of dorsal. Length 3 inches.

This minnow has, to the best of my knowledge, been recorded from but two localities in the state. It has been taken by Henshall in Hamilton County, "common in O'Bannon creek," and a single specimen was taken in Big Walnut creek, Franklin County, by Mr. E. B. Williamson and the writer in 1897. It is probably common nowhere in the state except in the southwestern part, as its range is for the most part farther south and west.

Genus: NOTROPIS.

Key to Species.

- A. Teeth 4-4, 1, 4-4, 0, or 1, 4-4, 1 (sometimes 2 teeth in one or both inner rows in *N. hudsonius* and *N. heterodon*).
- B. Scales not very closely imbricated, not notably deeper than long; dorsal inserted nearly over the ventrals; no black spot on dorsal fin.
- C. Teeth one-rowed, 4-4 (sometimes 2, 4-4, 2 in *N. heterodon*).
- D. Lateral line usually more or less incomplete; small species, usually with a dusky lateral band.
- E. Mouth very small, chin pale.— *cayuga*.
- EE. Mouth moderate; chin black.— *heterodon*.
- DD. Lateral line always complete; small, weak species.
- F. Fins all small and low, pectorals not reaching ventrals.— *blennius*.
- FF. Fins high, pectorals reaching ventrals.— *volucellus*.
- CC. Teeth two-rowed, 1, 4-4, 0; 1, 4-4, 1; or 1, 4-4, 2, the grinding surface more or less developed.
- G. No distinct dark spot at base of caudal.— *shumardi*.
- GG. A distinct dark spot present at base of caudal fin.— *hudsonius*.
- BB. Scales deeper than long, closely imbricated along side of body. Usually a distinct black spot on last rays of dorsal.— *whippitii*.
- AA. Teeth 2, 4-4, 2 (2, 4-4, 1 in *N. jejunus*).
- H. Anal fin short, of 7 to 9 developed rays.
- I. Teeth with the grinding surface developed.
- J. Scales closely imbricated along the sides, no dark spot at base of caudal.— *cornutus*.
- JJ. Scales not closely imbricated, a dark spot at base of caudal at least in young.
- K. 13 scales before dorsal fin.— *heterodon*.
- KK. 18 scales before dorsal.— *hudsonius*.
- II. Teeth without evident grinding surface, scales not closely imbricated.
- L. Eye very large, $2\frac{3}{8}$ in head; teeth 2, 4-4, 2.— *ariommus*.
- LL. Eye $3\frac{3}{4}$ in head, teeth 2, 4-4, 1.— *jejunus*.
- HH. Anal fin long, of 11 or 12 rays; dorsal inserted behind ventrals.
- M. Scales not closely imbricated on sides, not crowded anteriorly.
- N. Eye very large, $2\frac{3}{4}$ to 3.— *arge*.
- NN. Eye smaller, $3\frac{1}{4}$ to 4.
- O. Front of dorsal midway between snout and base of caudal fin; eye $3\frac{1}{4}$ — *atherinoides*.
- OO. Front of dorsal nearer to base of caudal than to snout; eye 4.— *rubrifrons*.
- MM. Scales small and crowded anteriorly, closely imbricated; a black spot at base of caudal.— *umbratilis*.

Notropis cayuga Meek.

Head 4 or a little over; depth $4\frac{1}{2}$; eye $3\frac{1}{2}$. D. 8; A. 8; scales in lateral line about 36, 14 before dorsal; teeth 4-4. Close to *N. heterodon*, from which it can be distinguished most readily by the absence of any black on the chin. Lateral line wanting on some scales. Jaws nearly equal. A black band along lateral line, continued forward along sides of head and around snout on upper jaw. Length $2\frac{1}{2}$ inches.

First recorded for the state by Kirsch, 1893, "a few specimens from the Maumee river at Toledo"; Franklin County, "rare in Big Walnut and Little Darby creeks, common in Mason's Run," Williamson and Osburn, 1897; Sandusky Bay and Ashtabula creek at Ashtabula, common in both places, R. C. Osburn, 1899. This species seems to have been overlooked or confused with some other species by the earlier investigators, as its occurrence in both the Lake and Ohio river drainage at the points above noted would indicate a pretty general distribution over the state in suitable localities.

* **Notropis heterodon** (Cope).

Head 4; depth 4; eye 3, longer than snout. D. 8; A. 8; scales 5-36-3, 13 in front of dorsal. The lateral line incomplete, extending usually about to dorsal fin, but varying greatly; teeth 4-4 (sometimes 2, 4-4, 2). Body moderate; the back slightly elevated, dorsal inserted nearer the snout than base of caudal. Coloration olivaceous, darker on the back; a distinct lateral band, which passes forward through eye and on both jaws; chin distinctly black. Said to be an exceedingly variable species.

Taken by the writer in Sandusky Bay, July, 1899, and again in Sandusky Bay at Cedar Point and Black Channel, 1900.

Notropis blennioides (Girard). STRAW-COLORED MINNOW.

D. 8; A. 8; scales 5-36-4, 14 in front of dorsal; teeth 4-4. Head 4; depth 4 to 5; eye large, 3 in head. Body moderately stout, but little compressed. Head rather broad; mouth small, inferior, horizontal. Lateral line complete. Dorsal fin low, its longest ray $\frac{3}{4}$ of head. Coloration, pale or yellowish olive; sometimes with a dark lateral band, and edges of mouth dark. Length $2\frac{1}{2}$ inches. An exceedingly variable Minnow.

This insignificant looking species occurs widely and abundantly throughout the state and has been recorded by all the recent writers upon the fishes of the state, beginning with Jordan (Ohio Rept.), under various names—*N. blennioides*, *N. deliciosus* and *N. stramineus*. Hamilton County, "abundant in Little Miami river and Clough creek," Henshall, 1888; Lorain County, given as two species, *N. deliciosus*, very abundant in all the streams, and *N. stramineus*, not common, McCormick, 1892; Maumee river at

* *Notropis anogenus* Forbes and *N. fretensis* (Cope), two small species closely resembling *N. heterodon* and *N. cayuga*, respectively, have been taken almost on our borders in streams flowing into the state. They may be looked for in north-western Ohio. *N. anogenus* may be known from *N. heterodon* by the usually complete lateral line and the included lower jaw. *N. fretensis* is separated from *N. cayuga* (with which it is perhaps identical), by the complete lateral line and the presence of 17 scales in front of the dorsal.

Antwerp, Cecil, Defiance and Waterville, Tiffin river at Brunersburg, Auglaize river at Cloverdale, Sugar creek at Lima, Blanchard river at Ottawa, Beaver creek at Grand Rapids, Kirsch, 1893; Franklin County, common in almost every stream, females with eggs, July 16, Williamson and Osburn, 1897; Knox County, Big Jelloway creek system, "abundant, females with ripe eggs on May 25," Parker, Williamson and Osburn, 1898; Ice creek at Ironton, John's creek at Waterloo, Huron river at Milan, Sandusky Bay, Ashtabula creek at Ashtabula, Wabash river at Celina, Stillwater and Wolf creeks near Dayton, North Fork of Licking river at Newark, abundant in most places, R. C. Osburn, 1899; Pippin lake, Cuyahoga river at Hawkins, Grand river at Painesville, Chagrin river at Willoughby, Wheeling creek at Bridgeport, Ohio river and McMahan's Run at Bellaire, Licking reservoir, R. C. Osburn, 1900.

Notropis volucellus (Cope).

Head $3\frac{3}{4}$; depth 4; eye $3\frac{1}{3}$. D. 8; A. 8; scales 4-34-3; teeth 4-4. Fins more elongate than in related species, the pectorals reaching ventrals. Very similar to *N. blennioides*, but distinguished especially by the noticeably higher fins. Length $2\frac{1}{2}$ inches.

The only record I am able to find of the occurrence of this species in Ohio is that given by Kirsch in his "Report upon Investigations in the Maumee River System," in which he mentions the fact that specimens from Gordon creek, taken by Prof. S. E. Meek, are given him as *Notropis deliciosus* var. *volucella* Cope. Cope's *volucellus* is now regarded as a distinct species.

Notropis shumardi (Girard).

Head $3\frac{3}{4}$; depth $4\frac{1}{3}$; eye very large, $2\frac{1}{3}$ to 3 in head. D. 8; A. 7 or 8; scales 4 or 5-36-2 to 4, 13 in front of dorsal; teeth 1, 4-4, 1, with deep grinding surface, and the edge strongly crenate. Body compressed, the back elevated; tail slender. Head compressed, flattened above, below and on the sides; snout short, obtuse; mouth very oblique, terminal, lower jaw included. Fins large. Lateral line complete, decurved. Color, olivaceous above, pale below; a dark lateral band, and vertebral line; scales above dark-edged. Length 3 inches.

Recorded by Kirsch as *N. boops* Gilbert, "common in the Maumee river at Grand Rapids," and "five specimens from the

Blanchard river at Findlay," 1893. Rare in Big Walnut creek, Franklin County, Williamson and Osburn, 1897; a single specimen from Stillwater creek near Dayton, R. C. Osburn, 1899.

Notropis hudsonius (De Witt Clinton). SPOT-TAILED MINNOW;
SHINER.

Head $4\frac{3}{4}$; depth 4; eye 3. D. 8; A. 8; scales 5-39-4, 18 before dorsal; teeth 1, 4-4, 0 or 1 or 2. Body elongate, considerably compressed in adult. Head short; muzzle blunt, decurved, shorter than the very large eye; mouth moderate, nearly horizontal, jaws sub-equal. Lateral line nearly straight, slightly decurved anteriorly. Coloration very pale, with a broad silvery band along side, this frequently overlaid with a dusky band. A dark spot at base of caudal, most distinct in young. Length 4 to 6 inches.

This species is apparently confined to the most northern portions of the state, in Lake Erie and its larger tributaries. Lorain County, "common in the lake and at the mouth of the rivers," McCormick, 1892; "very common in the Maumee river at Grand Rapids, a single specimen at Toledo," Kirsch, 1893; Lake Erie near Sandusky, abundant, R. C. Osburn, 1900; Sandusky Bay, Morse and Herbert T. Osborn, 1900.

Notropis whipplii (Girard). SILVER-FIN.

Head $4\frac{1}{4}$; depth 4 in adult males, females and young much slenderer; eye $4\frac{1}{2}$. D. 8; A. 8 or 9; scales 5 or 6-38 to 40-3 or 4; teeth 1, 4-4, 1. Body moderately elongate, compressed, the back and belly about equally arched. Head rather short and deep. Scales closely imbricated (much higher than wide) and of a very regular pattern, about 18 in front of dorsal. Color leaden or steel-blue, the sides silvery; a dark vertebral line; a black spot covering the posterior 3 membranes of the dorsal fin, this sometimes very much reduced in young and females, but always present. Breeding males have the fins tipped with creamy white, and the top of head and dorsal region in front covered with small prickles. Length 4 inches.

This elegant little fish is widely distributed throughout the state, and is usually quite common in all suitable localities. Recorded by Kirtland under the name *Luxilus kentukiensis*. Given by Jordan in his Ohio Report under the name *Hudsonius analostanus*, which he here confuses with *N. whipplii*. *Notropis* (*Hudsonius*) *analostanus* is an eastern form, possibly not specifically distinct from *N. whipplii* (see Jordan and Evermann, Bull. 47, U. S. Natl. Mus.) Hamilton County, common in all streams explored, Henshall, 1888; Lorain County, all streams examined,

but not very common, McCormick, 1892; taken throughout the Maumee river basin in Ohio, except in Gordon creek and the west end of Lake Erie, Kirsch, 1893; Franklin County, occurs abundantly in all the larger streams, females with ripe eggs June 28, Williamson and Osburn, 1897; Knox County, Big Jelloway creek and tributaries, not rare, Parker, Williamson and Osburn, 1898; Ohio river at Ironton, Huron river at Milan, Sandusky Bay, Ash-tabula creek at Ashtabula, Wabash river at Celina, Stillwater and Wolf creeks near Dayton, North Fork of Licking river at Newark, R. C. Osburn, 1899; Mahoning river, E. B. Williamson, 1900; Cuyahoga river at Hawkins, Chippewa lake, Grand river at Painesville, Chagrin river at Willoughby, Wheeling creek at Bridgeport, Ohio river and McMahan's Run at Bellaire, Licking reservoir, R. C. Osburn, 1900.

Notropis cornutus (Mitchill). COMMON SHINER; SILVERSIDES.

Head $3\frac{1}{4}$ to $4\frac{1}{4}$; depth about 3 ($2\frac{3}{4}$ to $3\frac{1}{2}$); eye $4-5\frac{3}{4}$. D. 8; A. 9; scales 6-41-3 or 4, closely imbricated, 18 or 20 before dorsal; teeth 2, 4-4, 2, with narrow grinding surface. Body varying much with age, in young slender, in adult short, deep and compressed. Lateral line decurved. Color above, dark olive green to steel-blue, sides silvery, with a brassy lateral band; a brassy vertebral line (this color showing only in fresh specimens, sometimes appearing as a dark line when out of water). Fins all plain, rosy tipped in breeding males. Females and young plainer. One of the most variable of our Minnows, varying with age, sex and season. Length about 10 inches.

One of the most abundant of fishes all over the state. Given by Kirtland as *Rutulus compressus* and *Luxulus chrysocephalus*; by Jordan as *Luxulus cornutus*. Hamilton County, as *Notropis megalops*, "abundant everywhere," Henshall, 1888; Lorain County, "very common everywhere," McCormick, 1892; Maumee river system, "every stream," Kirsch, 1893; Franklin County, "taken in every stream, generally abundant, females with eggs on July 6," Williamson and Osburn, 1897; Knox County, taken in every stream of the Big Jelloway creek system, Parker, Williamson and Osburn, 1898; Ohio river and Ice creek at Ironton, John's creek at Waterloo, Huron river at Milan, Sandusky Bay, Ashtabula creek, Wabash river at Celina, Stillwater and Wolf creeks at Dayton, and North Fork of Licking river at

Newark, R. C. Osburn, 1899; Niggermill Run and Mahoning river, E. B. Williamson, 1900; Cuyahoga river at Kent and Hawkins, Breakneck creek at Kent, Summit lake, Chippewa lake, Licking reservoir, Grand river at Painesville, Chagrin river at Willoughby, Wheeling creek at Bridgeport, Ohio river and McMahan's creek at Bellaire, R. C. Osburn, 1900.

Notropis ariommus (Cope).

Head $3\frac{3}{4}$ to $4\frac{1}{4}$; depth $4\frac{1}{4}$ to 5. D. 8; A. 9; scales 6-39-2, large, 15 before dorsal; teeth 2, 4-4, 2. Body stout, moderately elevated, somewhat compressed. Head heavy, broad above; snout moderate, somewhat decurved; mouth moderate, oblique, jaws equal. Eye very large, $2\frac{3}{8}$ in head, much longer than snout, larger than in any other Ohio *Cyprinid*. Lateral line much decurved. Color olivaceous, scales above dark-edged; sides and below bright silvery. Length 5 inches.

Two specimens from the Maumee river at Antwerp, Kirsch, 1893.

* **Notropis jejunos** (Forbes).

Head 4; depth $4\frac{2}{3}$; eye $3\frac{2}{3}$ in head, equal to snout, less than inter-orbital space. D. 8; A. 7; scales 5-37-3; teeth 2, 4-4, 1. Body moderately slender; head flattish above; snout blunt and rounded. Dorsal over ventrals; about 16 scales before dorsal. Color, pale olivaceous above, pale on sides and below, with a broad silvery band overlying a plumbeous shade. Length 3 inches.

The range of this species in the state seems to be limited to the Ohio river and the lower portions of its tributaries. Hamilton County, "common in Little Miami river and Bloody Run, Henshall, 1888; common in the Ohio river and Ice creek at Ironton and in John's creek at Waterloo, R. C. Osburn, 1899.

Notropis atherinoides Rafinesque.

Head $4\frac{2}{3}$; depth $5\frac{1}{2}$; eye $3\frac{1}{4}$. D. 8; A. 11; scales 5-38-3, 15 before dorsal; teeth 2, 4-4, 2. Body long and slender, compressed, back not elevated. Head blunt, conic, shorter than in related species. Mouth moderate, very oblique, upper lip on a level with upper part of pupil. Eye large, rather longer than snout. Fins low, front of dorsal midway between point of snout and base of caudal. Lateral line decurved. Color above clear, translucent olive-green, a yellow, iridescent vertebral line in life, which becomes darker in spirits; sides bright silvery, with sometimes a brassy lateral shade; breeding males with snout rosy. Length 4 to 6 inches.

* *Notropis scabriceps*, given by Jordan in the Ohio Rept., is confused probably with *N. shumardi*. *N. scabriceps* has not been noticed outside of the Kanawha river. (See Bull. 47, U. S. Natl. Mus.)

An elegant and graceful species, common and widely distributed, found in all larger streams, usually on gravelly or sandy bottom, and in lakes under the same conditions. Recorded for the state by Kirtland as *Minnilus dinemus*. "Exceedingly common in Lake Erie, and throughout the state one of the most abundant of minnows," Jordan (Ohio Rept.); Hamilton County, "common in Clough creek," Henshall, 1888; Lorain County, "very abundant at times," McCormick, 1892; Maumee river at Cecil, Grand Rapids and Toledo, St. Joseph river at Edgerton, Tiffin river at Brunersburg, Auglaize river at Wapakoneta and Cloverdale, "not common at any of these places," Kirsch, 1893; Franklin County, common in all of the larger streams, Williamson and Osburn, 1897; Knox County, "abundant in Big Jelloway creek," Parker, Williamson and Osburn, 1898; Ohio river at Ironton, Sandusky Bay, Lake Erie at Sandusky, Ashtabula creek, Wabash river at Celina, Stillwater creek at Dayton, North Fork of Licking river at Newark, R. C. Osburn, 1899; Cuyahoga river at Hawkins, Grand river at Painesville, Chagrin river at Willoughby, Wheeling creek at Bridgeport, Ohio river and McMahan creek at Bellaire, Licking reservoir, R. C. Osburn, 1900.

Notropis arge (Cope).

Head $4\frac{1}{4}$; depth 6; eye $2\frac{3}{4}$ to 3. D. 8; A. 11; scales 5-39-3. Close to *N. atherinoides*, but the eye very large, longer than snout; lateral line nearly straight, head large, the snout not very blunt; mouth large, chin projecting. Color pale-greenish olive; a dark vertebral line; belly and sides pale; a broad, silvery lateral band bounded by a dark line. Length $3\frac{1}{2}$ inches. "Apparently varying into *N. atherinoides*, hence of doubtful validity."

This species has been taken at such points in the state as to indicate a wide distribution, but it is not generally common. Hamilton County, "common in east fork of Mill creek," Henshall, 1888; Lorain County, "in company with *N. atherinoides*, but not nearly as common," McCormick, 1892; Maumee river at Grand Rapids, St. Joseph river at Edgerton, Tiffin river at Brunersburg, scarce, Kirsch, 1893; Cuyahoga river at Hawkins, rare, R. C. Osburn, June 25, 1900.

Notropis rubrifrons (Cope).

Head 4 to 5' depth $4\frac{3}{4}$ to $5\frac{1}{2}$. D. 8; A. 10; scales 5 or 6-39 or 40-3, 15 to 17 before dorsal (Ohio specimens run a little higher, some having as high as 20 before the dorsal); teeth 2, 4-4, 2. Body moderately elongate, back scarcely elevated, head conic and rather pointed. Eye moderate, usually shorter than snout. Resembling *N. atherinoides*, from which it can be readily told, in Ohio specimens at least, by the position of the dorsal fin, which is inserted nearer to base of caudal than to point of snout. Above clear olive, each scale dark-edged; sides and under parts silvery; a narrow, coppery lateral band in life, overlying dark pigment; a narrow vertebral line; a row of black dots on either side of anal fin. Males in spring with head and anterior parts reddish, and sometimes the bases of dorsal, ventral and pectoral fins red. Length $2\frac{3}{4}$ inches.

A common and widely distributed species, found in company with *N. atherinoides*, but much more common. Kirsch and McCormick record it under the name *N. dilectus* (Girard), but *N. dilectus*, as now restricted, is found farther southwest, so I include these records under *N. rubrifrons*. Possibly the two may not be distinct. Given by Jordan as abundant in southern Ohio; Hamilton County, "common in east fork of Mill creek," Henshall, 1888; Lorain County, "common in the lake and lower parts of all streams entering it," McCormick, 1892; St. Joseph river at Edgerton, Blanchard river at Findlay, Beaver creek at Grand Rapids, "common at these places," Kirsch, 1893; Franklin County, "all larger streams with *N. atherinoides*, abundant where found," Williamson and Osburn, 1897; Knox County, Big Jelloway creek and several of its tributaries, occasionally observed in large schools over clear, gravelly places in ripples, females with ripe eggs on May 24, Parker, Williamson and Osburn, 1898; Ohio river at Ironton, Huron river at Milan, Sandusky Bay, Lake Erie at Sandusky, Ashtabula creek, Wabash river at Celina, Stillwater and Wolf creeks at Dayton, North Fork of Licking river at Newark, R. C. Osburn, 1899; Niggermill Run and Mahoning river, E. B. Williamson, 1900; Cuyahoga river at Kent and Hawkins, Grand river at Painesville, Chagrin river at Willoughby, Wheeling creek at Bridgeport, Ohio river and McMahan's Run at Bellaire, outlet of Licking reservoir, R. C. Osburn, 1900.

Notropis umbratilis lythrurus (Jordan). REDFIN.

D. 7; A. 11; teeth 2, 4-4, 2; scales 9-45-3, crowded anteriorly. Head pointed, about 4 in length; body moderately elongated, compressed, depth 4 to 5. Eye $3\frac{1}{2}$. Color bright steel-blue above; pale below. Dorsal fin with a conspicuous black spot at base in front. Breeding males have the lower fins bright red. Females and young paler. Length 3 inches.

An exceedingly handsome species, especially during the breeding season. Widely distributed and generally common. Recorded for the state by Kirtland as *Semotilus diplema*. Jordan gives it under the name *Lythrurus diploemius* as "abundant throughout the state, especially in the southern part"; Henshall, Kirsch and McCormick record it under the name *N. ardens*; "abundant in all streams examined," in Hamilton County, Henshall, 1888; "found at all points explored in Maumee river system in Ohio except Maumee river at Cecil and Toledo, St. Joseph river at Edgerton and St. Mary's river at Rockford, Kirsch, 1893; Lorain County, "not very common, Black river and Vermillion river near Kipton," McCormick, 1892; Franklin County, "all-streams but the smallest, abundant," June 15 given as a breeding date, Williamson and Osburn, 1897; Ice creek at Ironton, Huron river at Milan, Ashtabula creek at Ashtabula, Wabash river at Celina, Stillwater and Wolf creeks at Dayton, North Fork of Licking river at Newark; exceedingly abundant in a small tributary of Ashtabula creek, in company with *Abramis crysoleucas*, R. C. Osburn, 1899; Niggermill Run at Salem, E. B. Williamson, 1900; Breakneck creek near Kent, Grand river at Painesville, Chagrin river at Willoughby, Wheeling creek at Bridgeport, Ohio river and McMahan creek at Bellaire, R. C. Osburn, 1900.

Genus: ERICYMBA.**Ericymba buccata** (Cope). SILVERY-JAWED MINNOW.

Head $8\frac{1}{2}$ to 4; depth $4\frac{1}{2}$ to 5; eye 4 to $4\frac{1}{2}$. D. 8; A. 7; scales 4 or 5-34-3, about 15 in front of dorsal; teeth 1, 4-4, 1 or 1, 4-4, 0, the inner slender and without grinding surface. Body rather elongate, little compressed, back not elevated. Head long, depressed above, with broad and prominent muzzle. Mouth small, horizontal, sub-inferior, lower jaw the shorter. Interopercle, suborbital and dentary bones containing mucous cavities,

which are visible externally. Color olivaceous above, pale and silvery on sides and below; a dark vertebral line and sometimes an indistinct, dark lateral band. Fins all plain. Length 3 to 5 inches.

Distributed throughout the state, a very common species, less abundant in the lake than in the Ohio river drainage. "Abundant in most streams tributary to the Ohio," Jordan's Report; Hamilton County, "abundant in Little Miami river and tributaries," Henshall, 1888; Lorain County, "taken once in Black river," McCormick, 1892; the Maumee river system in Ohio except at the following places: Maumee river at Cecil, Tiffin river at West Unity and Brunersburg, Auglaize river at Wapakoneta and Lost creek at Lima, Kirsch, 1893; Franklin County, every stream, generally abundant, June 15 given as a breeding date, Williamson and Osburn, 1897; Big Jelloway creek system, Knox County, "taken in every stream, abundant," Parker, Williamson and Osburn, 1898; Ohio river and Ice creek at Ironton, Huron river at Milan, Wabash river at Celina, Stillwater and Wolf creeks at Dayton, North Fork of Licking river at Newark, R. C. Osburn, 1899; Niggermill Run and Mahoning river, E. B. Williamson, 1900; Cuyahoga river at Hawkins, Chippewa lake, Grand river at Painesville, Chagrin river at Willoughby, Wheeling creek at Bridgeport, Ohio river and McMahan's Run at Bellaire, Licking reservoir, R. C. Osburn, 1900.

Genus: RHINICHTHYS.

Key to Species.

- A. Snout long and prominent, projecting much beyond the mouth, barbel evident, no distinct, black lateral band.— *cataractæ.*
 AA. Snout shorter, little projecting, barbel small, but always present; a distinct, black lateral band.— *atronasus.*

Rhinichthys cataractæ (Cuvier and Valenciennes).

LONG-NOSED DACE.

Head 4; depth 5; eye 2 in snout, 5 in head. D. 8; A. 7; scales small, 14-65-8; teeth 2, 4-4, 2. Resembling *R. atronasus*; from which it is distinguished by the longer head, by the prominent overhanging muzzle, much longer than in *atronasus*, by the longer barbels and by the absence of a distinct, dark lateral band. Color dark-brownish olive above, sometimes slightly mottled; paler below; a dark spot on opercle, but no distinct band through eye or along side. Length 5 inches.

Apparently a rare species in Ohio. Dr. Jordan (Ohio Rept.) says: "It is found in the tributaries of Lake Erie and even in the lake itself. It also occurs in the southeastern part of the state." Since then it has not been noticed by any other collector, and the writer has taken it but once, a single specimen from a small tributary of the Grand river near Painesville, August 2, 1900.

Rhinichthys atronasus (Mitchill). BLACK-NOSED DACE.

Head 4; depth $4\frac{1}{2}$; eye $1\frac{1}{2}$ in snout, $4\frac{1}{2}$ in head. D. 7 or 8; A. 7; scales 10-65-6; teeth 2, 4-4, 2. Body moderately elongate, little compressed. Head moderate, rather broad and flattish above; snout moderate; mouth horizontal, lower jaw included; barbels well marked in all Ohio specimens examined. Color above dark-yellowish olive, much blotched with black; a black lateral band passing forward through eye to snout; breeding males have the lateral band and the lower fins bright orange or crimson. All color markings less evident in females and young, but the lateral, dark band always present.

Distributed over the state and generally common or even abundant in suitable localities. It is essentially a "brook" species, being rarely found in larger streams, but swarming in clear, cold spring runs, in company with *Chrosomus erythrogaster*. Hamilton County, "common in all the streams," Henshall, 1888; Lorain County, "Spring brook and Chance creek, not common," McCormick, 1892; Maumee river system, "several from Lost creek near Cecil, by Prof. Meek, found nowhere else" (in Ohio), Kirsch, 1893; Franklin County, Grant's Run and Plum Run, common, Williamson and Osburn, 1897; Knox County, Little Jelloway creek, Parker's Run, Joe Sapp Run and Shadley Run, tributaries of Big Jelloway creek, common or abundant, May 24 given as a breeding date, Parker, Williamson and Osburn, 1898; Ohio river at Ironton, Huron river at Milan, Wabash river at Celina, Wolf creek at Dayton, North Fork of Licking river at Newark, in all of these cases the species has been taken in small nameless tributaries rather than in the main stream, with the exception of Wolf creek and the Ohio river, R. C. Osburn, 1899; Cuyahoga river at Kent and Hawkins, and Breakneck creek near Kent, R. C. Osburn, 1900.

Genus: HYBOPSIS.

Key to Species.

- A. Mouth inferior, horizontal, color silvery.
 B. Teeth one-rowed, 4-4.
 C. Eye $3\frac{1}{4}$ in head; no plumbeous blotches along lateral line.—*hyostomus*.
 CC. Eye very large, $2\frac{3}{4}$; an interrupted plumbeous lateral band.—*dissimilis*.
 BB. Teeth two-rowed, 1, 4-4, 1, or 1, 4-4, 0.
 D. Sides with a dusky lateral band.—*amblops*.
 DD. Sides silvery, no lateral band.—*storerianus*.
 AA. Mouth large, nearly terminal; eye small; not silvery.—*kentuckiensis*.

Hybopsis hyostomus (Gilbert).

Head 4; depth $5\frac{1}{2}$; eye $3\frac{1}{4}$. D. 8; A. 8; scales in lateral line 37, 13 before dorsal. Body and head very slender; snout long, acute, projecting beyond mouth for half its length; mouth short, wide, inferior; barbels long. Color silvery, everywhere dusted with fine, dark specks. Length $2\frac{1}{2}$ inches.

Very rare in the state, and, as far as my knowledge goes, confined to the Ohio river. Dr. Henshall recorded it first from the Ohio river at Raccoon Island, 1889, and the writer has taken it twice in the Ohio, at Ironton, May 31, 1899, and at Bellaire, August 31, 1900.

Hybopsis dissimilis (Kirtland). SPOTTED SHINER.

Head $4\frac{1}{2}$; depth 5. D. 8; A. 7; teeth 4-4; scales 6-40 to 47-5, about 20 in front of dorsal. Body long and slender, little compressed, with long caudal peduncle. Head long, flattish above; snout somewhat bluntly decurved, a little projecting; mouth small, horizontal, lower jaw included; barbel smaller than in *H. amblops*; eye about 3 in head, somewhat directed upward. Color above dusky or olivaceous, somewhat mottled; sides silvery, with a bluish lateral band, which is sometimes widened into several blackish blotches. In full coloration, one of the most striking of our Minnows.

This species has been taken in a number of localities in Ohio, and in both the lake and Ohio river drainage, but is nowhere common. Recorded by Kirtland for the Mahoning river and Lake Erie near Cleveland; Hamilton County, "rather common in Little Miami river and O'Bannon creek," Henshall, 1888; Franklin County, "Big Walnut creek, rare," Williamson and Osburn, 1897; Stillwater creek near Dayton, rare, R. C. Osburn, 1899; Cuyahoga river at Hawkins, R. C. Osburn, 1900.

Hybopsis amblops (Rafinesque). SILVER CHUB.

Head 4; depth $4\frac{1}{2}$ to 5; eye 3. D. 8; A. 7 or 8; scales 5-38-4, about 14 before dorsal; teeth 1, 4-4, 1. Body rather slender, little compressed, rather heavy anteriorly. Head large, flattened and broad above; mouth subinferior, horizontal; barbel evident. Lateral line somewhat decurved. Color above clear translucent green, scales dark-edged; sides with a broad, silvery lateral band, overlying dark pigment, which sometimes appears as a dark lateral band; a dark band through eye around snout. Fins all plain. Length about 3 inches.

Common or abundant throughout the state, found in nearly all streams, but not taken in lakes. Recorded by Kirtland. Given by Jordan as abundant in tributaries of the Ohio; Hamilton County; "common in Little Miami river," Henshall, 1888; Lorain County, "common in some of the streams," McCormick, 1892; Maumee river system; "all the smaller tributaries," Kirsch, 1893; Franklin County, common in all but the smallest streams, Williamson and Osburn, 1897; Big Jelloway creek, Knox County, abundant, Parker, Williamson and Osburn, 1898; Ohio river at Ironton, John's creek at Waterloo, Huron river at Milan, Ashtabula creek at Ashtabula, Wabash river at Celina, Stillwater and Wolf creeks near Dayton, North Fork of Licking river near Newark, R. C. Osburn, 1899; Cuyahoga river at Hawkins, Grand river at Painesville, Chagrin river at Willoughby, Wheeling creek at Bridgeport, Ohio river and McMahon's creek at Bellaire, R. C. Osburn, 1900.

Hybopsis storerianus (Kirtland).

Head $4\frac{1}{2}$; depth 4; eye 3, equal to snout. D. 8; A. 8; scales 5-42-4. Body elongate, somewhat compressed, the back somewhat elevated. Head short, compressed; preorbital bone large and silvery; mouth horizontal, lower jaw included; barbels conspicuous. Lateral line somewhat decurved. Dorsal inserted over ventrals, ventrals not reaching vent, caudal long, deeply forked. The teeth are said to be usually 1, 4-4, 0, but all Ohio specimens examined have the teeth 1, 4-4, 1. Translucent greenish above, elsewhere bright silvery, sides with a slight plumbeous lateral band, no caudal spot. Length 5 to 10 inches.

Apparently not well distributed over the state, though occurring in both the Lake Erie and the Ohio river drainage. Lake Erie, Kirtland; "abundant in Lake Erie," Jordan; Hamilton

County, "common in Little Miami river and Clough creek," Henshall, 1888; Lorain County, Beaver creek and Lake Erie, McCormick, 1892; Lake Erie near Sandusky, R. C. Osburn, 1900. Dead ones are frequently thrown upon the beach by the waves at Sandusky; not noticed in Sandusky Bay.

***Hybopsis kentukiensis* (Rafinesque). HORN-HEAD;
RIVER CHUB; JERKER; INDIAN CHUB.**

Head $3\frac{3}{4}$ to 4; depth 4 to $4\frac{1}{4}$; eye $5\frac{1}{4}$. D. 8; A. 7 or 8; scales 6-41-5, about 18 before dorsal; teeth 1, 4-4, 1 or 1, 4-4, 0, sometimes 4-4, in all Ohio specimens examined they are 1, 4-4, 1. Body rather robust, little elevated, little compressed. Head large, broadly rounded above; snout conical, bluntish; mouth large, nearly terminal; barbel evident. Dorsal inserted slightly behind ventrals. Color dusky or bluish or greenish olive above, sometimes with brassy luster, pale but not silvery below; sometimes with a clear, grass green lateral band in life; fins all plain, tinged with dull orange. Breeding males have the belly tinged with rosy, and a crimson spot on side of head behind eye, and have the top of the head swollen into a crest which is covered with tubercles. Young with dark caudal spot. Length 6 to 9 inches.

Well distributed over the state and generally common. Recorded by Kirtland. "Every stream in the state of Ohio," Jordan; Hamilton County, "Little Miami river," Henshall, 1888; Lorain County, "very common in larger streams," McCormick, 1892; Maumee river system in Ohio, "every point in every stream examined," Kirsch, 1893; Franklin County, common in larger streams, July 16 given as breeding date, Williamson and Osburn, 1897; Big Jelloway creek system, Knox County, abundant, May 23 noted as a breeding date, Parker, Williamson and Osburn, 1898, Ohio river at Iron-ton, Huron river at Milan, Ashtabula creek at Ashtabula, Wabash river at Celina, Stillwater and Wolf creeks at Dayton, North Fork of Licking River at Newark, R. C. Osburn, 1899; Cuyahoga river at Kent and Hawkins, Grand river at Painesville, Chagrin river at Willoughby, Wheeling creek at Bridgeport, Ohio river at Bellaire, R. C. Osburn, 1900.

Genus: EXOGLOSSUM.

***Exoglossum maxillingua* (Le Sueur). CUT-LIPS; NIGGER CHUB.**

Head 4; depth $4\frac{1}{2}$. D. 8; A. 7; scales 8-53-5; teeth 1, 4-4, 1. Body rather stout, little compressed. Head broad and flattish above, with tumid cheeks. Mouth peculiar, the mandible being contracted and incurved, its

outline 3-lobed; this appearance is due to the fact that the dentary bones lie close together, parallel, and are united throughout their length, instead of forming an arch as in all other *Cyprinidæ*; lower lip represented by a broad, fleshy lobe on either side of the mandible. Color olivaceous, smoky or dark above; a blackish bar behind opercle, and a dusky shade at base of caudal in young. Fins all plain. Length 6 inches.

Rare in Ohio. Six specimens were taken by the writer in Stillwater creek near Dayton, Aug. 15, 1899. The range of the species is to the eastward. West of the Alleghenies it has heretofore been known only from the Kanawha river, West Virginia.

Order : APODES.

Sub-Order : ENCHELYCEPHALI.

Family : ANGUILLIDÆ.

Genus : ANGUILLA.

Anguilla chrysypa Rafinesque. AMERICAN EEL;
FRESHWATER EEL.

Body elongate, compressed behind; appearing scaleless, but covered with fine, imbedded scales. Head long, conical, moderately pointed. Dorsal and anal fins confluent with caudal. Color brown, often tinged with yellowish; paler below, the color quite variable. Length 4 or 5 feet.

The Eel appears to be nowhere very common in Ohio, but is widely distributed throughout the state, and probably occurs in every lake, reservoir and large stream. Rafinesque mentions its occurrence in the Ohio "as far as Pittsburg;" Kirtland records it for the Ohio river drainage; Lake Erie and Ohio river, Henshall, 1889; Lorain County, "occasionally taken in the pounds," McCormick, 1892; Maumee river at Defiance, "said to inhabit all waters of the Maumee basin," Kirsch, 1893; Franklin County, observed in Big Walnut creek, reported by fishermen as "not rare," Williamson and Osburn, 1897; Pippin lake and Chippewa lake, R. C. Osburn, 1900. I have seen specimens taken in Licking reservoir, Licking river and North Fork of Licking river. According to Kirtland the Eel did not formerly inhabit the Lake Erie drainage, but if not, it has found its way there through the canals.

Order: ISOSPONDYLI.*Family:* HIODONTIDÆ.*Genus:* HIODON.*Key to Species.*

- A. Belly in front of ventrals carinated; dorsal with 9 developed rays.— *alosoides*.
 AA. Belly in front of ventrals not carinated; dorsal of 11 or 12 developed rays.—*tergisus*.

Hiodon alosoides (Rafinesque).

Head $4\frac{1}{2}$; depth $3\frac{1}{2}$; eye $3\frac{1}{2}$. D. 9; A. 32; scales 6-56-7. Body closely compressed, becoming deep in the adult, the ventral edge everywhere carinated. Maxillary reaching middle of eye. Caudal peduncle rather stouter than in *H. tergisus*, and the fin not so deeply forked; also, the pectorals are longer and the ventrals shorter than in *H. tergisus*. Color bluish, sides silvery, with golden luster. Length 12 inches.

Rare in Ohio, the range of the species being farther to the west. A single specimen, taken in a fisherman's net in the Ohio river, was recorded by Henshall for Hamilton County, 1888.

Hiodon tergisus Le Sueur. MOON EYE; TOOTHED HERRING.

Head $4\frac{1}{3}$; depth 3; eye 3. D. 12; A. 28; scales 5-55-7. Body oblong, moderately compressed. Eye large, the maxillary barely reaching its middle. Pectoral fins not reaching ventrals, the latter just short of vent. Belly somewhat carinated behind ventrals only. Color brilliantly silvery, olive-shaded above. Length 12 inches.

This species is confined to Lake Erie and the Ohio river, and the lower courses of their larger tributaries, but it is common where found. Rafinesque made four species of it, and reported two of them for the Ohio as far as Pittsburg. Three of these nominal species, *H. clodalus*, *H. vernalis* and *H. tergisus*, were recognized by Kirtland in his 1838 report, but he afterward dropped all but *H. tergisus*. "Common in the Ohio," Henshall, 1888; Lorain County, "common in the lake, ascending the streams sometimes," McCormick, 1892; "below the dams in the Maumee river at Defiance and Grand Rapids, at both places they were very abundant," Kirsch, 1893; Ohio river at Bellaire, R. C. Osburn, 1900.

Family: DOROSOMIDÆ.

Genus: DOROSOMA.

Dorosoma cepedianum (Le Sueur). GIZZARD SHAD.

Head $4\frac{1}{3}$; depth $2\frac{1}{2}$; eye $4\frac{1}{2}$. D. 12, its last ray prolonged and filiform, about as long as head; scales 56-23. Body deep, compressed, the back elevated in adult; belly compressed to an edge, serrated and covered by scutes, 17 in front of vent, 12 behind. Mouth small, inferior, no teeth. An adipose eyelid. No lateral line. Stomach short, muscular, like the gizzard of a fowl. Caudal fin widely forked, lower lobe the longer. Color silvery-bluish above; young with a round, dark spot at shoulder; tips of ventrals and edge of anal often dusky. Length 15 inches.

This handsome, worthless species is now well distributed over the state in the lake and larger streams, although it is said that previous to the opening of the canals it was not found in the lake drainage. The form resident in the Mississippi valley is known as var. *heturum*. Given by Kirtland as *Chatoessus ellipticus*. Ohio river, Lake Erie and Licking reservoir, Jordan's Report; Hamilton County, "very common in the Ohio river," Henshall, 1888; Lorain County, "quite common in the lake and ascending the rivers," McCormick, 1892; Maumee river at Defiance and Grand Rapids, St. Mary's river at St. Mary's and Rockford, Tiffin river at Brunersburg, Auglaize river at Cloverdale, Oakwood and Defiance, Hoaglin creek near Oakland and Gordon creek near Cecil, Kirsch, 1893; abundant in St. Mary's reservoir and in the wasteway of the St. Mary's reservoir into the headwaters of the Wabash river at Celina, R. C. Osburn, 1899; Chippewa lake, Ohio river at Bellaire and Licking reservoir, very abundant at the last place, R. C. Osburn, 1900.

Family: CLUPEIDÆ.

Genus: POMOLOBUS.

Pomolobus chrysochloris Rafinesque. SKIPJACK; BLUE HERRING.

Head $3\frac{3}{4}$; depth $3\frac{3}{4}$; eye shorter than snout, large, well covered by an adipose eyelid, $4\frac{1}{3}$ in head. D. 16, its posterior ray not prolonged; A. 18; about 52 scales in lateral line. Body elliptical, much compressed; belly compressed to an edge which is covered with scutes, 20 before vent, 13

behind. Head slender and pointed; lower jaw strongly projecting; upper jaw emarginate. Color, brilliant blue above, sides silvery with golden reflections; no dark spot behind opercle. Length 15 inches.

This is a deep water species, common in the Ohio river, and it has made its way through the canals into Lake Erie, where it is now said to be common. Ohio river, "seldom as far as Pittsburg," Rafinesque; "very rare, two specimens seen in Cincinnati market," Kirtland, 1838; Hamilton County, "abundant in Ohio river," Henshall, 1888.

Family: SALMONIDÆ.

Key to Genera.

- A. Mouth not deeply cleft; dentition feeble or incomplete, scales large.
 - B. Lower jaw short and more or less included, cleft of mouth short.—
COREGONUS.
 - BB. Lower jaw long, projecting beyond upper, cleft of mouth rather long.—
ARGYROSONUS.
- AA. Mouth deeply cleft; dentition strong and complete, scales small.
 - C. Vomer with raised crest, which is armed with strong teeth; hyoid bone with a broad band of strong teeth; no bright colors.—
CRISTIVOMER.
 - CC. Vomer without raised crest; hyoid with weak teeth or none; spotted with red.—
SALVELINUS.

Genus: COREGONUS.

Coregonus clupeiformis (Mitchill). COMMON WHITEFISH.

Head 5; depth 3 to 4; eye 4 to 5. D, 11; A, 11; scales 8-74 to 85-9. Body oblong, compressed, always elevated, especially so in adult. Head comparatively small and short; the snout obliquely truncated. Gill rakers numerous, long and slender. Color olivaceous above; sides white, but not silvery; lower fins sometimes dusky. Length 2 feet or more.

In Ohio the Whitefish is found only in Lake Erie, where it occurs in great numbers. It does not ascend streams. Recorded first by Kirtland. "The most important fish of Ohio, both as to quantity taken and quality as food," Jordan's Report; L. Erie, Henshall, 1889; "common in the lake," McCormick, 1892; "west end of Lake Erie," Kirsch, 1893. Great quantities from various parts of the lake are brought into the fish houses at Sandusky.

Genus: ARGYROSOMUS.*Key to Species.*

- A. Lower jaw projecting; depth in length $4\frac{1}{2}$.—
 AA. Jaws about equal; depth in length 3 to $3\frac{1}{2}$.—

artedi.
tullibee.

Argyrosomus artedi (Le Sueur). CISCO; LAKE HERRING.

Head $4\frac{1}{2}$; depth $4\frac{1}{2}$; eye 4 to $4\frac{1}{2}$. D. 10; A. 12; scales 8-75 to 90-7. Body elongate, compressed, not elevated. Head compressed, rather long; distance from occiput to snout usually a little less than half the distance from occiput to insertion of dorsal fin. Dorsal fin high, its rays rapidly shortened. Bluish black or greenish above; sides silvery, with dark specks; fins mostly pale, the lower dusky-tinged. Length 1 foot.

In Ohio taken only in Lake Erie, where it is very abundant. Recorded by Kirtland, Jordan and Heushall. Lorain Co., "very abundant, sometimes filling the pound nets almost solid with fish," McCormick, 1892; "west end of Lake Erie," Kirsch, 1893. Brought into Sandusky fish houses in enormous numbers.

Argyrosomus tullibee (Richardson). TULLIBEE; MONGREL WHITEFISH.

Head 4 to $4\frac{1}{2}$; depth 3 to $3\frac{1}{5}$; eye $4\frac{1}{2}$, as long as snout. D. 11 or 12; A. 11; scales 8 or 9-67 to 74-8. Body short, deep, compressed, shad-like, dorsal and ventral curves similar. Head conic, compressed; distance from occiput to tip of snout half the distance from occiput to insertion of D. Color bluish above; sides white, punctate with fine dots; each scale with a silvery area, these forming a series of distinct longitudinal stripes. Length 18 inches.

I have seen but one record of this species in Ohio, as follows: "I once received a photograph of a Tullibee from Dr. E. Sterling, of Cleveland. The specimen had been taken in Lake Erie," Jordan's Report.

Genus: CRISTIVOMER.**Cristivomer namaycush** (Walbaum). MACKINAW TROUT; GREAT LAKE TROUT; NAMAYCUSH.

Head $4\frac{1}{4}$; depth 4; eye large, $4\frac{1}{2}$. D. 11; A. 11; lateral line 185 to 205. Body elongate. Head very long and pointed, its upper surface flattened. Mouth very large, the maxillary extending much beyond eye; teeth strong. Caudal fin well forked; adipose fin small. General color dark gray, varying from pale to nearly black; everywhere with rounded, paler spots, which are often reddish tinged; dorsal and caudal reticulate with darker. Length 3 feet.

In Ohio taken only in Lake Erie, does not ascend streams. Kirtland records it for Lake Erie, "a few stragglers are taken." Jordan and Henshall also record it. McCormick says of its occurrence in Lorain County, "very rare, it is almost unknown to the fishermen here, though common in the eastern part of the lake."

Genus: SALVELINUS.

Salvelinus fontinalis (Mitchill). SPECKLED TROUT; BROOK TROUT.

Head $4\frac{1}{2}$; depth $4\frac{1}{2}$. D. 10; A. 9; scales 37-230-30. Body oblong, moderately compressed, not much elevated. Head large, but not very long, the snout bluntish; mouth large, the maxillary reaching more or less beyond eye; eye large. Color above more or less mottled with dark olive or black; sides in life with many red spots; dorsal and caudal mottled or barred with dark; belly in males often more or less red.

The Brook Trout now probably occurs in but one stream in the state, Castalia creek, near Sandusky. In 1838 Kirtland recorded the species as found "in only two streams, a small creek in Ashtabula County, and a branch of the Chagrin river in Geauga County." In 1889 Henshall recorded it for Castalia creek. It still occurs there in numbers under the protection of a fishing club, which, I understand, introduces young fry to keep up the supply.

Order: HAPLOMI.

Family: UMBRIDÆ.

Genus: UMBRA.

Umbra limi (Kirtland). MUD MINNOW.

Head $3\frac{3}{4}$; depth $4\frac{1}{4}$. D. 14; A. 8; scales 35-15, soft and leathery; no lateral line. Body oblong, compressed. Head large, shortish, cheeks and opercles and top of head forward to between the eyes, covered with scales. Caudal fin conspicuously rounded. Color dull olive green, with a dark dorsal band and about 14 light vertical bars, less distinct in young. A dark bar at base of caudal. Length $4\frac{1}{2}$ inches.

This species is rare in the Ohio river drainage, but is reported as very common in the northern part of the state. Recorded for streams of northern Ohio by Kirtland; abundant in the northern part of Ohio, Jordan's Report; Lorain County, "very common in sloughs and bayous," McCormick, 1892; Fish creek at Edger-

ton, Lost and Gordon creeks near Cecil, "very common on soft muddy bottom," Kirsch, 1893; a single specimen was taken April 3, 1897, in a small tributary of the Olentangy river at Columbus by Mr. E. B. Williamson and the writer; Niggermill Run at Salem, E. B. Williamson, 1900; abundant in the "Black Channel" in Sandusky Bay, R. C. Osburn, 1900.

Family: LUCIIDÆ.

Genus: LUCIUS.

Key to Species.

- A. Opercles entirely scaled, scales in lateral line 105.— *vermiculatus.*
 AA. Opercles with the lower half bare of scales.
 B. Cheeks entirely scaled, scales in lateral line about 123.— *lucius.*
 BB. Cheeks with the lower half bare of scales, scales in lateral line about 150.— *masquinongy.*

Lucius vermiculatus (Le Sueur). LITTLE PICKEREL; GRASS PIKE.

Head long, $3\frac{1}{4}$ to $3\frac{3}{4}$ in length of body; depth 5 to 6; eye 6 in head, large. D. 11 or 12; A. 11 or 12; scales 105. Body elongate, somewhat compressed. Opercles and cheeks entirely covered with scales. Color greenish or grayish olive, everywhere reticulated with irregular, light markings; the color extremely variable. Length about a foot.

The Little Pickerel, or "Grass Pike," as it is sometimes called, is common throughout the state in suitable localities. Its favorite haunt is the weedy pond or backwater or overflow pool of some stream, and in such places it is sometimes very abundant. Jordan in his Ohio Report gives it as more abundant in the Ohio river drainage than in that of the lake. "Lake Erie and Maumee river," Henshall, 1889; Lorain County, "common," McCormick, 1892; "common throughout the Maumee basin, all waters examined (in Ohio) except Hoaglin creek," Kirsch, 1893; Franklin County, "of general distribution, abundant in Hell Branch," Williamson and Osburn, 1897; John's creek at Waterloo, Huron river at Milan, Ashtabula creek at Ashtabula, R. C. Osburn, 1899; Sandusky Bay, Breakneck creek near Kent. Licking reservoir, R. C. Osburn, 1900.

Lucius lucius (Linnaeus). PICKEREL; PIKE.

Head $3\frac{1}{3}$; depth 5; eye $6\frac{1}{3}$ in head. Developed rays of dorsal 16 or 17, of anal 13 or 14; scales 123. Body moderately elongate, back little elevated. Head rather long. Cheeks scaly; the lower half of opercle bare. Color

bluish or greenish gray, with many whitish or yellowish spots arranged somewhat in rows. Dorsal, anal and caudal fins with roundish or oblong, black spots. Length 4 feet.

The Pickerel is said to have been very abundant at one time in all the streams flowing into Lake Erie and somewhat less common in the Ohio river drainage. In the latter it has now, as far as Ohio is concerned, become quite rare, and in the lake drainage, and even in the lake itself, it has noticeably diminished in numbers. Kirtland gives it as "common both to the waters of the Ohio and the lake." Lake Erie and Sandusky river, Henshall, 1889; Lorain County, Lake Erie and Black river, "often killed in the ponds and channels of the snipe ground when they are spawning," McCormick, 1892; St. Joseph river at Edgerton, Tiffin river at West Unity and Brunersburg, Auglaize river at Cloverdale, Kirsch, 1893; Sandusky Bay, R. C. Osburn, 1899; Licking reservoir, a single specimen, 1½ feet in length. R. C. Osburn, 1900.

Lucius masquinongy (Mitchill). MUSKALLUNGE.

Head 3¾; depth 6; eye 4 to 6 in snout. D. 17; A. 15; scales 150. General form of *L. luciuis*; the head proportionately longer. Cheeks and opercles both naked below. Color dark gray, sides in the typical form, *masquinongy*, with round or squarish, blackish spots of varying size on a ground color of grayish silvery; belly white; fins spotted with black. Length 4 to 8 feet.

This magnificent Pike is represented in Ohio by two varieties, as follows: *L. masquinongy* var. *masquinongy*, the typical form, confined to Lake Erie and its tributary rivers, and *L. Masquinongy ohioensis* (Kirtland), confined to the Ohio river and its tributary streams. The variety *ohioensis* is separated from the typical form by the presence of narrow irregular crossbars, formed by the coalescing of spots on the sides. Kirtland records the former for Lake Erie and the Ohio canal near Massilon, 1838, and the latter for the Mahoning river, 1854; Ohio river and Lake Erie, Henshall, 1889; McCormick records the species for Lorain County, and states that it is growing rare, being seldom taken in the pounds; Kirsch, in 1893, speaks in the same strain of their diminishing numbers in Maumee river and the west end of Lake Erie.

Family: PÆCILIIDÆ.

Genus: FUNDULUS.

Key to Species.

- | | | |
|-----|--|-------------------|
| A. | No broad, black lateral band. | |
| B. | Dorsal fin of 12 or 13 rays.— | <i>diaphanus.</i> |
| BB. | Dorsal fin of 7 rays.— | <i>dispar.</i> |
| AA. | A broad, black lateral band, its edges notched; dorsal fin of 9 rays.— | <i>notatus.</i> |

Fundulus diaphanus menona (Jordan and Copeland).

Head $3\frac{1}{2}$; depth 5. D. 12; A. 10; scales 48-12. Body rather slender, not elevated, compressed posteriorly. Head flattened above. Fins rather small and low. General color olivaceous, below pale, sides somewhat silvery; back always spotted; sides with about 16 distinct, irregular, dark bands, these often replaced by the same number of shining, silvery bands narrower than the interspaces. Length $3\frac{1}{2}$ inches.

Taken only in the northern part of the state, where in suitable places it is common. "Taken once near Lorain, common near Huron and Put-in-Bay," McCormick, 1892; "Maumee river at Toledo, abundant," Kirsch, 1893; noted commonly by Prof. D. S. Kellicott, E. B. Williamson and the writer in Sandusky Bay in 1896, and again by the writer in 1899 and 1900.

Fundulus dispar (Agassiz).

Head $3\frac{3}{4}$; depth $3\frac{1}{2}$. D. 7; A. 9; scales 35-10. Body short and deep, much compressed. Head short and very broad, the distance between the eyes above greater than the distance between them below. Snout broadly rounded. Dorsal fin much smaller than anal. Color pale olive, bluish in life; about 10 longitudinal, wavy, brown stripes along sides formed by the dark edges of the scales. Males have these stripes interrupted and have about 9 dark crossbars; a black blotch below eye. Length $2\frac{1}{2}$ inches.

Given for Ohio by Jordan (Ohio Rept.), and Jordan and Evermann (Bull. 47, U. S. Natl. Mus.) Dr. B. W. Evermann, in a recent letter regarding this species, says: "I learned of its occurrence in the Celina reservoir through students of mine who seined there. No record was published, however."

Fundulus notatus (Rafinesque). TOP MINNOW.

Head 4; depth $4\frac{1}{2}$; eye 3. D. 9; A. 11 or 12; scales 34-11. Body slender, compressed posteriorly. Head depressed, rather long, the snout somewhat produced; interorbital space half the length of head. Color olivaceous or brownish olive, with a broad, blackish lateral band from tip of

snout to caudal, this band usually notched above and below, giving it a serrated appearance. A light, translucent spot is conspicuous on the top of the head when the fish is swimming at the surface. Length 2 to 3½ inches.

The Top Swimmer is a common species in suitable localities in the Ohio river drainage, but is rather rare in the tributaries of the lake. Hamilton County, very abundant in Ross lake, Henshall, 1888; Maumee river at Grand Rapids, St. Mary's river at St. Mary's and Rockford, Tiffin river at West Unity and Brunersburg, Auglaize river at Wapakoneta, Cloverdale, Oakwood and Defiance, Blanchard river at Ottawa, Hoaglin creek at Ottawa, "seemingly scarce at all these points," Kirsch, 1893; Franklin County, of general distribution, abundant in places, Williamson and Osburn, 1897; Wabash river at Celina, Stillwater creek near Dayton, very common, R. C. Osburn, 1899.

Order: HEMIBRANCHII.

Family: GASTEROSTEIDÆ.

Genus: EUCALIA.

Eucalia inconstans (Kirtland). BROOK STICKLEBACK.

Head 3½; depth 4. D. IV-I, 10; A. I, 10. Body moderately elongate, little compressed; caudal peduncle slender, not keeled. Dorsal spines low, subequal, 4 or 5 in number in a right line; a cartilaginous ridge along base of fin; ventral spines short and sharp, serrated. Color, males in spring jet black, tinged with red anteriorly; females and young, olivaceous, mottled and dotted with black. Length 2½ inches.

This species is probably confined to the central and northern parts of Ohio. It is said to be abundant in some localities. Kirtland described the species in 1841, from brooks of Trumbull County; Jordan gives it as "abundant in many streams in northern part of Ohio"; "Castalia creek" near Sandusky, Henshall, 1889; Lorain County, "I have found sticklebacks in but two places," McCormick, 1892; Mr. E. B. Williamson writes me that he has found the species in Niggermill Run at Salem, Columbiana County, 1899.

Order: ACANTHOPTERI.

Sub-Order: SALMOPERCÆ.

Family: PERCOPSIDÆ.

Genus: PERCOPSIS.

Percopsis guttatus Agassiz. TROUT PERCH.

Head $3\frac{1}{2}$ to 4; depth 4 to $4\frac{1}{2}$. D. II, 9; A. I, 7; scales about 50, strongly ctenoid. Head rather long, slender and conical, mouth subinferior. Body rather slender; caudal peduncle long and slender. A small but distinct adipose fin behind dorsal. Color, pale olivaceous on back, colorless and somewhat translucent below; about 11 small, dark spots along lateral line, and another row of smaller dots between this and mid-dorsal line. Length 4 to 6 inches.

Jordan and Evermann (Bull. 47, U. S. Natl. Mus.) in discussing the range of this species give it as "rare in streams south of Lake Erie." This statement does not seem to hold good for the State of Ohio, for in suitable localities the species is common as far as the southern limits of the state, and in some places is very abundant. Hamilton County, "abundant in Little Miami river below the dam at Loveland," Henshall, 1888; Lorain County, "common in Lake Erie, Black river and Beaver creek," McCormick, 1892; Franklin County, taken in most of the streams of the county, abundant in streams west of the Scioto, after some hauls in Scioto Big Run the seine contained more of this than all the other species combined, Williamson and Osburn, 1897; John's creek at Waterloo, Huron river at Milan, common at both places, R. C. Osburn, 1899; Ohio river at Bellaire, R. C. Osburn, 1900.

Sub-Order: XENARCHI.

Family: APHREDODERIDÆ.

Genus: APHREDODERUS.

Aphredoderus sayanus (Gilliams). PIRATE PERCH.

Head 3; depth 3. D. III, 11 to IV, 10; A. II, 6; scales 45 to 60. Body oblong, elevated at base of dorsal, compressed behind. Head thick, depressed; mouth moderate, lower jaw projecting. Lateral line imperfect or wanting. The position of the anus is peculiar, being always anterior; it

varies in position with age from just behind the ventrals in the young, to below the preopercle in the adult. Color, dark olive, profusely speckled with dark points, which may form streaks along the rows of scales; 2 blackish bars at base of caudal. Length 5 inches. The Ohio form is the variety *isolepis*.

The Pirate Perch seems to be a rather rare species in Ohio, and thus far it has been taken only in Lake Erie and the Maumee river system. "Lake Erie," Henshall, 1889; Maumee river system, "only two small specimens were taken, one by Prof. Meek in Gordon creek near Cecil, and one by us in warm sluggish water in St. Mary's river at Rockford," Kirsch, 1893.

Sub-Order: PERCESOCES.

Family: ATHERINIDÆ.

Genus: LABIDESTHES.

Labidesthes sicculus Cope. BROOK SILVERSIDES.

Head $4\frac{1}{4}$ to $4\frac{1}{2}$; depth 6; eye large, $3\frac{1}{2}$. D. IV-I, 11; A. I, 23; scales 75. Body very long and slender, compressed. Head long, flattened above; snout long, slender and conic; mouth very large, the jaws produced into a sort of beak. First dorsal very low, inserted well back; caudal forked. Color pale olive green, translucent, dotted above with fine, dark specks; a broad, distinct, silvery lateral band, bounded above by a dark line. Length $3\frac{1}{2}$ inches.

This peculiar and interesting little fish is widely distributed over the state and is generally common. Quiet pools of streams and shallow waters of lakes on sandy or gravelly bottom are its favorite haunts. Hamilton County, "one specimen from Bloody Run, common in Ross lake," Henshall, 1888; Lorain County, "quite common in the lake and in the larger streams below the dams," McCormick, 1892; "generally distributed in the waters of the Maumee basin," Kirsch, 1893; Franklin County, generally distributed, abundant, Williamson and Osburn, 1897; Huron river at Milan, Sandusky Bay, Wabash river at Celina, Stillwater creek near Dayton, very abundant on sandy bottom in shallow water in Sandusky Bay, R. C. Osburn, 1899; Mahoning river, E. B. Williamson, 1900; Pippin lake, Chippewa lake, Summit lake, Grand river at Painesville, Chagrin river at Willoughby, Ohio river at Bellaire, Licking reservoir, R. C. Osburn, 1900.

Sub-Order: RHEGNOPTERI.*Group:* PERCOIDEA.*Family:* CENTRARCHIDÆ.*Key to Genera.*

- A. Dorsal fin scarcely longer than anal.— POMOXIS.
 AA. Dorsal fin much larger than anal.
 B. Body comparatively short and deep, the depth usually more than $\frac{2}{3}$ the length.
 C. Tongue and pterygoids with teeth; mouth large, maxillary reaching past middle of eye.
 D. Opercle emarginate behind; anal spines 6.— AMBLOPLITES.
 DD. Opercle ending in a black, convex process or flap; anal spines, 3.— CHÆNOBRYTTUS.
 CC. Tongue and pterygoids toothless; mouth small, maxillary barely reaching past middle of eye.
 E. Supplemental bone of maxillary perfectly distinct.— APOMOTIS.
 EE. Supplemental bone of maxillary rudimentary or wanting.
 F. Lower pharyngeal bones narrow, the teeth usually sharp, not conical.— LEPOMIS.
 FF. Lower pharyngeals broad and concave, especially in the adult, teeth more or less blunt and paved.— EUPOMOTIS.
 BB. Body comparatively elongate, depth in adult about $\frac{1}{3}$ the length; mouth large.— MICROPTERUS.

Genus: POMOXIS.*Key to Species.*

- A. Dorsal spines 6, occasionally 5, rarely 7; profile strongly sinuate, anal fin plain.— *annularis*.
 AA. Dorsal spines 7, rarely 8; profile not strongly sinuate; anal fin reticulate with dark markings.— *sparoides*.

Pomoxis annularis Rafinesque. CRAPPIE; LAKE ERIE BASS;
 CALICO BASS.

Head 3; depth $2\frac{1}{3}$; eye large, 4. D. V or VI, or sometimes VII, 15; A. VI, 18; scales 6-48-14. Body elongate, much compressed. Head long; the profile from snout to dorsal strongly sinuate; mouth very wide. Fins very high, but lower than in *P. sparoides*. Color, silvery olive, mottled with dark green, the dark marks chiefly on upper part of body and having a tendency to form vertical bars; dorsal and caudal marked with dark green, anal nearly plain. A lighter colored fish than *P. sparoides*. Quite variable. Length 12 inches.

Well distributed over the state in larger streams and lakes, common. Recorded for the state by Dr. Kirtland, who gave it the name *Cichla storeria*. "It occurs in large numbers in the Ohio river and its tributaries, rarely taken in Lake Erie," Jordan's Report; Muskingum river, Ohio river at Raccoon Island, Henshall, 1889; Lorain County, common, McCormick, 1892;

Franklin County, Scioto river, Olentangy river, Big Walnut creek, Big Darby creek, abundant, Williamson and Osburn, 1897; Ohio river at Ironton, Huron river at Milan, Wabash river at Celina, North Fork of Licking river at Newark, R. C. Osburn, 1899; Ohio river at Bellaire, Chippewa lake, R. C. Osburn, 1900. It is worthy of note that in Chippewa lake, which drains into the Ohio river system, this species was found exceedingly abundant, but none of the next species, *P. sparoides*, were taken, while in Summit lake, with very similar surroundings, but draining into Lake Erie, only *P. sparoides* was taken. These lakes are but a short distance apart, the former being near Medina, the latter at Akron.

Pomoxis sparoides (Lacepede). CALICO BASS; GRASS BASS;
LAKE ERIE BASS; CRAPPIE; BACHELOR.

Head 3; depth 2. D. VII or VIII, 15; A. VI, 17 or 18; scales 7-44-12. Body less elongate than in *P. annularis*; the profile less sinuate, the region over the eye not being so much depressed. Fins very high, anal higher than dorsal, its height 4 or 5 times in length of body. Color silvery olive, mottled with olive green or dark, the markings not tending to vertical bars, but to small, irregular groups and covering the whole body. Anal fin heavily marked like the other vertical fins, with dark olive markings; a dusky opercular spot. Length 12 inches.

Not so common as the preceding, but widely distributed, and occurring throughout the state; perhaps not ascending streams as far as *P. annularis*. It is said to be more common than *P. annularis* in the lake drainage, while in the Ohio Valley, *P. annularis* is the more common. "In the Great Lakes in large numbers. I have seen but few from the Ohio Valley," Jordan's Report; Hamilton County, "common in Ross lake near Elmwood," Henshall, 1888; Lorain County, Lake Erie and lower parts of Beaver creek and Black river, McCormick, 1892; Maumee river at Defiance and Grand Rapids; St. Joseph river at Edgerton, Fish creek at Edgerton, St. Mary's river at St. Mary's and Rockford, Tiffin river at Brunersburg and West Unity, Hoaglin creek near Oakland, Kirsch, 1893; Franklin County, Scioto and Olentangy rivers, not common, Williamson and Osburn, 1897; Ohio river at Ironton, Wabash river at Celina, R. C. Osburn, 1899; Summit lake, Ohio river at Bellaire, R. C. Osburn, 1900.

Genus: AMBLOPLITES.

Ambloplites rupestris (Rafinesque). ROCK BASS; GOGGLE-EYE;
RED-EYE.

Head $2\frac{3}{4}$; depth 2 to $2\frac{1}{2}$; eye very large, $3\frac{1}{2}$. D. XI, 10 or 11; A. VI, 10; scales 5 to 7-40-12. Body oblong, compressed. Head large, profile little depressed above eye; mouth large and oblique, lower jaw projecting. Preopercle serrate near its angle. Color olive green, tinged more or less with brassy yellow, with much dark mottling; each scale with a dark spot producing longitudinal rows; a black opercular spot. Soft dorsal, anal and caudal with dark mottlings. Length 12 inches.

A widely distributed and abundant species found in all larger streams and lakes. Recorded by Kirtland as common. Abundant, Jordan's Report; "Lake Erie, Ohio river, near Little Sandy river," Henshall, 1889; Lorain County, "common in the larger streams, sometimes taken by the pound nets in the lake," McCormick, 1892; "A common fish at nearly all points where investigations were made," Maumee river basin, Kirsch, 1893; Franklin County, nearly every stream, common, Williamson and Osburn, 1897; Big Jelloway creek, Knox County, not common, Parker, Williamson and Osburn, 1898; John's creek at Waterloo, Huron river at Milan, Sandusky Bay, Ashtabula creek, Wabash river at Celina, Stillwater and Wolf creeks near Dayton, North Fork of Licking river at Newark, R. C. Osburn, 1899; Niggermill Run and Mahoning river, E. B. Williamson, 1900; Pippin lake, Cuyahoga river and Breakneck creek at Kent, R. C. Osburn, 1900.

Genus: CHÆNOBRYTTUS.

Chænobryttus gulosus (Cuvier and Valenciennes). WARMOUTH.

Head $2\frac{1}{3}$ to $2\frac{2}{3}$; depth 2 to $2\frac{1}{2}$; eye 4 to $4\frac{1}{2}$. The general form and dentition of *Ambloplites*, with the convex opercle, 10 dorsal and 3 anal spines of *Lepomis*. Preopercle entire. Head large, snout about equal to eye; mouth large, maxillary reaching posterior border of eye, teeth on vomer, palatines, pterygoids and tongue. D. X, 9 or 10; A, III, 8 or 9; dorsal spines low. Color dark olive green, clouded with darker, usually with red or blue, and brassy; a dark spot on each scale; belly yellowish or brassy. Length 8 to 10 inches.

Taken by Kirsch in the Maumee basin in Fish creek, at Edgerton, and Tiffin river at Brunersburg, "not common," 1893. Not recorded for the state by any other collector.

Genus: APOMOTIS.

Apomotis cyanellus (Rafinesque). GREEN SUNFISH;
CREEK SUNFISH; LITTLE RED-EYE.

Head 3; depth $2\frac{1}{2}$. D. X, 11; A. III, 9; scales about 7-48-17, 8 rows on cheek. Body oblong, rather elongate in young, becoming short and deep in adults. Mouth large, larger than in *Lepomis* or *Eupomotis*, maxillary reaching nearly to middle of eye, lower jaw projecting. Gill rakers long and stiff. Lower pharyngeal teeth acute; a patch of teeth on basibranchial between second and third hypobranchials. Color generally greenish, sometimes nearly black; vertical fins marked with blue or green, in adults in spring the lower fins are very dark and all the fins are edged with silvery; dorsal and anal generally with a black spot on the posterior rays. Quite variable. Length 7 inches.

The Green Sunfish is an abundant resident of the streams of Ohio, but is rarely found in the lakes. It ascends the streams farther than any other species of this family, being found even in small brooks and spring runs. Hamilton County, "abundant in Ross lake and Little Miami river," Henshall, 1888; Lorain County, "abundant in the upper part of small streams and in small ponds," McCormick, 1892; Maumee river basin, "taken at nearly every point in all the streams that were examined," Kirsch, 1893; Franklin County, abundant in nearly every stream, Williamson and Osburn, 1897; Big Jelloway creek, Knox County, not common, Parker, Williamson and Osburn, 1898; Ohio river at Ironton, Huron river at Milan, Ashtabula creek, Wabash river at Celina, Stillwater and Wolf creeks near Dayton, North Fork of Licking river at Newark, R. C. Osburn, 1899; Mahoning river, E. B. Williamson, 1900; Breakneck creek near Kent, outlet of Licking reservoir, R. C. Osburn, 1900.

Genus: LEPOMIS.

Key to Species.

- A. Pectoral fins short, obtuse, not reaching beyond front of anal, considerably shorter than head.— *megalotis*.
- AA. Pectoral fins more or less pointed, not much if any shorter than head, and reaching to or beyond front of anal.
- B. Opercular flap margined with red, sides with many red spots.— *humilis*.
- BB. Opercular flap without red margin or spot; no red spots on sides, a large spot on posterior rays of dorsal and anal fins at base.— *pallidus*.

Lepomis megalotis (Rafinesque). LONG-EARED SUNFISH.

Head (without earflap) 3 in length; depth $1\frac{2}{3}$ to $2\frac{1}{2}$; eye $3\frac{1}{2}$ to 4. D. X, 10 to 12; A. III, 8 to 10; scales about 6-38-12, about 5 rows on cheek. Body short and deep, compressed; the back very strongly arched in adult, the profile very steep. Mouth small, oblique. Gill rakers very short and soft. Dorsal spines very low, 3 in head. Pectoral $1\frac{1}{3}$ to $1\frac{1}{2}$ in head. Opercular flap in adult very broad and long, with a pale blue or red margin which may be very broad or almost wanting; the flap much smaller in young. Color brilliant blue and orange; above chiefly blue, the belly entirely orange, lips blue; cheeks orange, with bright blue stripes; soft parts of vertical fins with the rays blue and membranes orange. An extremely variable species. Length 8 inches.

An abundant species in the Ohio river system, but not so common in the lake drainage. It occurs both in lakes and streams, but to greater extent in the latter. It does not ascend streams as far as *Apomotis cyanellus*, however. Given by Kirtland as *Pomotis nitida*. Hamilton County, "abundant in Ross lake," Henshall, 1888; Lorain County, rare, two specimens from Black river, 1890, McCormick; Maumee system, "all the larger streams and nearly all the smaller ones," July 17 given as a breeding date, Kirsch, 1893; Franklin County, nearly all the streams, apparently the most common sunfish, June 18 given as a breeding date, Williamson and Osburn, 1897; John's creek at Waterloo, Huron river at Milan, Ashtabula creek, Wabash river at Celina, Stillwater and Wolf creeks near Dayton, North Fork of Licking river at Newark, R. C. Osburn, 1899; Niggermill Run at Salem, E. B. Williamson, 1900; Sandusky Bay, Summit lake, Ohio river at Bellaire, Licking reservoir, R. C. Osburn, 1900.

Lepomis humilis (Girard). RED-SPOTTED SUNFISH.

Head $2\frac{3}{4}$ to 3; depth $2\frac{1}{4}$ to $2\frac{1}{2}$; eye large, 3 to $3\frac{1}{2}$. D. X, 10 or 11; A. III, 8 or 9; scales large, 5-34-11, about 5 rows on cheek. Body oblong, profile not very steep. Mucous pores on head very large; opercular flap long, broad and with a very broad, red margin, which entirely surrounds the black. Longest dorsal spine not quite half head, pectoral a little shorter than head. Gill rakers rather long and blunt, well developed. Color, bluish with conspicuous greenish spots posteriorly; sides with many conspicuous round, salmon-red spots; a faint black spot on last rays of dorsal; belly and lower fins red. Length 4 inches.

This small, highly colored sunfish is found in Ohio in the southwestern part only. I know of but one record, as follows: Hamilton Co., "common in Ross lake and Clough creek," Henshall, 1888.

Lepomis pallidus (Mitchill). BLUE-GILL; BLUE BREAM;
COPPER-NOSED BREAM; BLUE SUNFISH.

Head $2\frac{3}{4}$ to $3\frac{1}{4}$; depth about 2; eye $3\frac{1}{2}$ to 4. D. X, 11; A. III, 10 to 12; scales about 7-45-12, 5 rows on cheek. Body comparatively short and deep, compressed; the young slender, adults nearly orbicular, caudal peduncle rather slender. Head rather small, the projecting snout forming an angle above eye. Mouth quite small, the maxillary barely reaching front of eye. Opercular flap very short in young, somewhat larger in adult, without pale edge. Gill rakers of moderate length, rather stiff. Dorsal fin high; pectoral fin long and narrow, longer than head, reaching past front of anal. Color, olive green, sometimes quite dark, sometimes with a silvery or golden luster. Adults in spring with the belly coppery red. Young, silvery with more or less distinct, chain-like bars of darker on the sides. No blue stripes on cheek; a black blotch at base of posterior rays of dorsal and anal. Extremely variable. Length 12 inches.

The Blue-gill is a very abundant species in the lakes of Ohio. It is quite common and widely distributed in the larger streams, but does not ascend small streams. Hamilton County, "abundant in Little Miami river and Ross lake," Henshall, 1888; Lorain County, "not common," McCormick, 1892; Maumee river system, "taken in all the streams and at nearly every point examined," Kirsch, 1893; Franklin County, Scioto and Olentangy rivers, Big Walnut and Big Darby Creeks, rare, June 14 given as a breeding date, Williamson and Osburn, 1897; Huron river at

(*Lepomis machrochirus* Rafinesque, has been taken in the head waters of the Ohio in western Pennsylvania, by Cope, and in the Ohio river, by Rafinesque and Jordan, but as I know of no record of its capture within the state, I hesitate to include it in the list, though it doubtless occurs rarely in the Ohio.)

Milan, Sandusky Bay, Wabash river at Celina, R. C. Osburn, 1899; I have observed the species also at Licking and St. Mary's reservoirs. In both of these and in Sandusky Bay it is very abundant; Pippin lake, Chippewa lake, Summit lake, Ohio river at Bellaire, R. C. Osburn, 1900.

Genus: EUPOMOTIS.

Key to Species.

- A. Cheeks without marked blue or orange spots or lines.
 B. Scales large, 34 to 39 in lateral line.— *heros.*
 BB. Scales moderate, 33 in lateral line. *euryorus.*
 AA. Cheeks with wavy blue lines, scales about 45; lower posterior border of opercular flap always scarlet. *gibbosus.*

Eupomotis heros (Baird and Girard).

Head $2\frac{3}{4}$ to 3; depth 2 to $2\frac{2}{3}$; eye $3\frac{1}{2}$ to $4\frac{1}{3}$; snout $3\frac{1}{2}$ to 4. D. X, 11; A. III, 11; scales 4-34 to 39-13, 4 rows on cheek. Appearance of *Lepomis pallidus*. Body robust, moderately elongate, dorsal and ventral outlines about equally curved. Head rather large, a considerable depression in profile above eye; mouth rather large, maxillary reaching past front of eye. Dorsal spines rather high; pectorals reaching beyond middle of anal. Opercular flap smaller than eye, much as in *E. gibbosus*. Pharyngeal teeth not so blunt as in *gibbosus*. Color dark greenish above, gradually becoming brassy on belly; opercular spot greenish black, the flap with a broad, blood-red border in male, plain in females. No spot on dorsal or anal. Length about 8 inches.

This is a species of southern distribution, and in Ohio probably occurs only in the southwestern part of the state. It has been recorded, in 1888, for the Little Miami river in Hamilton County, by Henshall, under the name *Lepomis notatus*.

Eupomotis euryorus (McKay).

Head $3\frac{3}{4}$; depth $2\frac{2}{3}$. D. X, 11; A. III, 10; scales 6-43-14, 6 or 7 rows on cheek. Body very robust, compressed, dorsal outline more convex than ventral; profile steep, convex. Mouth oblique, small, maxillary reaching front of eye. Teeth on front of palatines. Lower pharyngeals with the rather long posterior spur turned up, stoutish; the inner angle rounded, somewhat obtuse. Teeth stout, very much blunted, not close set. Gill rakers short and stout, the inner surface roughened. Opercular flap nearly as long as snout, with a very broad, pale membranous margin. Dorsal spines low; ventrals and pectorals short, reaching vent. Color in spirits, mottled olive, yellowish below; top of head blackish; membranes of vertical fins dusky; ventrals dusky, with lighter margins; pectorals pale. Length 8 inches.

This rare sunfish has been recorded from but two localities in Ohio, both of these to the credit of Mr. McCormick, who says of them: "I took several specimens near Huron, July 6, 1891, and two near Lorain, in September." Only two other specimens were known at the time Mr. McCormick took these.

Eupomotis gibbosus (Linnaeus). COMMON SUNFISH;
PUMPKIN SEED; SUNNY.

Head 3 to $3\frac{1}{4}$; depth $1\frac{3}{4}$ to 2; eye 4 to $4\frac{1}{2}$; snout $4\frac{1}{2}$. D. X, 10 to 12; A. III, 10 or 11; scales about 6-44-13, 4 rows on cheek. Body short and deep, compressed, the profile steep, convex. Head rather small; mouth small, maxillary scarcely reaching front of eye. Dorsal spines high, the longest 2 to $2\frac{1}{2}$ in head, equal to distance from snout to posterior edge of pupil; pectorals long, as long as head. Gill rakers short and soft, weaker than in any other species except *Lepomis megalotis*. Pharyngeal teeth all bluntly rounded, paved, the bones very broad and somewhat concave. Opercular flap small, the lower posterior part always bright scarlet, a character which distinguishes this species at once in the adult. Color greenish olive, brilliantly marked with blue and orange on the sides; belly orange; lower fins orange, upper blue and orange-spotted; cheeks orange, with wavy blue streaks. One of the most gaudy of our Sunfishes, and quite variable. Length 8 inches.

An abundant species in the ponds and lakes of central and northern Ohio, common in the large streams and in the quiet waters of bayous. Not common in the smaller streams, and said to be rather rare in the southern part of the state. In Sandusky Bay and in Licking reservoir it is the most abundant sunfish. Ross lake, Hamilton County, and Lake Erie, Henshall, 1889; Lorain County, "very abundant below the ripples in the larger streams, and in the bayous near the lake. A few taken in the pounds," Camden lake, McCormick, 1892; Maumee river system, "abundant in all the lakes, common in all the larger streams, except the Auglaize river, less common in the smaller streams," Kirsch, 1893; Franklin County, Scioto and Olentangy rivers, Big Walnut and Big Darby creeks, not common, Williamson and Osburn, 1897; Huron river at Milan, Sandusky Bay, St. Mary's reservoir, Wabash river at Celina, North Fork of Licking river at Newark, R. C. Osburn, 1899; Pippin lake, Chippewa lake, Summit lake, Licking reservoir, abundant in all these localities, R. C. Osburn, 1900.

Genus: MICROPTERUS.

Key to Species.

- A. Eleven rows of scales above lateral line, about 17 rows on cheek:— *dolomieu*.
 AA. Seven rows of scales above lateral line, about 10 rows on cheek.— *salmoides*.

Micropterus dolomieu Lacepede. SMALL-MOUTHED BLACK BASS.

Head $2\frac{1}{2}$ to $3\frac{1}{2}$; depth $2\frac{3}{4}$ to $3\frac{1}{2}$; eye 5 to $6\frac{1}{2}$. D. X, 13 to 15; A. III, 10 to 12; scales 11-72 to 85-25 (Ohio specimens average about 75 in lateral line). Body rather elongate in young, becoming deeper with age. Mouth large, but smaller than in *M. salmoides*, the maxillary usually not extending back of posterior edge of orbit. This species can always be distinguished at once from *M. salmoides* by the smaller scales, there being 11 rows of scales above the lateral line, while in *salmoides* there are but 7 rows. The color is exceedingly variable, giving rise to a number of local names among sportsmen. The usual color is a dark green, with bronze or golden reflections, sometimes almost black on the back; belly lighter. A lateral band never present. Said to reach a length of 2 feet.

Widely distributed over the state and common everywhere in suitable localities. Dr. Jordan aptly says in regard to its habits, "as compared with *M. salmoides* it is a fish of the running waters, having little liking for warm and grassy ponds, bayous or lakes." It is found in nearly all streams, sometimes even ascending small, spring-fed brooks. Recorded by all students of Ohio fishes from Rafinesque and Le Sueur on down, and under a great variety of names. I give the locality records of later investigators. Hamilton County, "common in Little Miami river," Henshall, 1888; Lorain County, "common in the larger streams, not so often seen in the lake as the next species," McCormick, 1892; Maumee river system, "common in all the streams, none from the lakes," Kirsch, 1893; Franklin County, generally abundant, Williamson and Osburn, 1897; Big Jelloway creek system, Knox County, nearly all streams, abundant in some places, Parker, Williamson and Osburn, 1898; John's creek at Waterloo, Ice creek at Iron-ton, Huron river at Milan, Sandusky Bay, Ashtabula creek, Wabash river at Celina, Stillwater and Wolf creeks near Dayton, North Fork of Licking river at Newark, R. C. Osburn, 1899; Mahoning river, E. B. Williamson, 1900; Cuyahoga river at Hawkins, Grand river at Painesville, Chagrin river at Willoughby, Wheeling creek at Bridgeport, Ohio river and McMahan creek at Bellaire, Licking reservoir, R. C. Osburn, 1900.

Micropterus salmoides (Lacepede). LARGE-MOUTHED BLACK BASS;
OSWEGO BASS; GREEN BASS; BAYOU BASS.

Head 3 to $3\frac{1}{2}$; depth 3 to $3\frac{1}{4}$; eye 5 to 6. D. X, 12 or 13; A. III, 10 or 11; scales 7-65 to 70-18. Body much as in *M. dolomieu*, ovate-fusiform. Mouth very large, maxillary (except in very young) reaching past eye. Always distinguishable from *M. dolomieu* by the larger scales, 7 rows above lateral line. Color variable, usually dark green above, becoming greenish silvery on sides and belly. Young always with a distinct, black lateral band, which becomes fainter with age and disappears entirely at about the fourth year. Length $1\frac{1}{2}$ to $2\frac{1}{2}$ feet.

This species is found in lakes, bayous and in channels of larger streams. It is a fish of the quiet water. Widely distributed. Like the preceding species it has been the subject of much synonymy. Rafinesque records it under the name *Lepomis pallida*, for the Ohio, Miami and Hocking rivers. Hamilton County, "common in Ross lake," Henshall, 1888; Lorain County, "more common in the lake than in the streams," McCormick, 1892; Maumee river system, common in all the lakes, also common in the Maumee river and most of its larger tributaries, but none in Auglaize river or its tributaries, Kirsch, 1893; Franklin County, Scioto river, Big Walnut creek, Big Darby creek, not common, Williamson and Osburn, 1897; Ohio river and Ice creek at Ironton, John's creek at Waterloo, Huron river at Milan, Sandusky Bay, Wabash river at Celina, R. C. Osburn, 1899; Pippin lake, Chippewa lake, Summit lake, Grand river at Painesville, Licking reservoir, R. C. Osburn, 1900.

Family: PERCIDÆ.

Key to Genera.

- A. Pseudobranchiæ well developed; preopercle serrate; branchiostegals 7; no anal papilla.
- B. Canine teeth on jaws and palatines; body elongate; ventral fins well separated.— STIZOSTEDION.
- BB. Canine teeth none; body oblong, ventral fins near together.— PERCA.
- AA. Pseudobranchiæ imperfect or wanting; preopercle entire or nearly so; branchiostegals 6; anal papilla usually present.
- C. Parietal region of skull depressed, not strongly convex in transverse section, ~-shaped in section.
- D. Cranium broad between the eyes, snout conic, projecting pig-like beyond the inferior mouth.— PERCINA.
- DD. Cranium not broad between the eyes, snout not much projecting.
- E. Body not hyaline nor extremely elongate, its surface almost entirely covered with scales.
- F. Premaxillaries not protractile, the skin of the premaxillary continuous in the middle with that of the forehead with no cross groove between.— HADROPTERUS.
- FF. Premaxillaries protractile (in *Cottogaster shumardi* a narrow, connecting frenum sometimes crosses from the premaxillary to the forehead).
- G. Anal spines 2, both well developed, the first usually the longer.
- H. Mid-line of belly naked or covered by caducous shields; gill membranes scarcely connected.— COTTOGASTER.
- HH. Belly covered with ordinary scales; gill membranes broadly connected.— DIPLESION.
- GG. Anal spine single, obscure; anal fin small, much shorter than soft dorsal.— BOLEOSOMA.
- EE. Body extremely elongate, hyaline, subterete, the belly mostly naked.
- I. Premaxillaries not protractile; dorsal spines 12 or 13.— CRYSTALLARIA.
- II. Premaxillaries protractile; dorsal spines 9 to 11.— AMMOCRYPTA.
- CC. Parietal region of skull not depressed, more or less strongly convex in cross-section, □-shaped; premaxillaries never protractile; belly covered with ordinary scales.
- J. Lateral line straight; body rather robust.— ETHEOSTOMA.
- JJ. Lateral line with a slight arch running high anteriorly; body slender.— BOLEICHTHYS.

Genus: STIZOSTEDION.

Key to Species.

- A. Pyloric coeca 3; soft dorsal with about 20 rays; a black spot on last dorsal spines.—
vitreum.
- AA. Pyloric coeca 4 to 7; soft dorsal with about 17 rays; no black spot on posterior dorsal
spines, a black blotch at base of pectoral: second dorsal with rows of dark spots.—
canadense.

Stizostedion vitreum (Mitchill). WALL-EYED PIKE; PIKE PERCH;
YELLOW PIKE; BLUE PIKE; JACK SALMON.

Head $3\frac{2}{3}$; depth about $4\frac{1}{2}$; eye $4\frac{1}{2}$ to 5. D. XII to XVI, 19 to 21; A. II, 12 to 14; scales 10-110 to 132-25; lateral line incomplete. Body slender, becoming compressed with age. Cheeks and upper surface of head nearly naked. Dorsal spines high, more than one-half the length of head; dorsal fins well separated; soft dorsal nearly as long as the spinous. Pyloric coeca, 3. Color, dark olive, finely mottled with brassy; sides of head more or less vermiculated; belly and lower fins pinkish; spinous dorsal with a large, jet black spot on posterior 2 or 3 membranes. Length about 3 feet.

Common in Ohio river and Lake Erie, and sometimes ascending their larger tributaries. Kirtland reported it from Lake Erie and the Maumee and Ohio rivers under the name *Lucio-perca americana*. Hamilton County, "abundant in the Ohio river," Henshall, 1888; Lorain County, "very common in the lake, entering the streams occasionally," McCormick, 1892; Maumee river at Grand Rapids and Toledo, and Lake Erie around the mouth of the Maumee in large numbers, Kirsch, 1893; Huron river at Milan, Sandusky Bay, R. C. Osburn, 1899.

Stizostedion canadense griseum (De Kay). SAUGER; SAND PIKE;
GRAY PIKE; PICKERING.

Head $3\frac{1}{2}$; depth varying with age, $4\frac{1}{2}$ to 6; eye 5. D. XI to XV-I, 17 to 19; A. II, 11 or 12; scales 9-100 to 125-27; lateral line incomplete. Body more terete than in *S. vitreum*. Head depressed, pointed; opercular spines fewer than in the typical *S. canadense*, and the head less completely scaled. Color, olive gray, sides brassy or orange, with dark mottlings; spinous dorsal with 2 or 3 rows of irregular, dark spots, no large, black spot on posterior rays. A more translucent fish than *S. vitreum*. Pyloric coeca 4 to 7. Length about 18 inches.

Distributed about as the preceding species. Common both in the lake and Ohio river. "Abundant in the Great Lakes, plentiful in Ohio river," Jordan's Report; Hamilton County, "common in the Ohio river," Henshall, 1888; Lorain County, "common in the lake, entering streams oftener than *S. vitreum*,"

McCormick, 1892; Maumee river at Grand Rapids, Waterville and Toledo, Blanchard river at Ottawa, west end of Lake Erie, Kirsch, 1893. I have seen many dead ones on the lake beach at Sandusky.

Genus: PERCA.

Perca flavescens (Mitchill). YELLOW PERCH; RINGED PERCH.

Head $3\frac{1}{4}$; depth $3\frac{1}{4}$. D. XIII to XV-II, 13 to 15; A. II, 7 or 8; scales 7-74 to 88-17; lateral line incomplete. Body slender in young, becoming stouter with age; adults have the back considerably arched, the profile convex from dorsal to occiput, thence concave forward to the projecting snout. Cheeks closely scaled; well developed striae on operculars and rugosities on top of head. Color, dark olivaceous above, sides golden yellow, with 6 or 8 broad, dark vertical bars; belly pale, lower fins red or orange. Length 1 foot.

A fish of the quiet waters, found abundant in the reservoirs, ponds, bayous and lakes of central and northern Ohio, but not recorded for the southern part of the state. Kirtland recorded it (*Bodianus flavescens*) as abundant in Lake Erie and the small lakes of northern Ohio. "St. Mary's reservoir and Lake Erie," Henshall, 1889; Lorain County, "common in the lake and lower portions of the rivers," McCormick, 1892; Maumee river at Grand Rapids, Waterville and Toledo, St. Mary's river at St. Marys, Tiffin river at Brunersburg, west end of Lake Erie, Kirsch, 1893; Huron river at Milan, Sandusky Bay, Wabash river at Celina, St. Mary's reservoir, R. C. Osburn, 1899; Summit lake and Licking reservoir, R. C. Osburn, 1900. It is very abundant in Sandusky Bay and common in Licking reservoir. I have also seen the species from the Ohio canal at Newark.

Genus: PERCINA.

Percina caprodes (Rafinesque). LOG PERCH; HOGFISH;
HOG MOLLY; STONE ROLLER.

Head 4 to $4\frac{3}{4}$; depth 5 to $6\frac{1}{2}$; eye 4. D. about XV-15; A. II, 11, Body elongate, slender. Head long and pointed, depressed and sloping above; snout "pig-like," projecting beyond the inferior mouth; eyes widely separated. Color, light yellowish or yellowish green, with about 15 vertical, dark bars extending down on sides below lateral line and alternate with the same number of shorter bars. Length 8 inches.

This largest of Ohio darters is widely distributed over the state and generally common. It is found in the quiet waters of streams of all sizes (but more commonly in the larger ones), and in lakes, on gravelly or sandy bottom. Given by Rafinesque for the Ohio and Miami. Kirtland reported it "common," and Jordan, "generally abundant." Hamilton County, "common in Little Miami river and Ross lake," Henshall, 1888; Lorain County, "not very common, taken both in rivers and the lake, abundant in Sandusky Bay and Put-in-Bay, and it formed the bulk of the fishes that I saw among the terns' nests on Rattle Snake Island," McCormick, 1892; Maumee river system, rather common, nearly all streams, Kirsch, 1893; Franklin County, generally distributed, common, but nowhere abundant, Williamson and Osburn, 1897; Big Jelloway creek, Knox County, "common," Parker, Williamson and Osburn, 1898; Ohio river at Ironton, Huron river at Milan, Ashtabula creek, Wabash river at Celina, Stillwater creek at Dayton, North Fork of Licking river at Newark, R. C. Osburn, 1899; Lake Erie at Sandusky, Cuyahoga river at Kent and Hawkins, Breakneck creek at Kent, Chippewa lake, Summit lake, Grand river at Painesville, Ohio river at Bellaire, Licking reservoir, R. C. Osburn, 1900.

To the northward this species is represented by the following variety :

Percina caprodes zebra (Agassiz). MANITOU DARTER.

This variety is found in the northern part of the state, with the typical *caprodes*. It is known chiefly by the lack of scales on the nuchal region, the rather more slender form, and the shorter vertical bars. It intergrades with the typical *caprodes*.

The Manitou Darter has been recorded for the state by McCormick in Lorain County, 1892, as "occurring with the typical form in proportion of about 1 to 3, some specimens showing intermediate stages;" Lake Erie at Sandusky, Cuyahoga river at Hawkins, and Grand river at Painesville, R. C. Osburn, 1900.

Genus: HADROPTERUS.

Key to Species.

- A. Mid-line of belly with a series of enlarged caducous plates, which fall off at certain intervals, leaving a naked strip from breast to vent; preopercle strictly entire, not serrated.
- B. Lower jaw as long as upper, snout very narrow and pointed.—*phoxocephalus*.
- BB. Lower jaw shorter than upper, included; head moderate, not long and pointed.
- C. Cheeks with very small scales; dorsal spines 13 to 15.—*aspro*.
- CC. Cheeks naked; dorsal spines 10 to 12.—*evides*.
- AA. Enlarged plates of mid-line of belly persistent at least posteriorly; preopercle finely serrated.—*scierus*.

Hadropterus phoxocephalus (Nelson).

Head $3\frac{2}{3}$ to 4; depth $5\frac{1}{2}$ to 6; eye $4\frac{1}{2}$. D. XI or XII—12 to 14; A. II, 8 or 9; scales 12–80 to 85–16; lateral line incomplete. Body slender. Head very long and pointed; mouth terminal, large; jaws sub-equal; snout very long, acuminate. Cheeks, opercles and neck with small scales, breast naked; caducous shields of midline of belly small. Gill membranes somewhat connected. Color, brownish olive, much vermiculated; a row of about 14 dark, quadrate spots, sometimes confluent, along lateral line. Length 6 inches.

Recorded from three widely separated localities, which would indicate a general distribution, yet it seems to be quite rare except in the southwestern part of the state, where Henshall, 1888, reports it as common in Little Miami river. One specimen was taken near Lorain, by McCormick, 1892; and Mr. E. B. Williamson and the writer took a single specimen in Big Walnut creek near Lockbourne, Franklin County.

Hadropterus aspro (Cope and Jordan). BLACK-SIDED DARTER.

Head 4; depth 5 to 6; eye 4. D. XIII to XV—11 to 13; A. II, 8 to 10; scales 9–65 to 80–17, lateral line incomplete. Body rather elongate, subterete, compressed behind. Head moderately elongate; snout blunt; mouth sub-inferior, lower jaw included; gill membranes slightly or not at all connected. Opercle with rather large scales; cheek with very small, imbedded scales; breast naked; caducous scales of mid-ventral line rather large. Color light yellowish or greenish yellow, tessellated above with dark olive or blackish; white below; about 8 large, dark blotches along lateral line, these often confluent; fins barred. Length about 4 inches.

A common species throughout the state. Found in clear streams on gravelly bottom. Hamilton County, "common in East Mill creek," Henshall, 1888; Lorain County, "nowhere common, but found in most streams and the lake," McCormick, 1892; Maumee river system, "abundantly distributed in all the

streams examined," Kirsch, 1893; Franklin County, a common darter of general distribution, Williamson and Osburn, 1897; Big Jelloway creek, Knox County, "common," Parker, Williamson and Osburn, 1898; John's creek at Waterloo, Huron river at Milan, Ashtabula creek, Wabash river at Celina, Stillwater creek at Dayton, North Fork of Licking river at Newark, R. C. Osburn, 1899; Ohio river at Bellaire, outlet of Licking reservoir, R. C. Osburn, 1900.

***Hadropterus evides* (Jordan and Copeland).**

Head $4\frac{1}{3}$; depth $5\frac{1}{3}$; eye $3\frac{1}{2}$, large and high in head. D. XI-10; A. II, 8 or 9; scales 9-52 to 67-9 to 11. Body moderate, somewhat compressed. Head heavy, the profile rather convex. Mouth moderate, lower jaw included. Cheeks, nape and throat naked; opercles with rather large caducous scales; ventral shields but little enlarged. Fins large, pectorals long. Coloration extremely brilliant in breeding males, females and young plainer. General color above, dark olivaceous, tessellated with darker; back and sides with about 7 broad, transverse bars; fins marked with orange, black, bronze, yellow and blue-black. "One of the most brilliant of all fishes." Length 2 or 3 inches.

Rare in Ohio, its distribution being more westerly. The species has, however, been taken in the Ohio river at Raccoon Island, by Dr. Henshall, 1889, and by Kirsch, in the Maumee river at Grand Rapids.

***Hadropterus scierus* Swain.**

Head 4 to $4\frac{1}{3}$; depth 5 to 6; eye 4 to $4\frac{1}{2}$. D. XIII-13 or 14; A. II, 9; scales 7-68 to 70-17. Body robust. Head rather short, snout bluntish; mouth small, lower jaw included; preopercle more or less distinctly serrate. Gill membranes broadly connected. Opercle with large scales, those on cheek slightly smaller. Throat naked, breast nearly so. Ventral shields but little enlarged and not caducous except anteriorly. Color yellowish olive, everywhere vaguely blotched with black; top of head, dorsal, anal and ventral fins black in male, paler in female; scales everywhere finely punctulate with brown; sides with a few larger, black specks. Length 5 inches.

Rare. Like the preceding species, its distribution is westerly. I know of but one record for the state, that by Henshall, "Ohio river, near Little Sandy river, 1889."

HADROPTERUS PELTATUS (Stauffer).

Mr. McCormick has recorded (1892) this species from Vermillion river, two specimens. *H. peltatus*, as now understood, occurs from southeastern Pennsylvania southward along the coast, and is not known west of the Alleghanies, so I am inclined to think there must be some error in the above record. Under this belief I omit the species from the Ohio list.

Genus: COTTOGASTER.*Key to Species.*

- A. Mid-line of belly with a series of enlarged caducous scales or plates.— *copelandi*.
 AA. Mid-line of belly naked anteriorly, covered with ordinary scales posteriorly.—
shumardi.

Cottogaster copelandi (Jordan).

Head $3\frac{3}{4}$ to $4\frac{1}{4}$; depth $5\frac{1}{2}$ to $6\frac{1}{2}$; eye about $3\frac{1}{2}$. D. X to XII—10 to 12; A. II, 8 or 9; scales 6-44 to 56-8. Body rather slender. Head rather large and long, much resembling that of *Boleosoma*. Mouth small, horizontal, sub-inferior, cheeks naked; opercles and neck with a few scales, throat naked; ventral plates well developed. Pectoral fin as long as head. Color, brownish olive, tessellated above; a series of small, oblong, dark blotches along lateral line, sometimes indistinct. Vertical fins with dusky specks; a black spot on anterior rays of spinous dorsal. Length $2\frac{1}{2}$ or 3 inches.

Widely distributed over the state, but apparently very rare everywhere. Muskingum river, and Ohio river at Raccoon Island, 1889, and Lake Erie at Put-in-Bay, Henshall; Lorain County, "Vermillion river, but one specimen taken," McCormick, 1892; Maumee river at Toledo, two specimens, Kirsch, 1893; in Huron river at Milan, in 1897, two specimens were taken by Prof. D. S. Kellicott, Mr. E. B. Williamson and the writer.

Cottogaster shumardi (Girard).

Head $3\frac{2}{3}$ to 4; depth 5 to $5\frac{1}{2}$; eye $3\frac{1}{2}$. D. IX to XI—13 to 15; A. II, 10 to 12; scales 6-48 to 60-11. Body stout, heavy forward, compressed behind. Head broad and thick. Mouth large and broad, lower jaw the shorter. Premaxillaries usually protractile, but a narrow frenum sometimes present. Cheeks, opercles and neck usually scaly; chest naked; belly naked anteriorly, scaled for a short distance before vent. Color dark, densely but vaguely spotted with darker; sides with 8 or 10 obscure blotches; a large, black spot at base of spinous dorsal behind, and a small one in front. Length 3 inches.

Not common, but occurring in both the Lake Erie and Ohio river drainage. Found on sandy bottom in rivers, not found in small streams. Recorded by Henshall for the Muskingum river and for the Ohio river near Parkersburg, 1889; recorded for Vermillion river as *Etheostoma wrighti*, by McCormick, 1892; in 1899 the writer took a half dozen specimens in the Ohio river at Ironton, and in August, 1900, the species was again taken at Bellaire.

Genus: DIPLESION.**Diplesion blennioides** (Rafinesque). GREEN-SIDED DARTER.

Head about $4\frac{1}{2}$; depth $4\frac{3}{4}$ to 6. D. XII to XIV-12 to 15; A. II, 8 or 9; scales 6-58 to 78-14. Body elongate, subterete. Head short, profile very convex, snout very blunt, cheeks tumid; eyes large, $3\frac{1}{2}$, high up and close together; mouth small, inferior; gill membranes broadly connected. Cheeks with fine scales, opercles with large ones, breast naked. Color dark olive green, tessellated above; sides with 7 or 8 Y-shaped, dark bars, these sometimes confluent to form a dark zigzag band. In highly colored males a number of broad, bright green bands almost encircle the body. Females and young may be quite dull, but the pattern of the dark marks on the side is characteristic. Length 3 to 5 inches.

The Green-sided Darter is an abundant resident of the clear, rapid streams of the state, found especially on stony ripples. Rafinesque records it from the Ohio and Muskingum. Kirtland mentions its occurrence in the state, and Jordan gives it as "abundant." Hamilton County, "abundant in East Mill creek and Little Miami river," Henshall, 1888; "Vermillion river, scarce, not uncommon in Sandusky Bay," McCormick, 1892; Maumee river system, taken in all the large streams (except St. Mary's river) and nearly all the smaller ones, Kirsch, 1893; Franklin County, abundant, and of general distribution, Williamson and Osburn, 1897; Big Jelloway creek system, common on ripples, Parker, Williamson and Osburn, 1898; John's creek at Waterloo, Huron river at Milan, Ashtabula creek, Wabash river at Celina, Stillwater creek at Dayton, North Fork of Licking river at Newark, R. C. Osburn, 1899; Mahoning river, E. B. Williamson, 1900; Cuyahoga river at Hawkins, Breakneck creek at Kent, Grand river at Painesville, Chagrin river at Willoughby, Wheeling creek at Bridgeport, Ohio river and McMahan creek at Bellaire, R. C. Osburn, 1900.

Genus: BOLEOSOMA.**Boleosoma nigrum** (Rafinesque). JOHNNY DARTER.

Head about 4; depth 5 to 6; eye $3\frac{1}{2}$ to 4. D. IX-11 to 14; A. I, 7 to 9; scales 5-44 to 55-9. Body fusiform, slender. Head moderate, snout somewhat bluntly decurved; mouth small, lower jaw included. Cheeks and breast usually naked; opercles scaly. Anal spine short and weak; fins all high.

Color usually pale olivaceous, much tessellated above; sides with numerous small W-shaped, dark blotches. Males in breeding season heavily pigmented, especially anteriorly, with blue-black. A black line forward and downward from eye. Fins barred. Length 2 to 2½ inches.

The little Johnny Darter is found all over Ohio, and is usually quite abundant. It inhabits lakes and rivers on sandy bottom, the clear creeks of Ohio are favorite abiding places, and every small brook and spring run large enough to contain any fish at all will be found to have its quota of "Johnnies." Hamilton County, "common in Little Miami river," Henshall, 1888; Lorain County, "very common everywhere, one of the few species that may be depended upon when the seine is drawn," McCormick, 1892; Maumee river system, common everywhere, Kirsch, 1893; Franklin County, taken in every stream, abundant, April 3rd given as a breeding date, Williamson and Osburn, 1897; Big Jelloway creek system, abundant in every stream, Parker, Williamson and Osburn, 1898; John's creek at Waterloo, Huron river at Milan, Sandusky Bay, Ashtabula creek, Wabash river at Celina, Stillwater and Wolf creeks at Dayton, North Fork of Licking river at Newark, R. C. Osburn, 1899; Niggermill Run and Mahoning river, E. B. Williamson, 1900; Pippin lake, Chipewa lake, Summit lake, Cuyahoga river at Kent and Hawkins, Breakneck creek at Kent, Grand river at Painesville, Chagrin river at Willoughby, Wheeling creek at Bridgeport, Ohio river and McMahan creek at Bellaire, Licking reservoir, R. C. Osburn, 1900.

Genus: CRYSTALLARIA.

Crystallaria asprella (Jordan).

Head $4\frac{1}{3}$ to $4\frac{1}{2}$; depth 7 to 8. D. XII to XIV-13 to 15; A. I, 12 to 14; scales 7 to 10-98 to 100-10. Body long and slender. Head long and slender; eye large; mouth not large, subterminal; premaxillaries not protractile; opercular spine well developed. Cheeks and opercles with pectinate scales; throat and belly naked, space between ventrals scaled. Color translucent olive, pellucid in life; with 3 or 4 more or less distinct, dark cross bands on back and sides; a dark lateral band made up of about 10 more or less confluent blotches. Length 5 or 6 inches.

Apparently a very rare species in Ohio, and confined to larger streams. Recorded by Henshall for the Muskingum river, 1889; and one specimen was taken on sandy bottom in the Ohio river at Ironton, May 31, 1899, by the writer.

Genus: AMMOCRYPTA.

Ammocrypta pellucida (Baird). SAND DARTER.

Head 4 to $4\frac{3}{4}$; depth 7 to $8\frac{1}{2}$. D. X-10; A. I, 8 to 10; scales in lateral line about 75, about 6 rows above lateral line. Body very long, terete, quite pellucid in life. Head stout; eyes large, high up, interorbital space narrow. Cheeks, opercles, and temporal region with embedded scales; belly and sides below lateral line entirely naked; much of dorsum in front and on either side of dorsal fin naked or thinly scaled. Translucent, sometimes tinged with olivaceous; scales with narrow, dark edging; about 12 or 15 black blotches along the sides; a gilt lateral band. Length 3 inches.

The Sand Darter is well distributed over the state and is common locally in larger streams on sandy bottoms. Taken also in the lake. Hamilton County, common in Little Miami river, Henshall, 1888; Lorain County, Lake Erie and the larger streams, not common, McCormick, 1892; "common everywhere on sandy bottom in the Maumee river, and in the lower courses of the larger tributaries," Kirsch, 1893; Franklin County, Olentangy river, Big Walnut and Little Walnut, Big Darby and Black Lick creeks, not common, June 28 given as a breeding date, Williamson and Osburn, 1897; Huron river at Milan, Wabash river at Celina, Stillwater creek near Dayton, R. C. Osburn, 1899; Grand river at Painesville, Ohio river at Bellaire, R. C. Osburn, 1900.

Genus: ETHEOSTOMA.

Key to Species.

- A: Lateral line complete. (A few tubes rarely wanting.)
- B. Gill membranes broadly connected across the isthmus.
- C. Anal fin nearly as large as soft dorsal; spinous dorsal with about 13 spines.—*variatum.*
- CC. Anal fin much smaller than soft dorsal; spinous dorsal with 10 or 11 spines.—*zonale.*
- BB. Gill membranes scarcely connected across the isthmus.
- D. Head short, the muzzle abruptly decurved, mouth somewhat inferior; lower jaw included.—*canurum.*
- DD. Head rather long and pointed, snout not decurved, mouth terminal, jaws subequal.—*maculatum.*
- AA. Lateral line more or less incomplete.
- E. Humeral region without differentiated black, scale-like process.—*coeruleum.*
- EE. Humeral region with distinct, black process or scale.
- F. Gill membranes scarcely connected; lower jaw not projecting.—*tippecanoe.*
- FF. Gill membranes connected; lower jaw strongly projecting.—*flabellare.*

Etheostoma variatum Kirtland.

Head $3\frac{1}{2}$ to 4 or more; depth $4\frac{1}{3}$ to $5\frac{1}{2}$; eye $3\frac{1}{2}$ to 4. D. XII-13 (XII to XIV-11 to 13); A. II, 7 to 10; scales 8-51 to 63-12. Body moderately elongate, not much compressed, the back somewhat arched. Head short and thick; snout short and blunt, decurved, parietal region broad and depressed, resembling *Hadropterus* in this respect; profile above eyes strongly decurved; mouth small, lips thick, lower jaw included; premaxillary not protractile; gill membranes united. Head naked except 1 to 3 scales on opercle above; breast loosely scaled. Fins all very large, pectorals reaching beyond tips of ventrals. General color above, dark greenish olive, becoming barred vertically on the sides posteriorly, about four black blotches across the back. Females and young similarly marked, but paler. The following color description taken from the living specimen is typical of breeding males: Color, dark olive, with about 8 greenish cross-bars on posterior part of body; interspaces pale, each with 2 bright carmine spots; back crossed by 4 black bars; sides of belly bright orange; middle of belly pale; first dorsal dark brown at base, then a pale space, above this a wide, dark bar, then another pale space, bordered with bright orange; second dorsal and caudal flecked with carmine; anal greenish, bordered with pale orange; ventrals greenish black with a little orange at the margin; pectorals tinged with orange and green, the rays with carmine spots. Length $3\frac{1}{2}$ inches.

This elegant darter was described by Dr. Kirtland from the Mahoning river in 1838, and was not taken again in the state for fifty years, until, in 1888, Henshall recorded it for the Little

Miami river, near Red Bank, as "not rare." In April, 1897, Mr. J. B. Parker found it common on swift ripples in Big Jelloway creek, Knox County, and in May, 1898, Messrs. Parker, Williamson and the writer, seining the Big Jelloway creek system, found this to be "the most abundant darter, especially frequenting swift ripples." In Franklin County, in the summer of 1897, the species was taken by Mr. E. B. Williamson and the writer on swift ripples in Big Walnut creek, Little Walnut creek, and Black Lick, but nowhere common. In 1899 the writer took the species in North Fork of Licking river near Newark; and in 1900, in the Ohio river at Bellaire.

***Etheostoma zonale* (Cope).**

Head 4 to 5; depth 4 to 6; eye $3\frac{1}{2}$ to 4. D. X or XI-10 to 12; A. II, 6 to 8; scales about 6-5c-9. Body rather slender, somewhat compressed. Head small and short; mouth small, subinferior; snout blunt, profile rapidly descending; gill membranes broadly connected. Cheeks, opercles and neck usually scaled, breast usually naked. Color clear olive green above, with 8 or 10 greenish blue vertical bands which encircle the body posteriorly; below paler, with a brassy tinge; breast greenish black. First dorsal black at base, then a wide orange bar margined with black anteriorly, with greenish posteriorly; second dorsal orange at base, dark above; caudal and pectorals plain, tinged with green; anal and ventrals green, black at base. Young and females dull and speckled, the vertical bars indistinct and the fins speckled. Length 2 or 3 inches.

This species has been taken in a number of localities of the state, indicating a pretty general distribution. It is locally common, but is only taken on swift ripples. Hamilton County, "common in East Mill creek and Little Miami river," Henshall, 1888; Franklin County, Scioto river, Olentangy river, Big Walnut creek, Little Walnut creek, Alum creek, Black Lick, common where found, Williamson and Osburn, 1897; Big Jelloway creek system, Knox County, "common on swift ripples," Parker, Williamson and Osburn, 1898; Huron river at Milan, Stillwater and Wolf creeks near Dayton, North Fork of Licking river at Newark, R. C. Osburn, 1899; Ohio river at Bellaire, R. C. Osburn, 1900.

***Etheostoma camurum* (Cope). BLUE-BREASTED DARTER.**

Head $3\frac{1}{2}$ to 4; depth 4 to $4\frac{1}{2}$. D. XI-12 or 13; A. II, 8; scales 7-50 to 58-8. Body stout, rather compressed. Head short; snout blunt, profile

rapidly descending; lips thick, lower jaw included. Caudal peduncle deep. Color, dark olivaceous, sometimes nearly black above, somewhat barred on the sides; a dark longitudinal line on each row of scales; sides irregularly flecked with crimson dots; belly pale; throat and breast deep dark blue. Fins marked with brown, green, black, yellow and crimson. Females less distinctly marked. Length $2\frac{1}{2}$ inches.

The Blue-breasted Darter is rather rare in Ohio, although it has been taken at a number of widely separated localities, which would indicate a general distribution. It is found in company with *E. zonale*, on swift, stony ripples, but is much less frequent in occurrence. Jordan mentions it for the Mahoning river; "Muskingum river," Henshall, 1889; Franklin County, Scioto river, Olentangy river, Big Walnut creek, not common, Williamson and Osburn, 1898; Huron river at Milan, Stillwater creek at Dayton, North Fork of Licking river at Newark, R. C. Osburn, 1899.

***Etheostoma maculatum* Kirtland.**

Head $3\frac{3}{4}$ to 4; depth $4\frac{3}{4}$ to $5\frac{1}{4}$. D. XII-12 or 13; A. II, 8 or 9; scales 9-56 to 63-14. Body elongate, caudal peduncle very deep. Head acuminate, the front descending very gradually, the mandible rising as gradually to its extremity; jaws subequal. Lateral line complete; cheeks naked; opercles scaled; gill membranes not connected. Color, above black, shading to dark olive below; throat turquoise blue; sides and dorsum marked with small, circular spots of bright crimson. First dorsal uncolored, with a black spot at its base in front and a dark shade through the middle; second dorsal blood red; caudal with two large, crimson spots confluent on the mid-line of the tail at its base. Female dull, the fins dark barred and not crimson. Length $2\frac{1}{2}$ inches.

Very rare. The species was described in 1838 from specimens taken in the Mahoning river by Dr. Kirtland. I know of but one subsequent record of its capture within the state. Mr. E. B. Williamson and the writer took a single specimen, a female with ripe eggs, from a swift ripple in Big Walnut creek, near Lockbourne, Franklin County, on June 26, 1897.

***Etheostoma cœruleum* Storer. RAINBOW DARTER; BLUE DARTER;
SOLDIER FISH.**

Head $3\frac{1}{2}$ or more; depth $4\frac{1}{4}$; eye 4 to $4\frac{1}{2}$. D. IX to XII-12 to 14; A. II, 7 or 8; scales 5-37 to 50-10. Body robust, rather deep and compressed. Head large, compressed. Mouth moderate, terminal, oblique, the lower jaw somewhat included; gill membranes not united. Cheeks naked

or nearly so, opercles scaled, neck and breast usually naked. Color, olivaceous, tessellated above; sides with a varying number (about 12) of vertical, indigo-blue bars, separated by orange interspaces; throat, breast and sides of belly orange; cheeks blue-green; first dorsal crimson at base, above this an orange bar, margined with blue; other vertical fins chiefly orange, tipped with blue. Females much plainer, with very little blue or red. Length $2\frac{1}{2}$ inches.

This elegant little fish is widely distributed over the state, and is generally abundant. It is most common in the smaller streams, and is always found in running water, usually on ripples, and does not occur in lakes. Kirtland reported it in 1854 from near Cleveland, under the name *Poecilosoma erythrogastrum*. Jordan gives it as "the most abundant member of the family." Hamilton County, "very common in East Mill creek," Henshall, 1888; Lorain County, "one of the most common darters," McCormick, 1892; Maumee river system, "not taken in the Maumee, St. Mary's and St. Joseph rivers, common in all the other larger streams and nearly all the small ones," Kirsch, 1893; Franklin County, abundant, of general distribution, Williamson and Osburn, 1897; Big Jelloway creek, "very common," Parker, Williamson and Osburn, 1898; John's creek at Ironton, Huron river at Milan, Ashtabula creek, Wabash river at Celina, Stillwater and Wolf creeks at Dayton, North Fork of Licking river at Newark, R. C. Osburn, 1899; Mahoning river, E. B. Williamson, 1900; Cuyahoga river, at Hawkins, Grand river at Painesville, Chagrin river at Willoughby, Wheeling creek at Bridgeport, McMahan creek at Bellaire, R. C. Osburn, 1900.

The following variety of this species is also taken in Ohio :

***Etheostoma cœruleum spectabile* (Agassiz).**

It is known from the typical species by the "faded out" appearance of the ground color of the back, and by the arrangement of the olivaceous into distinct longitudinal lines. It is also rather more slender than the typical *cœruleum*, into which, both in color and in measurement it insensibly grades.

This variety is found in brooks and smaller streams, replacing to some extent the typical form in central and western Ohio. Specimens from Ohio streams show many intermediate stages. Recorded by Kirsch from Sugar creek, near Lima; Franklin County, taken only in the small streams, "grading insensibly into

the typical species," Williamson and Osburn, 1897; headwaters of Wabash river at Celina, Wolf creek near Dayton, brooks tributary to North Fork of Licking river near Newark, R. C. Osburn, 1899; Breakneck creek at Kent, tributaries of Grand river at Painesville, R. C. Osburn, 1900.

Etheostoma tippecanoe Jordan and Evermann.

Head $3\frac{1}{2}$ to $4\frac{1}{4}$; depth $4\frac{1}{4}$ to $4\frac{3}{4}$; eye small, $4\frac{1}{2}$ in head. D. XII-12; A. II, 7; scales 5 or 6-46 to 50-8; lateral line straight, developed on only about 30 scales. Body compressed, caudal peduncle deep. Head rather small, little compressed; mouth large, terminal, oblique, the lower jaw somewhat included; gill membranes scarcely connected. A small, well defined, black humeral scale. Cheeks, throat and breast naked; opercles scaled. Color in life, dark olive green, strongly tinged with yellow, especially posteriorly, passing into greenish yellow on belly; about 14 narrow, well defined, greenish black vertical bands encircling the body posteriorly; breast deep blue-black, the color extending forward on the throat and backward on the ventral fins; dorsal and anal fins golden yellow, pigmented with blue-black; pectorals plain golden yellow; ventrals golden yellow, blue-black at base. Female paler, no high colors, dark markings less distinct. Length $1\frac{1}{2}$ inches.

In Ohio this exceedingly rare darter has been taken only in Franklin County. Four specimens were taken by Mr. E. B. Williamson and the writer, one in the Olentangy river at Columbus, in September, 1896, the other three in Big Walnut creek near Lockbourne, on June 26, 1897. The species was taken in very swift ripples.

Etheostoma flabellare Rafinesque. FAN-TAILED DARTER.

Head $3\frac{1}{2}$ to 4; depth $4\frac{1}{2}$ to 6; eye 4 to 5. D. VIII-12 to 14; A. II, 7 to 9; scales about 9-50-14. Body slender, compressed. Head long and pointed; snout not decurved, mouth very oblique, lower jaw projecting; gill membranes well connected. Fins all low, the first dorsal notably so, and, in the male, the spines tipped with fleshy knobs; caudal large, rounded. Head entirely naked; a narrow, bare strip along base of spinous dorsal. Color very dark olivaceous, forming vertical bars on sides; each scale with a dark center; dark humeral spot conspicuous; dorsal and caudal fins barred with black. Some Ohio specimens approach the variety *lineolatum*, characterized by distinct longitudinal lines along the rows of scales. Length $2\frac{1}{2}$ inches.

A common species in the clear, rapid streams of the state, found especially on ripples. Hamilton County, "common in East Mill creek," Henshall, 1888; Lorain County, "rare,

Vermillion river," McCormick, 1892; Maumee river system, St. Joseph river at Edgerton, Tiffin river at Brunersburg, Sugar creek at Lima, Beaver creek at Grand Rapids, Kirsch, 1893; Franklin County, nearly every stream, abundant, Williamson and Osburn, 1897; Big Jelloway creek, Knox County, "a very common species," Parker, Williamson and Osburn, 1898; John's creek at Waterloo, Huron river at Milan, Ashtabula creek, Wabash river at Celina, Stillwater and Wolf creeks near Dayton, North Fork of Licking river at Newark, R. C. Osburn, 1899; Niggermill Run at Salem, E. B. Williamson, 1900; Lake Pippin, Cuyahoga river at Kent, Wheeling creek at Bridgeport, Ohio river and McMahan creek at Bellaire, R. C. Osburn, 1900.

Genus: BOLEICHTHYS.

Boleichthys fusiformis (Girard).

Head $3\frac{1}{2}$ to 4; depth $3\frac{3}{4}$ to 6; eye 3 to 4. D. VIII to X-9 to 12; A. II, 6 to 8; scales 3-43 to 60-12. Body usually elongate, compressed. Head rather long and narrow; snout short, decurved; mouth terminal, lower jaw slightly included; premaxillaries not protractile; gill membranes connected. Cheeks, opercles, nape and breast usually scaled. Lateral line incomplete, high up, often interrupted. Color, olivaceous, the sides and back blotched with darker, pale below; in adult males the sides are usually flecked with crimson; base of caudal with 4 dark spots in a vertical row; spinous dorsal usually blue, with a median crimson band. An extremely variable species.

Jordan records the species for the state as "noticed only in tributaries of the Maumee, in Ohio." No other collector mentions it. However, it seems to be distributed over northern and central Ohio, in suitable localities. The writer has found it to be rather common in shallow water in Sandusky Bay, and has taken it also in the Huron river at Milan, 1899, and in Pippin and Summit lakes and in Licking reservoir, 1900.

Family: SERRANIDÆ.

Genus: ROCCUS.

Roccus chrysops (Rafinesque). WHITE BASS.

Head $3\frac{1}{2}$; depth $2\frac{1}{2}$; eye 5. D. IX-I, 14; A. III, 11 or 12; scales 10-55 to 65-15. Body rather deep and compressed; back considerably arched. Head subconical; mouth moderate, nearly horizontal, lower jaw slightly projecting. Head scaled to between nostrils. Color, silvery, tinged with golden below; sides with narrow, dusky lines. Length 15 inches.

An abundant species in Lake Erie, ascending the larger tributaries to some distance. The species is said to be common in the lower Ohio, but no one seems to have noticed it within the limits of the state, though it probably ascends to that distance. Lake Erie, Henshall, 1889; Lorain County, "quite common in the lake, ascending the streams to the dams," McCormick, 1892; Maumee river at Grand Rapids, Waterville and Toledo, Kirsch, 1893; abundant in Lake Erie at Sandusky, rare in Huron river at Milan, R. C. Osburn, 1899.

Family: SCIÆNIDÆ.

Genus: APLODINOTUS.

Aplodinotus grunniens Rafinesque. SHEEPSHEAD; DRUM;
WHITE PERCH.

Head $3\frac{1}{2}$; depth $2\frac{3}{4}$; eye 3. D. X, 30; A. II, 7. scales 9-55-13. Body oblong; back much elevated and compressed; profile long and steep, straightish. Head slightly compressed; mouth moderate, subinferior. Lower pharyngeal bones fully united, with course, blunt, paved teeth. Color, grayish silvery, dusky above, sometimes very dark; back sometimes with dusky streaks along the rows of scales. Attaining a weight of 50 or 60 pounds.

An abundant species both in Lake Erie and the Ohio river, and ascending their larger tributaries to some distance. Kirtland, following Le Sueur, recorded the lake form as *Sciæna oscula*, and the Ohio river form as *S. grisea*. Jordan gives it as very abundant in Lake Erie, and also mentions it for the Ohio. Hamilton County, "abundant in Ohio river," Henshall, 1888; Lorain County, "very common in the lake, Vermillion river, Black river," McCormick, 1892; Maumee river at Defiance, Grand Rapids, Waterville and Toledo, west end of Lake Erie, Kirsch, 1893; Muskingum river at McConnellsville, Prof. D. S. Kellcott; Ohio river at Ironton, Huron river at Milan, Lake Erie at Sandusky, R. C. Osburn, 1899; Ohio river at Bellaire, R. C. Osburn, 1900.

Family: COTTIDÆ.

Genus: COTTUS.

Cottus ictalops (Rafinesque). MILLER'S THUMB; SPRING FISH.

Head about $3\frac{1}{3}$; depth 4 to 6; eye 4. D. VI to VIII-16 or 17; A. about 12; ventral fin I, 4, the spine slender and closely attached to the first ray. Body stout anteriorly, tapering regularly back to the slender caudal peduncle. Skin smooth, except just behind the pectorals, where it is beset with very small, sharp prickles, these sometimes obsolete; lateral line conspicuous. Gill membranes not meeting across the very broad isthmus. Olivaceous, more or less barred and speckled with darker; fins mostly barred or mottled. Quite variable. Males in breeding season with a wide, black bar margined with orange on dorsal fin, and under side of head pigmented with dark or blue-black. Length 3 to 7 inches.

Widely distributed, but never abundant; sometimes locally common. It occurs in clear, cold brooks and rapid streams. Recorded as *Cottus bairdii*, by Girard, from specimens taken by Spencer F. Baird, in Mahoning river at Poland. Given by Jordan as *C. richardsoni*; Lorain County, common in Spring brook and Chance creek, McCormick, 1892; Maumee river system, St. Joseph river at Edgerton, Kirsch, 1893; Franklin County, four specimens from Brackenridge's Run, Williamson and Osburn, 1897; Big Jelloway creek system, Knox County, Parker's Run and Black's Run, common in the latter, Parker, Williamson and Osburn, 1898; a small brook tributary to North Fork of Licking river at Newark, R. C. Osburn, 1899.

Family: GADIDÆ.

Genus: LOTA.

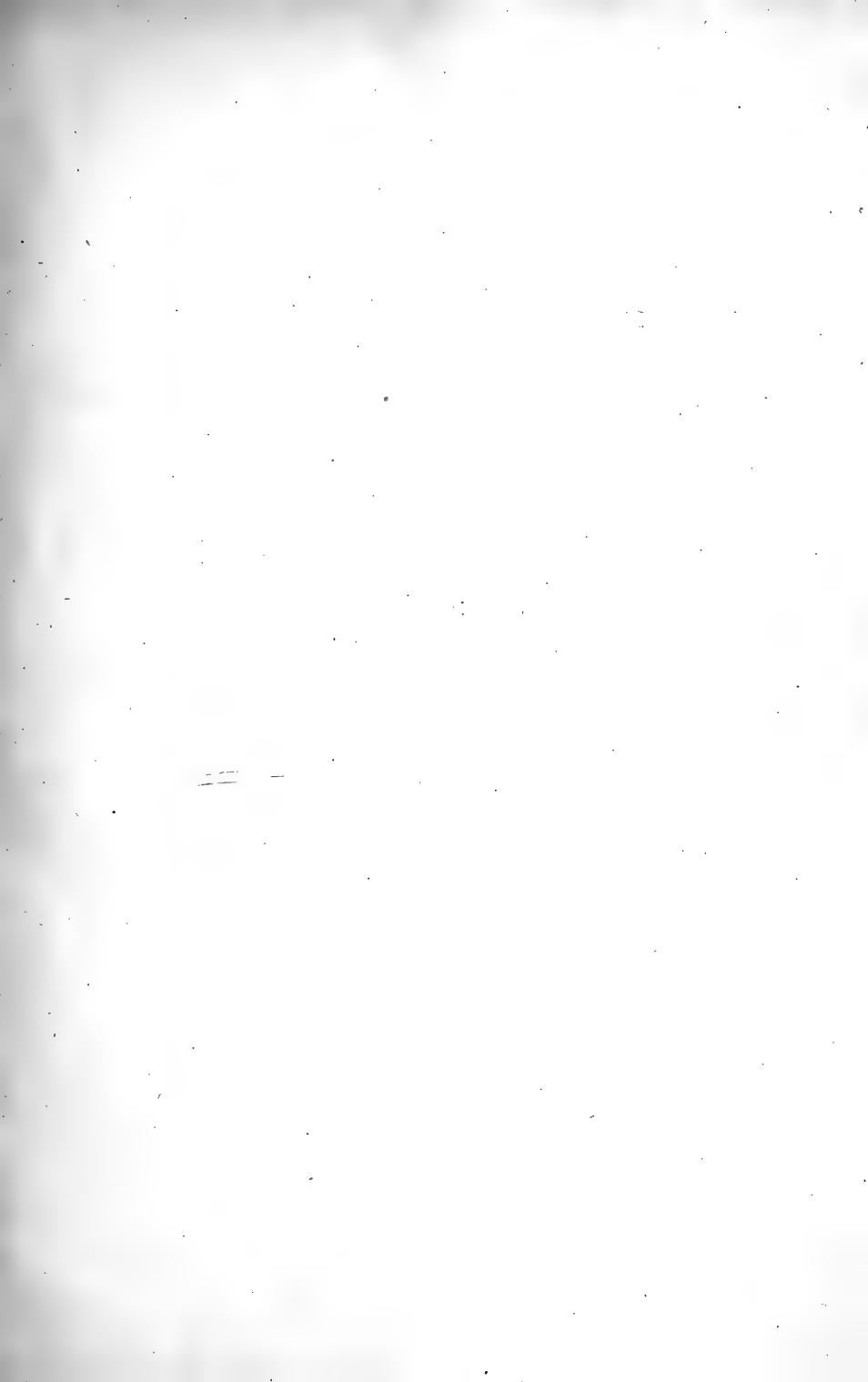
Lota maculosa (Le Sueur). BURBOT; LING; LAKE LAWYER.

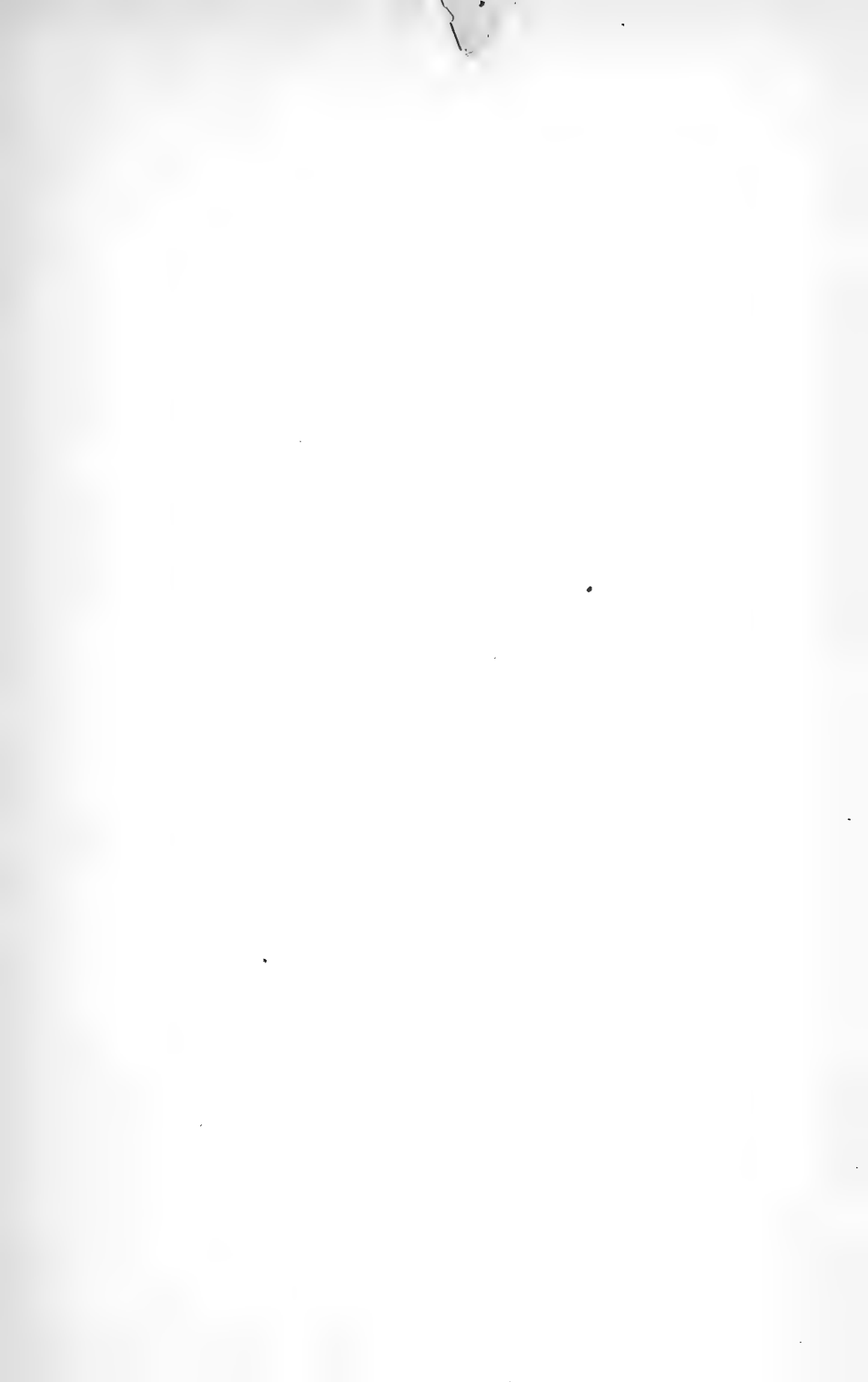
Head $4\frac{1}{2}$; depth $5\frac{1}{2}$; eye 7. D. 13-76; A. 68; scales very small, embedded. Body elongate, not much compressed anteriorly. Head slightly depressed; mouth large; a single barbel on the chin. 30 pyloric coeca. Color, dark olive, thickly marbled and reticulated with blackish; below, yellowish or dusky. Length about 2 feet.

Common in Lake Erie, not recorded elsewhere in the state. Recorded for Lake Erie by Le Sueur, 1817, by Kirtland, 1838; by Henshall, 1888, and by McCormick for Lorain County, Lake Erie, 1892; Sandusky, R. C. Osburn, 1899 and 1900.

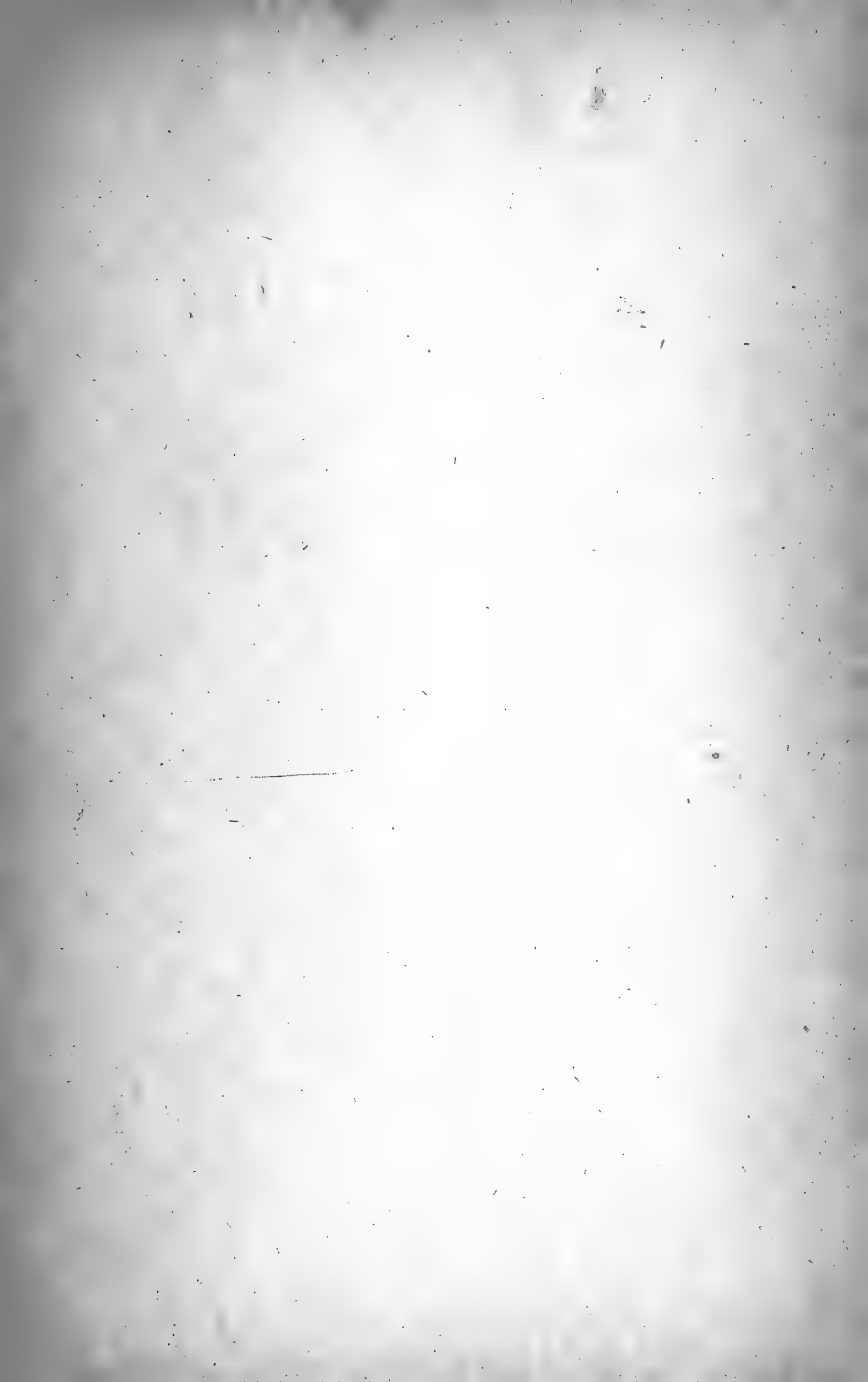
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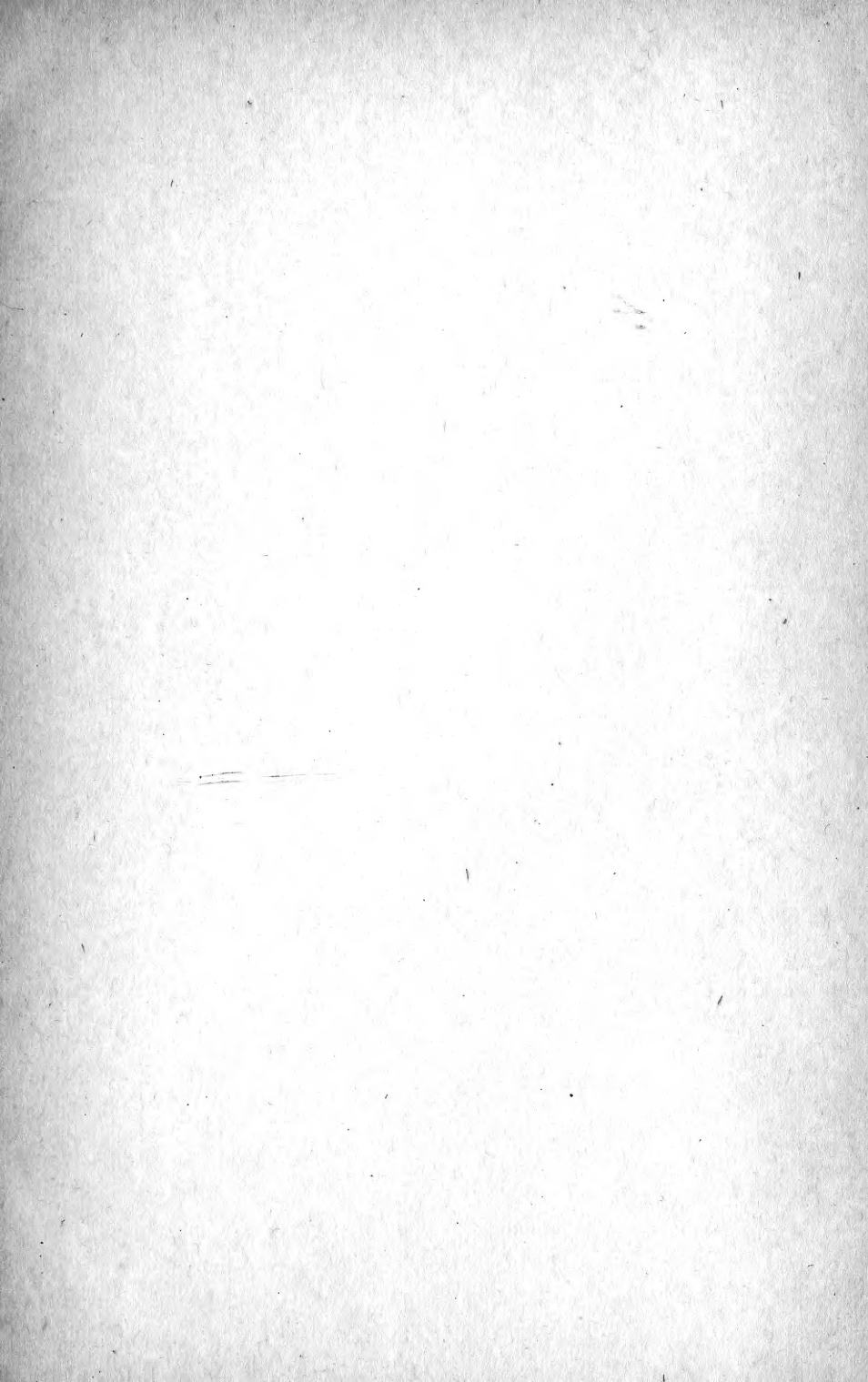
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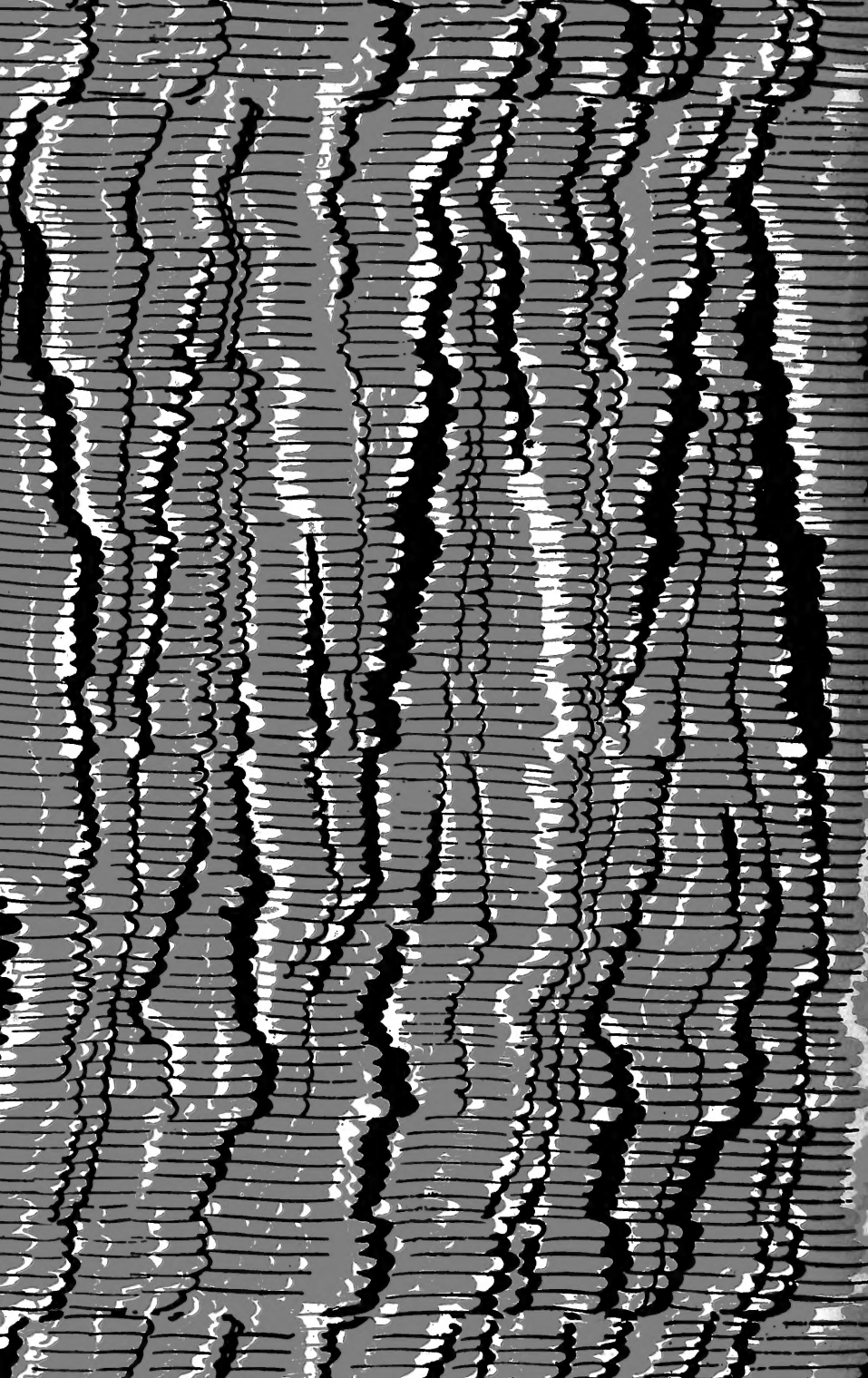


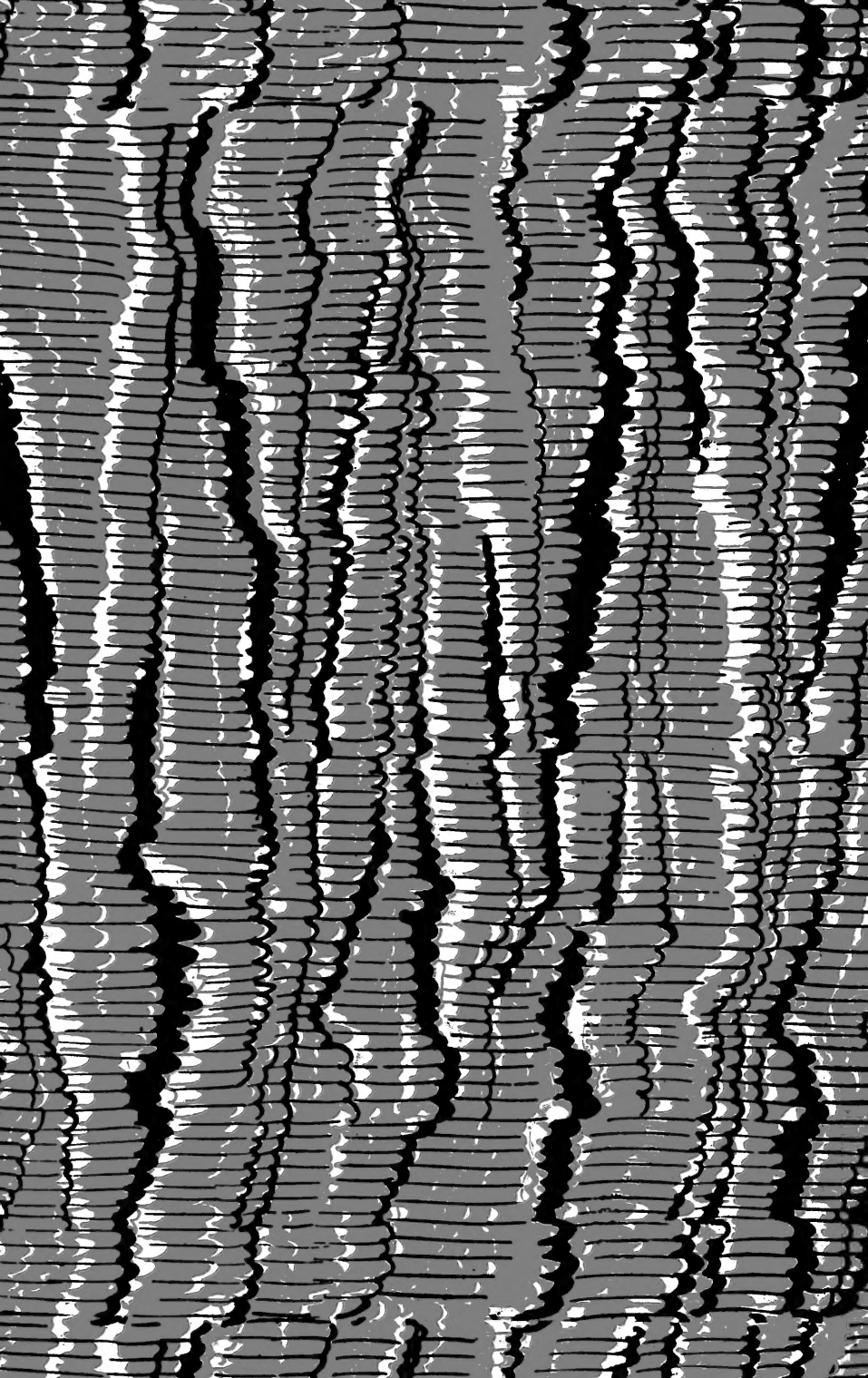












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