

Completed by  
BRYANT WALKER.

# THE DISTRIBUTION

NH

OF THE

# UNIONIDÆ

IN MICHIGAN

By

BRYANT WALKER.



Read before the Michigan Academy of Science

March 31, 1898

UNIVERSITY OF MICHIGAN  
21255

REPUBLIC OF INDONESIA  
KEMENTERIAN PERTANIAN  
KANTOR WILAYAH  
KABUPATEN

130.7  
16W177  
898  
1611.

# THE DISTRIBUTION

OF THE

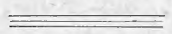
# UNIONIDÆ

IN MICHIGAN

BY

BRYANT WALKER.

111



Read before the Michigan Academy of Science  
March 31, 1898.



## THE DISTRIBUTION OF THE UNIONIDÆ IN MICHIGAN.

This paper is based upon the reports filed in connection with the census of Michigan mollusca, undertaken by the Conchological Section of the Academy, shortly after its organization two years ago. The reports now on file comprise every collection, both public and private, known within the state, and purport to give not only every species represented in these collections, but every locality where they have been collected. Every species known to belong to the fauna of the state, with one exception, is represented by from two to more than one hundred entries. The compilation which has been made from these reports may, therefore, be said to represent accurately the extent of our present knowledge of the fauna of the state and of its distribution.

The unione fauna of this state is the largest and most varied of any portion of the continent included within the drainage area of the great lakes. Michigan is the only one of the states which lies wholly within the St. Lawrence basin and consequently the only one, whose fauna can be considered as a whole without any of the complications arising from a conflict of political and topographical boundaries. The consideration of the origin and distribution of its existing fauna is therefore of great interest and, it is believed, of some scientific importance.

In the "Review of Our Present Knowledge of the Molluscan Fauna of Michigan" which was read before the Academy at its first meeting in December, 1894, there were recognized as belonging to the fauna of the state—of

<i>Unio</i> .....	42 species.
<i>Margaritina</i> ,.....	5    "
<i>Anodonta</i> ,.....	18   "

---

Total.....65

Since that time two species of *Unio* have been added to the list, while, for various reasons, four species there given have been either dropped entirely or united as varieties or synonyms to other forms.

Of the *Anodontas*, while it is probable that in the future the number of recognized species will be considerably reduced, it has been thought that at present two only should be eliminated.

The list of *Margaritinae* remains unchanged.

For the purposes of this paper, therefore, the total number of species recognized is sixty-one, divided as follows:

Unio, .....	40
Margaritina, .....	5
Anodonta .....	16
	<hr/>
	61

A full list of these and of those considered doubtful and synonymous will be found in appendix I.

Of each of these species a list of localities has been compiled from the reports above mentioned and these again have been spread upon an outline map of the state prepared for the purpose and showing the principal rivers and lakes. By this means the range of each species over the state is shown in connection with the principal drainage systems in such a way that at a glance the relations, if any, between the two are obvious. An examination of these maps will show that there is a great difference in the range of the various species. Some appear to be of general distribution all over the state; others are confined to the northern part; while others are apparently restricted to the more southern streams; while still others seem to be limited to much smaller districts.

On collating the species, which seem to have substantially the same range, and considering each genus separately, we find the following results.

#### UNIO.

Of the forty species of this genus, but seven appear to range over the whole state, viz:

*Unio gibbosus* Bar.  
*luteolus* Lam.  
*nasutus* Say.  
*novi-eboraci* Lea.  
*phaseolus* Hild.  
*pressus* Lea.  
*ventricosus* Bar.

Three species are peculiar to the northern part of the state, viz:

*Unio borealis* Gray.  
*complanatus* Sol.  
*superiorensis* Marsh.

Of these the first and last are variations of the common *luteolus* stock, so abundantly distributed throughout the state.

*Unio complanatus* has recently been ascertained to exist in Macomb, Monroe and Lenawee counties, in the southeastern part of the state, and at Muskegon on the west shore. It is essentially a northern species, however, and unless further observations shall increase its southern range, it can scarcely be considered a species of general distribution.

A few species have thus far been found only in Lake Erie, the Detroit river and the streams tributary to them. They are

*Unio fabalis* Lea.  
*hippopæus* Lea.  
*leibii* Ler.  
*multiradiatus* Lea.  
*rangianus* Lea.  
*sulcatus* Lea.

The range of the remaining thirty-four species belonging to our fauna is apparently bounded on the north, roughly speaking, by line drawn diagonally across the state from the mouth of the Saginaw river to the mouth of the Grand river.

Of these, three species have been found only in the Grand river, viz:

*Unio lævissimus* Lea.  
*kirtlandianus* Lea.  
*tenuissimus* Lea.

Two others appear only in the Grand river on the west side of the state and near the mouth of the Saginaw river on the east coast.

*Unio asperrimus* Lea.<sup>1</sup>  
*cornutus* Bar.

Most of the remainder of this group appear to have a general range around the entire southern part of the state. A considerable number, however, have not yet been reported from the interior of the state, viz:

*Unio alatus* Say.  
*circulus* Lea.  
*donaciformis* Lea.  
*elegans* Lea.  
*ellipsis* Lea.  
*glans* Lea.  
*gracilis* Bar.

<sup>1</sup> Since this was written, a single valve of this species has been found on the shore of Belle Isle, Detroit River.

*Unio ligamentinus* Lam.  
*parvus* Bar.  
*plicatus* Lea.  
*pustulosus* Lea.  
*rectus* Lam.

Two others have not been found in the extreme southeastern part of the state, viz:

*Unio spatulatus* Lea.  
*trigonus* Lea.

Omitting these species, whose distribution is apparently restricted to a greater or less degree, we have a remainder of five species which have a general range over the whole southern portion of the state. They are

*Unio coccineus* Hild.  
*rubiginosus* Lea.  
*triangularis* Lea.  
*undulatus* Bar.  
*verrucosus* Bar.

#### MARGARITINA.

Of the five species of these genus, two range over the whole state, viz:

*Margaritina deltoidea* Lea.  
*rugosa* Bar.

One, *Margaritina hildrethiana* Lea, has thus far been found only in Wayne and Monroe counties, in the southeastern corner.

*Margaritina complanata* Bar, has not been found outside of the Saginaw-Grand valley, except in one locality, the River Rouge, near Detroit.

*Margaritina marginata* Say, is apparently of general distribution through the southern part of the state and has been found as far north as Houghton Lake, Roscommon county, the source of the Muskegon river.

#### ANODONTA.

Any satisfactory consideration at the present time of the distribution of the species of this genus is rendered very difficult by the extreme variability of nearly all of the species, the lack of authentic specimens in the hands of local collectors as a basis for identification and the consequent uncertainty as to the reliability of many of the citations, which have



been filed with the Section. *Anodonta imbecilis* Say, is the only species, which is not more or less burdened with synonymy.

For the purposes of this paper, therefore, I have combined the sixteen species now recognized into six groups and in this way the general results can be considered as approximately correct. The groups are

1. Group of *Anodonta corpulenta* Cpr.<sup>1</sup>
2. " " " *grandis* Lea.<sup>1</sup>
3. " " " *edentula* Say.
4. " " " *ferussaciana* Lea.
5. " " " *fragilis* Lam.
6. " " " *imbecilis* Say.

Of these, four, in their various forms, are our most abundant species, and have been found practically everywhere where any collecting has been done. They are the groups of

*Anodonta grandis* Lea.  
*edentula* Say.  
*fragilis* Lam.  
*ferussaciana* Lea.

One species of the group of *Anodonta grandis*, *Anodonta simpsoniana* Lea is a northern form, originally described from the Great Slave Lake, and has not been noticed further south than Houghton Lake, Roscommon county. It is, however, believed to be an offshoot of the parent stock "altered and dwarfed" by peculiar environmental conditions, such as in the case of the *Unio luteolus*, have given rise to the forms known as *Unio borealis* Gray, and *superiorensis* Marsh, in the same region.

*Anodonta corpulenta* Cpr. and its allies have thus far been found only in the western waters of the state.

*Anodonta imbecilis* Say is a species substantially confined to the southern portion of the state, although it has been found as far north as Ludington, Mason county, on the Lake Michigan shore.

Summarizing these results, we find that of the forty species of *Unio*, only seven, or less than one-fifth, are known to range over the whole state. Three species are characteristic of the northern part of the state, while thirty, or seventy-

<sup>1</sup>These groups in a purely systematic arrangement would probably be united. Their separation here is solely to bring out their apparently peculiar distribution.

five per cent., are confined to the southern portion of the state and do not extend north of the Grand-Saginaw valley. Of these, six are found only in the southeastern portion of the state, in the streams tributary to Lake Erie.

Of the five species of *Margaritina*, two only are of general distribution, the three others being inhabitants of the southern part of the state, and one of these is apparently restricted to the tributaries of Lake Erie.

Of the six groups of *Anodonta*, four, embracing all the species but three, are of general distribution. One of the remaining groups, (that of *Anodonta corpulenta* Cpr.), seems to be restricted to the rivers immediately tributary to Lake Michigan and the third, a single species, is of general distribution in the southern part of the state.

In other words, taking the fauna as a whole, we find:

1st:—That but a comparatively small number of the species are of general distribution.

2nd:—That a few are peculiar to the northern part of the state.

3d:—That a few appear to be restricted to Lake Erie and the waters immediately tributary to it in the southeastern part of the state.

4th:—That a great majority (75 per cent.) of the species of *Unio* and *Margaritina* are only found in the southern part of the state, and are substantially confined to the Grand-Saginaw valley and that portion of the state lying south of it.

In view of the fact that the state lies wholly in one drainage area and is not traversed or cut up by any of the great natural barriers, which ordinarily limit the range of species and form the boundaries of zoological provinces, and that in the lower peninsular, at least, there are no such marked differences in topographical, geological or climatological conditions in any of its parts, which would naturally suggest such a radical difference in their fauna, these results seem strange and, if true, very curious and interesting.

The most obvious and natural reply to these conclusions is, of course, that they are not true, or rather, perhaps, that the most thorough work of our collectors has been done in the southern portions of the state, and that consequently, a greater number of species have been found there; that comparatively little thorough work has been done in the northern portions of the state, and that in all probability, if it were done, the number of species would be largely increased, and that until such work is done it is entirely wrong to attempt make any such generalizations at all. In short, that at the

present time our knowledge of the distribution of the various species belonging to our fauna is too imperfect and incomplete to justify any attempt in that direction.

While this criticism is undoubtedly just to a certain extent, and while it is true that our knowledge of the northern part of the state is far less perfect than that of the southern portion, and that the work done in the north has been somewhat fugitive in its character, and that there are, indeed, whole counties of whose fauna we know nothing, yet it seems to me that there is a fair basis for reaching the conclusions above stated.

While the work which has been done in the northern part of the state has been, perhaps, comparatively small, it has nevertheless been pretty well spread over the entire upper end of the lower peninsula.

I have indicated upon the accompanying map (Pl. I) the known range of two of our most common species, *Unio luteolus* Lam. and *Anodonta footiana* Lea, which experience shows are to be found practically everywhere.

This shows, therefore, exactly where work has been done and how much of the territory has been covered. I have also shown upon the same map the range of *Unio rubiginosus* Lea, which the reports show to be one of the most abundant species in the southern part of the state.

Other species could be added if it were necessary, but these will, I think, be sufficient for the purpose. It will be noticed that in the southern part of the state the range of the three species is substantially the same, but that, while in the northern portion the two species of general distribution still continue to be found together, the southern form has disappeared entirely.

Now these species are all about of the same size and are what would be called good-sized species and are not likely to be overlooked by the average collector.

Moreover, the work in both parts of the state has been done by the same persons, so that the difference cannot be laid to any personal equation on the part of the collectors.

It seems very improbable, therefore, that if the southern forms did extend into the northern part of the state, they would have been so completely overlooked by the same collectors, who had no difficulty in finding them in the south.

If this were the case of a few species only, the present fragmentary condition of our knowledge on the subject might be considered an adequate reason for the discrepancy. But where, as here, it exceeds to seventy-five per cent. of the whole fauna, it does not seem to me to be a satisfactory explanation.

While there is no doubt that future investigation will extend the range of some of the species, and thus to a certain extent, perhaps, modify the conclusions based on our present information, yet, in view of all the facts, I cannot but feel that they are substantially correct, although of course they must be considered rather tentative than final, and are presented now simply as embodying the present state of our knowledge on the subject.

If then, these facts are true, the question at once arises, as to what explanation can be found for them.

As has been stated, there are at the present time no natural barriers which limit the range of any of the species north or south.

The comparatively slight differences in temperature cannot be considered as a factor, because many of the species which are limited apparently to southern Michigan range north up the Mississippi valley into Minnesota and through the valley of the Red River of the North and similar streams into Manitoba, and even farther north, and the far greater extremes of temperature occurring in those regions do not appear to have any effect upon their size and vigor.

So far as known, the existing geological formations of the state are not such as to have any influence upon the chemical constituents of the water of the different rivers, which would effect the mollusca inhabiting them.

There being, then, no apparent solution of the problem to be obtained from existing conditions, it becomes necessary to consider the constituents of our present fauna, its origin and history and, in connection with them, those great geological and topographical changes in past ages which have resulted in the state as it now exists.

The eastern part of the United States in respect to its unione fauna is divided into two areas or provinces, known as Atlantic Region and Mississippi Region, the dividing line south of the St. Lawrence river being the Appalachian Mountains. Towards the north, however, some of the species of the Atlantic fauna have an extended western range through the great lakes and in British North America. In the same way many of the species characteristic of the Mississippi valley have extended north and east into Manitoba and the St. Lawrence valley.

In Canada and throughout the lake region, we have, then, a commingling of the two faunas, varying in proportion in different places.

In Michigan, the fauna taken as a whole, is almost en-

tirely Mississippian in character, only two of the sixty-one species being peculiar to the Atlantic fauna. In the northern part of the state, however, where the total number of species is greatly reduced, the proportion as a faunal element of course, becomes much greater.

Of the two species belonging to this fauna found in Michigan, one, *Anodonta fragilis* Lam., is of universal distribution through the state and is usually found in great abundance in all our inland lakes. It is extremely variable, no less than six species having been established on its varieties by Anthony and Currier.

The other, *Unio complanatus* Sol., has until lately been supposed to be confined to the northern part of the state, but recently evidence has been obtained that it is found at Muskegon, on the Lake Michigan shore, and in Macomb, Lenawee and Monroe counties on the eastern side. The latter are the first instances on record of the species having been found in any streams flowing into Lake Erie from the south and west, while the former is the only known record of the occurrence in any waters tributary to Lake Michigan.

Both of these species undoubtedly found their way into the state from the north and east. In view of the uninterrupted water-ways which have existed from time immemorial between the great lakes and the Atlantic Region, the route of this immigration is obvious and requires no explanation.

In regard to the existence of so large an element of our fauna of Mississippi valley species, however, the case is quite different. There is at the present time no natural water connection between the great lakes and either the Mississippi or Ohio river valleys. All the rivers in Michigan are tributary to the great lakes and reach the ocean through the St. Lawrence river.

How then, did such an immigration of species from a region now entirely separated from the great lakes occur? The explanation is to be sought for in the topographical changes incident to the glacial period.

During the glacial period, the entire state of Michigan was buried for several thousands of years under an ice cap of enormous thickness, which extended in some places as far south as the Ohio river. This undoubtedly resulted in the complete extermination of all forms of molluscan life in this region, which may have previously existed. With the receding of the ice, great bodies of water were formed, bounded on the south by the height of land and the north by the constantly retreating glacier. No outlet being possible to the eastward on account of the ice, the water made a way for

itself toward the south, and until the ancient Laurentian outlet was re-established, the overflow of the lake region was to the south into the Ohio and Mississippi valleys.

The channels of the great ancient water-ways can still be traced and are very clearly shown upon the accompanying relief map of the region. (Pl. II.)

One of them extended from the present western end of Lake Erie, southwesterly through what is now known as the valleys of the Maumee and Wabash rivers and emptied into Ohio river. The other connected the lower extremity of Lake Michigan with the Mississippi river along the present valleys of the DesPlaines and Illinois rivers.

At first these glacial lakes were entirely separated by the high land in the interior of the state, the ice forming a barrier to any communication on the north, and as the land to the south and west of Lake Michigan was lower than that lying south of Lake Erie, their waters were not on the same level. The beach of Lake Maumee—as it is called—being about 237 feet above the present level of Lake Erie, while the beach of the western lake, or Lake Chicago, was only about 125 feet above that of Lake Michigan.

As soon, however, as the ice had retreated far enough north to expose the valley of an ancient pre-glacier river, sometimes called the Huronian river and which is now known as the Saginaw-Grand valley, extending across the state from Saginaw Bay to the mouth of the Grand river, a channel was made which connected the two lakes. This resulted in the lowering of the water of Lake Maumee to the level of Lake Chicago, and the consequent closing of the Maumee outlet, and from that time until the St. Lawrence was reopened, the only outlet of the eastern lake was through this channel into the western lake and from that through the DesPlaines outlet into the Mississippi.

This channel across the state, as shown by the map, (Pl. III) was, in nearly all its course, several miles in width, and was from forty to one hundred feet in depth, and in the narrow portions there was doubtless a strong and very rapid current.

The remnant of this channel is to-day the most conspicuous feature in the topography of the state. It is well shown upon the relief map. At the present time the highest land in this valley between Lake Michigan and Lake Huron is only a little more than seventy feet, and it is said that in an early day in Gratiot county, where the head waters of the existing rivers centre, in the times of high water in the spring

the slight barrier offered by the existing watershed was overcome, and the water flowed both east and west.

Toward the close of the glacial period therefore, the northern part of the lower peninsula was an island separated from the main land by this great channel.

The existence of this ancient waterway is of peculiar interest to the conchologist because, as has already been stated, it to-day apparently forms the northern limit of the range of nearly three-fourths of our *Unione* fauna.

There can be no doubt that it was through these ancient channels that the barren waters of the lake region was peopled by an immigration of southern forms.\*

That the more hardy and vigorous species of the Mississippi fauna followed closely the retreating glacier, is shown by the fact that two species, *Unio ellipsis* Lea and *lutcolus* Lam. have been found fossil in the ancient beaches of Lake Agassiz, a glacial lake in Minnesota and Manitoba, contemporaneous with the Maumee and Chicago lakes, at heights varying from 165 to 275 feet above the present level of Lake Winnipeg.<sup>1</sup> While in the glacial drift near Toronto, Ontario, three species have been found fossil, which are not known to exist at the present time in the lake region.

It has been suggested that this latter find has an "important bearing upon the theory of a mild inter glacial period, preceded and followed by an advance of the ice. If the ice receded to the vicinity of Toronto, allowing these Mississippi species to attain to that region, the fact that they did not establish themselves there would be easily accounted for by the subsequent advance of the ice and the destruction of the colony. The final melting and disappearance of the ice cap, being complicated by change in the direction of the drainage, might not afford a second opportunity for the immigration of the species in question."<sup>2</sup> In view of the fact that all of these species are found abundantly in the Ohio valley and that one of them, *U. clavus* Lam, is not found in the upper waters of the Mississippi river, the query naturally arises, whether the closing of the Maumee outlet did not have something to do with their failure to re-establish themselves in the lake region upon the final receding of the ice.

And, in this connection, it is interesting to notice in reference to the six species which are restricted in the south-

\*. Simpson. Am. Nat XXX, p. 379, and Pro. U. S. Nat. Mus. XVIII, p. 338.

1. Upham—The Glacial Lake Agassiz, page 237.

2. Simpson—Pro. U. S. Nat. Mus. XXI., p. 595.

eastern part of the state to Lake Erie and the streams immediately tributary to it, that while two, *U. hippopæus* Lea and *Leibii*, Lea are local forms of questionable specific value, which are not found elsewhere, the remaining four are peculiar to the Ohio Basin and are not found in the upper waters of the Mississippi.

The inference, therefore, that these species found their way through the Maumee outlet and established themselves in southeastern Michigan before that outlet was closed seems conclusive. The fact, that they have not yet apparently spread beyond the streams tributary to the Detroit river and Lake St. Clair, explains why they did not effect an entrance into the western part of the state through the Huron outlet before that too was closed. The further fact, that one of them, *U. fabalis* Lea, is quoted from the upper waters of the St. Joseph river, in northern Indiana, by Call,<sup>1</sup> does not militate against this theory, but is rather to be explained by the close proximity of the head waters of that stream and those of some of the tributaries of the Wabash, which is pointed out by that author, and a probable immigration from them into the St. Joseph.

In the same way, the fact that two of our species *U. asperimus* Lea and *cornutus* Bar. are now apparently found only at the extremities of the Grand—Saginaw valley; and that three others, *U. levissimus* Lea, *kirtlandianus* Lea and *tenuissimus* Lea are reported from the Grand river only, would seem to indicate that these species were about the last to find their way into our waters before communication with the Mississippi was cut off, and for that reason succeeded in establishing themselves only in the ancient channel of the Huron outlet.

In a like manner, the present apparent distribution of the *Anodonta corpulenta* Cpr. and its allies in the state, would seem to indicate in some degree the history of its immigration. The typical species is a characteristic and peculiar form restricted to the upper waters of the Mississippi valley. In Michigan, the group seems to be confined to the streams tributary to Lake Michigan. A significant fact when taken into connection with its centre of distribution.

In regard to the remaining members of our fauna of Mississippian descent, which have a more or less general distribution over the southern part of the state, there is little, if anything, to indicate the route taken by them in their immigration. Most of them are common species of general and

<sup>1</sup> Hydrographic Basins of Indiana and their Molluscan Fauna. Pro. Ind. Acad. Sci. 1896, p. 247.



abundant distribution in both the Mississippi and Ohio valleys. They may have, and their general distribution in lower Michigan, would seem to indicate that they did make use of both of the DesPlaines and Maumee outlets in their invasion of the lake region.

Two of them, *U. circulus* Lea and *glans* Lea, are purely Ohio Basin forms and their occurrence in southwestern Michigan is probably to be attributed to some former connection between the head waters of the St. Joseph river and the northern tributaries of the Wabash, rather than to an incursion through the Maumee outlet and a round-about journey into the western streams by means of the Huron outlet. The fact that neither of these forms have been reported from the interior waters of the state, would seem to corroborate this view.

In regard to the fact that a considerable number of species have not been reported from the interior of the southern part of the state, it is quite possible that more thorough and extended connections may give them a wider range than they now seem to have. If, however, on further investigation this fact should be established, the reason for it will probably be found in some local conditions, such as, perhaps, the shallow waters of the interior streams, which are unfavorable to their development.

Coming finally to the consideration of the first question raised in this discussion, viz: the apparent restriction of so large a part of the Mississippian portion of our fauna to the Grand-Saginaw valley and that part of the state lying south of it, as has already been stated, there is no apparent reason in the present condition of things, why these species should not have made their way into the northern waters of the state. The explanation, then, must be sought for, if at all, in conditions existing prior to or contemporaneous with the formation of the present topography of the state.

As has already been stated there is reason to believe that the immigration of the southern *Unionida* followed very closely upon the receding of the ice-cap. The southern outlets of Lakes Maumee and Chicago must have become established almost simultaneously with the formation of the lakes themselves, and this done, the way was open to the invaders.

The *Unionida* of this country are essentially inhabitants of comparatively shallow water, and it was, no doubt, along the margin of these glacial lakes that the immigrants gradually spread, after they had passed through the rapidly flowing waters of the Maumee and DesPlaines outlets. The beach

lines of these lakes, therefore, represent with substantial accuracy the first territory occupied by the new fauna.

The accompanying diagram (Pl. III) of the 100 and 200 levels, taken from the contour map of the state, prepared by the late Dr. Alexander Winchell, in 1878, and believed to be substantially correct, shows approximately the position of these ancient beaches with reference to the present lake shore of the state.

The 200 feet level on the southeast being substantially the shore line of Lake Maumee, while the 100 feet level represents the eastern shore of Lake Chicago and, after the opening of the Saginaw outlet, and the consequent lowering of Lake Maumee, the shores of both lakes, whose waters were then on practically the same level.

In process of time as the level, first of Lake Maumee and then of both lakes, was lowered, and the present system of drainage was established, the *Unionidæ* would naturally follow the retreating waters, and thus finally found their way into the rivers on either side of the state as we now find them.

From the line of the glacial lake beaches down to their mouths the *Unionidæ* seems to have had no difficulty in occupying the rivers of the southern portion of the state. But in the upper waters of these streams, above that line, few species seem to have been able to obtain a foothold. As has already been stated of the large number of species which are now found south of the Saginaw-Grand valley but five appear to range generally across the state. The remainder are found only in the lower waters of the rivers on either one or both sides of the state, and in the Saginaw-Grand valley. And it is certainly significant, that so far as the returns show, the range of these species toward the interior, is substantially coincident with the beach line of the glacial lakes. That is to say that it would appear that the majority of our species, which come from the south, have migrated down stream from the place where they first obtained a foothold in the present river systems, but for some reason, with the exception of a few species, have not succeeded in spreading up stream to any considerable extent.

As the low land which had been occupied by the Huron outlet was the last to emerge from the waters, so it was probably the last to receive its unionidæ fauna. And until it was substantially closed, the width and depth of this great channel was apparently too great to be overcome by the species, which

must by that time have become established along its southern shore and in the streams tributary to it in what was then the southern peninsula. Otherwise, there seems to be no reason why they should not have established themselves along its northern margin, and from thence spread into the lower waters of the rivers on both sides of the northern part of the state, as they seem to have done in the southern streams.

With the final disappearance of this channel and the peopling of the streams, which now occupy its bed, the northern advance of the greater part of the southern *Unionida* seems to have ceased.

Why all of these species have not continued to spread to the north up the numerous rivers, which now drain the northern part of the state, as a few seem to have done, is unknown.

I have no theory to suggest, except that it may be owing to the same unfavorable conditions of local environment, which have apparently prevented many of them from extending into the head waters of the streams of the southern part of the state, from the margins of the ancient glacial lakes where, if the theories here advanced are true, was originally their home, and from which they have spread so generally into the lower waters of the streams on either side. The fact that some of them have extended their range northerly along the Lake Michigan shore and establish themselves in the lower waters of some of these northern rivers, would seem to substantiate this view.

In conclusion, I desire to express my obligations to collectors of the state and to the custodians of the public museums who, by their cordial co-operation in the work of the census have not only permitted it to be accomplished, but have most materially contributed to whatever measure of success that has been attained.

# APPENDIX I.

## CATALOGUE OF THE UNIONIDÆ OF MICHIGAN.

NOTE.—This list is believed to contain every species which has at any time been cited as belonging to the fauna of Michigan. No attempt has been made to complete the synonymy of any species beyond that required to exhibit all citations, which have been made whether under the accepted nomenclature or under names now considered obsolete. The five columns represent the distribution of the species as follows:

- G.—General over the whole state.  
 N.—Northern part only.  
 E.—Saginaw-Grand Valley only.  
 S.—Southern part only.  
 S. E.—Southeastern part only.

	G	N	V	S	SE	REMARKS.
<b>Unio</b>						
<i>alatus</i> Say.....				x		Not in interior.
<i>asperrimus</i> Lea.....			x			
<i>borealis</i> Gray.....		x				
<i>circulus</i> Lea.....				x		Not in interior.
<i>coccineus</i> Hild.....				x		Also St. Mary's river?
<i>complanatus</i> Sol.....		x				Also in Macomb, Lenawee and Monroe counties and at Muskegon.
<i>purpureus</i> Say.....						
<i>cornutus</i> Bar.....			x			
<i>donaciformis</i> Lea.....				x		Not in interior.
<i>elegans</i> Lea.....				x		Not in interior.
<i>ellipsis</i> Lea.....				x		Not in interior.
<i>olivarius</i> Raf.....						
<i>fabalis</i> Lea.....					x	
<i>lapillus</i> Say.....						
<i>gibbosus</i> Bar.....	x					
<i>dilatatus</i> Raf.....						
<i>glaucus</i> Lea.....				x		Not in interior.
<i>gracilis</i> Bar.....				x		Not in interior.
<i>fragilis</i> Raf.....						
<i>hippopæus</i> Lea.....					x	
<i>kirtlandianus</i> Lea.....			x			Grand river only.
<i>levisimus</i> Lea.....			x			Grand river only.
<i>leibii</i> Lea.....					x	
<i>ligamentinus</i> Lam.....				x		
<i>crassus</i> Say.....						
<i>luteolus</i> Lam.....	x					
<i>distans</i> Anth.....						
<i>siliquoides</i> Bar.....						
<i>multiradiatus</i> Lea.....					x	
<i>nasutus</i> Say.....		x				
<i>novi-eboraci</i> Lea.....		x				
<i>opifinus</i> Anth.....						
<i>parvus</i> Bar.....				x		Not in interior.
<i>phaseolus</i> Hild.....		x				
<i>fasciolaris</i> Raf.....						
<i>plicatus</i> Lea.....				x		
<i>pressus</i> Lea.....		x				
<i>compressus</i> Lea.....						
<i>pustulosus</i> .....				x		Not in interior.
<i>bullatus</i> Raf.....						
<i>prasinus</i> Con.....						
<i>schoolcraftii</i> Lea.....						
<i>rangianus</i> Lea.....					x	Not in interior.
<i>rectus</i> Lam.....				x		
<i>leprosus</i> Miles.....						
<i>sagrei</i> Con.....						

	G	N	V	S	SE	REMARKS.
<b>Unio</b>						
<i>rubiginosus</i> Lea.....				x		Not in extreme southeast.
<i>spatulatus</i> Lea.....				x		
<i>sulcatus</i> Lea.....					x	Grand river only.
<i>perplexus perobliquus</i> Con.....	x					
<i>superiorensis</i> Marsh.....			x			
<i>tenuissimus</i> Lea.....				x		
<i>triangularis</i> Lea.....				x		
<i>trigonus</i> Lea.....				x		
<i>undulatus</i> Bar.....				x		
<i>ventricosus</i> Bar.....	x					
<i>occidens</i> Lea.....					x	
<i>verrucosus</i> Bar.....					x	
<i>tuberculosis</i> Raf.....						
	7	3	4	20	6	Total 40 species.
<b>Margaritina</b>						
<i>complanata</i> Bar.....				x		Total 5 species.
<i>delloidea</i> Lea.....	x				x	
<i>hildrethiana</i> Lea.....				x		
<i>marginata</i> Say.....	x					
<i>rugosa</i> Bar.....						
	2			2	1	
<b>Anodonta</b>						
I. Group of <i>A. corpulenta</i> Cpr ...				x		In Lake Michigan drainage only.
<i>A. corpulenta</i> Cpr.....						
<i>subinflata</i> Anth.....						
<i>subgibbosa</i> Anth.....						
II. Group of <i>A. grandis</i> Say.....	x					
<i>benedictii</i> Lea.....						
<i>decora</i> Lea.....						
<i>inornata</i> Anth.....						
<i>footiana</i> Lea.....						
<i>mcneillii</i> Anth.....						
<i>opalina</i> Anth.....						
<i>ovata</i> Lea.....						
<i>subangulata</i> Anth.....						
<i>plana</i> Lea.....						
<i>salmonia</i> Lea.....						
<i>simpsoniana</i> Lea.....						
<i>maryattana</i> Lea.....						
<i>houghtonensis</i> Lem.....						
III. Group of <i>A. edentula</i> Say.....	x					
<i>edentula</i> Say.....						
<i>rhombica</i> Anth.....						
IV. Group of <i>A. ferussaciana</i> Lea.....	x					
<i>ferussaciana</i> Lea.....						
<i>modesta</i> Lea.....						
<i>subcylindracea</i> Lea.....						
V. Group of <i>A. fragilis</i> Lam.....	x					
<i>fragilis</i> Lam.....						
<i>flava</i> Anth.....						
<i>glandulosa</i> Ant.....						
<i>imbricata</i> Anth.....						
<i>irisans</i> Anth.....						
<i>pallida</i> Anth.....						
<i>subcarinata</i> Cur.....						
VI. Group of <i>A. imbecilis</i> Say.....				x		
<i>imbecilis</i> Say.....						
	4		2			

## DOUBTFUL AND EXTRA-LIMITAL SPECIES.

---

Unio anodontoides Lea.	Unio pustulatus Lea.
cœlatus Con.	radiatus Lam.
canadensis Lea.	subovatus Lea.
cariosus Say.	subrotundus Dea.
cuneolus Lea.	tappanianus Lea.
ellipsiformis Con.	Margaritina undulata Say.
iris Lea.	Auodonta buchanensis Lea.
latecostatus Lea.	ferruginea Lea.
negatus Lea.	fluvialis Dill.
penitus Con.	cataracta Say.
perplexus Lea.	lacustris Lea.
gibbosus Raf.	pepiniana Lea.
	schæfferiana Lea.

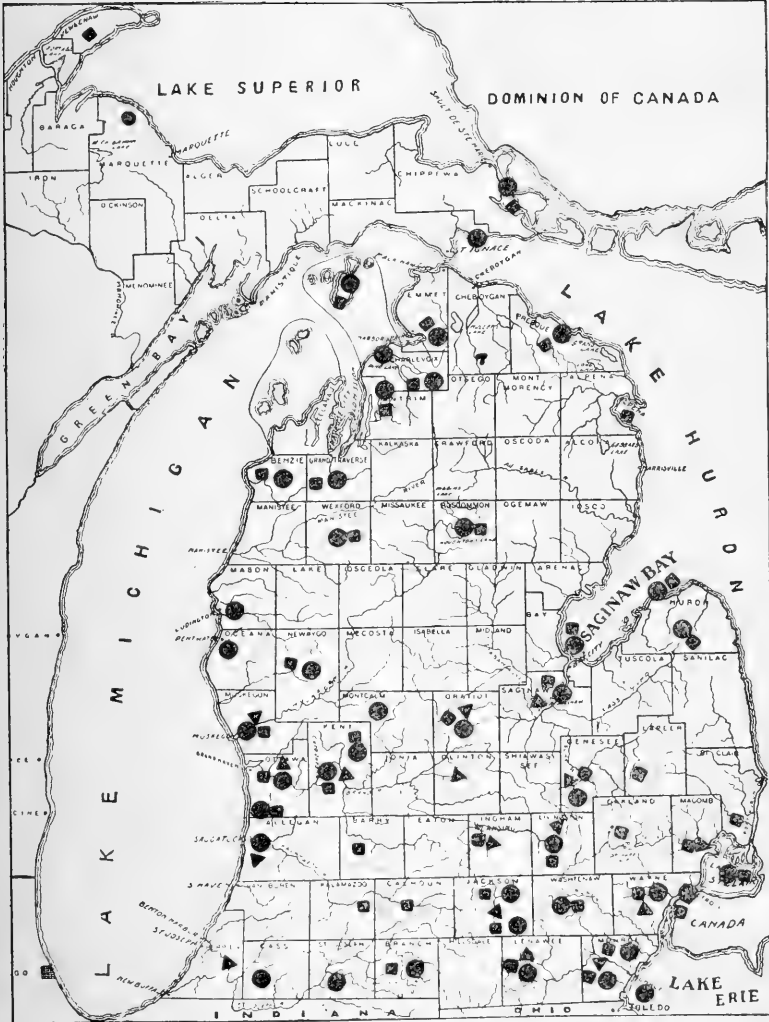
---

## APPENDIX II.

## List of contributors to the census of Michigan mollusca.

A. H. Boies,	Hudson, Mich.
C. A. Davis,	Alma, Mich.
T. Jansen,	Chicago, Ill.
Kent Scientific Institute by C. A. Whitte-	
more,	Grand Rapids, Mich.
R. J. Kirkland,	Grand Rapids, Mich.
A. C. Lane,	Houghton, Mich.
C. D. McLouth,	Muskegon, Mich.
Michigan Agricultural College by Dr Manly	
Miles,	Lansing, Mich.
C. E. Miller, Jr.,	Grand Rapids, Mich.
W. Miller,	Grand Rapids, Mich.
R. H. Pettit,	Agricultural College, Mich.
Elwood Pleas,	Dunreith, Ind.
St. Mary's Academy by Sister M. Catherine,	Monroe, Mich.
State Normal School, by W. H. Sherzer,	Ypsilanti, Mich.
Frederick Stearns,	Detroit, Mich.
L. H. Streng,	Grand Rapids, Mich.
Jerome Trombley,	Petersburg, Mich.
University of Michigan by H. E. Sargent,	Ann Arbor, Mich.
Bryant Walker,	Detroit, Mich.
Frank E. Wood,	Bay City, Mich.

PLATE I.



Distribution in Michigan of *Unio luteolus* Lam. ■; *Unio rubiginosus* Lea ◆; *Anodonta footiana* Lea ●.

PLATE II.

