



Examination of the district was undertaken at the suggestion of Prof. C. Juday, under whom the writer had the pleasure of working during the summers of 1929 and 1930. The work on the Mollusca was done in whatever time was to spare from the quantitative work on the bottom fauna of these lakes.

In the preparation of the lists, records have been secured from the following sources: (1) Collections made during the summers of 1929 and 1930. (2) Previous collections, hitherto unrecorded, including those from the Wis. Geol. & Nat. Hist. Survey (1928), and some made by Dr. O. Park, near Sayner, during September 1927. (3) Previous records, included in Baker's Monograph of Wisconsin Fresh Water Mollusca.

Acknowledgments are due the following people who have aided the work: Prof. Juday under whose supervision the work was done; Dr. Wm. J. Clench for determination of the Physidae; Dr. Victor Sterki for determination of the Sphaeriidae; Dr. Bryant Walker for determination of the Ancyliidae; to Edward Schneberger, Mrs. J. P. E. Morrison, and others whose assistance in the field has been invaluable.

The lakes in the region examined for Mollusca show a wide range in degree of softness, with a corresponding range in acidity. The amount of fixed carbon dioxide present in the open water of the lakes varies from 1.0 to 30.5 parts per million. The pH range is from 5.1 to 8.3. In the softest lakes the calcium content of the water is as low as 0.1 part per million.

It would seem at first sight that molluscs would be unable to exist in such soft waters as is indicated by a fixed carbon dioxide content of from 1.0 to 5.0 parts per million. However, careful search has shown their presence in even the softest and most acid of the lakes. There are two general types of the extremely soft lakes: (1) the type with clear water and usually a sandy or rocky gravel margin, more or less devoid of plants; (2) the type with highly colored water, surrounded usually in part by bog.

Two of the characteristic forms of molluscs found in the soft, clear lakes are *Pisidium* and *Campeloma*. It is a puzzle as to how *Pisidium* can draw enough substance for a shell (thin, to be sure) from water with a pH of 6.0 and a fixed carbon dioxide content of 1.0 part per million. The snail *Campeloma* builds a much larger and thicker shell under the same conditions.

In lakes of the soft, bog-surrounded type, there is usually a little more dissolved carbonate (3.0-5.0 p.p.m.), with a pH of 6.1 to 6.1. Here are to be found in certain lakes, some of the largest and finest specimens of *Pisidium* (sp. undescr.), nearly reaching the dimensions of the largest found in the state. Are these small bivalves able to hoard enough of the shell building materials from the water, or is there a better supply in the particular place in the bottom they inhabit?

None of the family Valvatidae are found at a pH lower than 7.1 and in water softer than that containing 8 parts per million of fixed carbon dioxide.

The *Campelomas*, the only representatives of the family Vivicampelomidae in the region are able to withstand the more extreme conditions of a pH of 5.7 or 5.8 and a fixed CO<sub>2</sub> content of 1.0 part per million. The range of the two species is almost identical, showing both of them to be equally generalized in their habitats.

Among the Amnicolidae, only two species are widespread, and of these only one is found at any great range below neutrality. The commonest species (*Amnicola limosa porata*) is found in situations ranging from pH 5.7 to 8.3, and from 1 to 30 parts per million of fixed CO<sub>2</sub>; all the other species are found above pH 6.8 and 8 parts per million of fixed CO<sub>2</sub>.

Among the gill-breathing snails, only three species are able to tolerate the conditions of the extremely soft waters of the near lake type. There is a probability that the data used for these snails may be in error in certain cases. It is only reasonable to suppose that *Campeloma*, where found in abundance in the (glacial till) clay bottom of an extremely soft water lake, is getting its necessary supply of carbonates from the clay bottom directly, and not from the open water of the lake. In the case of *Amnicola*, an extra source of shell-building materials must be sought in the plant food.

Among the Lymnaeidae, three forms are especially tolerant of acid water (pH to 6.0), while the majority of the species are found only in water having an alkaline reaction (pH 7.0 to 8.0). Specialization of habitat seems to be rather well marked in this group, as indicated by the attendant chemical data. The genus *Lymnaea* is restricted to waters of pH 7.2 or more, and a fixed carbon dioxide content of 15 or more parts

per million. In the genus *Stagnicola*, we find the common form of southern Wisconsin (*S. palustris elodes*) largely replaced in the northern lakes and ponds by *S. exilis* and *S. lanceata*. These two last named species are found in more acid and softer lakes than is *palustris elodes*. On the other hand, the species of the *emarginata* group seem to be confined to lakes of pH 7 to 8. In the genus *Fossaria*, the common species *obrussa* is found from pH 5.9 to 8.3, while the supposed ancestral form *F. o. decampi* is found under much more restricted conditions, chiefly in waters having a H-ion concentration of pH 7.5. This immediately raises the question as to which is the ancestral form, and which the special form found under a peculiar set of conditions attendant upon recently formed glacial lakes.

Examination of the family as a whole shows that only *Stagnicola* and *Fossaria* are generally distributed under variable conditions while *Lymnaea*, *Acella*, *Pseudosuccinea*, and *Bulimnaca* are restricted to greater or less degree. Must not the four last-named genera be considered as more highly specialized or "senescent" groups as compared with *Stagnicola* and *Fossaria*?

Examination of the several described varieties of *Helisoma antrosa* brings out some interesting conclusions. The thin-shelled form, *H. a. unicarinata*, seems to be restricted to the softer, more acid waters of the region, while *H. a. sayi*, which has a noticeably thicker shell, is not found in lakes that are acid (pH below 7.0). On the other hand, the two other varieties, *H. a. antrosa* and *H. a. cahni*, are found under variable conditions (pH 6.0 to 8.0).

The range of the varieties of *H. trivolvis* and *H. campanulata* show simply that the varieties are more restricted in habitat than is the typical form of each species; for example, *H. t. pilsbryi* is found within narrower pH limits than is the typical *H. trivolvis*.

In the case of *campanulata*, the varieties listed in order of increasing restriction are *H. c. campanulata*, *c. wisconsinensis*, *c. minor*, and *c. ferrissii*.

Different sets of chemical conditions in these lakes seem to produce specific varieties in a few cases. Also, it would seem that the variation in chemical nature of the habitat may be the stimulus for production of non-specific variation in form of the animal or of the shell it builds.



la, we find the common forms (S. elodes) largely replaced in

S. exilis and S. lanceata, found in more acid and softer water. On the other hand, the species are confined to lakes of pH 7 and above. The common species obrussa is the supposed ancestral form in more restricted conditions, at a concentration of pH 7.5. This is the concentration to which is the ancestral form found under a peculiar set of conditions formed glacial lakes.

The whole shows that only Stagnicola is distributed under variable conditions, Pseudosuccinea, and Balamia to a lesser degree. Must not be considered as more highly specialized than with Stagnicola and Pseudosuccinea.

ribed varieties of Helisoma are being drawn. The thinnest-shelled seems to be restricted to the acid side, while H. a. sayi, which is found in lakes that are acid, the two other varieties, H. a. and under variable conditions.

volvris and H. campanulata are more restricted in habitat than the species; for example, H. l. is more restricted in pH limits than is the typical.

varieties listed in order of increasing pH: H. panulata, c. wisconsinensis.

conditions in these lakes seem to be variable. Also, it would seem that the nature of the habitat may be the cause of the specific variation in form of

Among the small Planorbids, the forms of the Genus Gyraulus, when regarded in the subgeneric groups, show a tendency toward serial arrangement of the different forms across the different conditions of the lakes. In the subgenus Gyraulus sensu stricto listed from more acid to more alkaline limits of range are: G. deflectus, G. d. obliquus, G. hirsutus. Of these three species, that found in the more acid conditions is most carinate, and the one found under most alkaline conditions is the least carinate on the periphery of the whorl. In the subgenus Torquus, a much more marked series is indicated, consisting of: G. circumstriatus, G. parvus, G. arcticus.

In spite of the paucity of records in the Ancyliidae, one difference is indicated. Ferrissia parallela is the only species in the region found in neutral or acid waters. The other three species are bunched (with one record each) at about pH 7.6. Parallela is to be found from pH 6.0 to the most alkaline of the lakes examined for mollusks (pH 8.4).

Two species of Physa show up in a wide range of conditions. These two are large, thin-shelled, and apparently annual in these lake habitats. P. sayii ranges as far as pH 5.7 on the acid side, while P. laphami is found down to pH 6.4. P. gyrina, which is more common in southern Wisconsin than in the northern lakes, is not in acid waters in the lakes. Likewise, the four other forms recorded were restricted to alkaline water (pH 7.6-8.0).

All the species of the Unioninae in the region are restricted to streams of slightly alkaline reaction (pH 7.0-8.0). The lower limit of fixed carbon dioxide observed was 12.07 parts per million. The only one of the forms of this subfamily found in lakes in Vilas Co., is recorded from a lake in the same range of acidity and hardness of water.

In the subfamily Anodontinae, all except species of Anodonta are similarly restricted in the chemical nature of the habitat. Thinnest-shelled of the genus, among the species to be found in northern Wisconsin, Anodonta marginata is found in many of these northern lakes, in water varying from pH 6.0 to 8.4 and in fixed carbon dioxide content from 2.6 to 30.5 parts per million. Under the extremely soft and acid water conditions, the shell developed by this form is so thin, that it may be twisted (when fresh and still wet) through about 20 degrees, with-

out even cracking. It is impossible to twist the thicker shells developed when the animals have grown under slightly alkaline conditions.

All of the species of the subfamily *Lampsilinae*, like the majority of species of the fresh water mussels, are limited to slightly alkaline waters. Detailed examination of the range of the two species of *Lampsilis* shows that the lake and the stream variety of each have approximately the same limits. The development of the lake form is not due to differences of H-ion concentration or of the amount of fixed carbon dioxide present, as far as the writer's studies are concerned.

In the Sphaeriidae, some striking differences of chemical nature of the habitat are seen. In general the distribution of species of the "Finger-nail" and "Pill" Clams shows the condition expected of a diversified group, some widespread, some intermediate, and some species confined to narrow limits of H-ion concentration and of amount of fixed carbon dioxide present in the water.

On examination of the groups within the family, or within genera, we get more precise information. For example: *Pisidium* surpasses the other two genera in tolerance for acidity and ability to thrive in the softest waters. It is found in water with pH 5.7 and a fixed carbon dioxide content of 1.5 parts per million. *Musculium*, which has a proportionately thinner shell, is found only as low as pH 5.9 and with a fixed carbon dioxide content of 2.6 parts per million. *Sphaerium*, as a unit, is found in habitats approximately neutral, or alkaline in reaction (pH 6.8-8.4) and with a fixed carbon dioxide content of 9.3 or more parts per million. But there is one straggler. *S. occidentale* is restricted to the acid side of the scale, having been taken in the region only from temporary ponds, with pH 5.8-5.9 and a fixed carbon dioxide content of 5.5 to 7.5 parts per million. Is this physiological difference not marked enough to indicate that *S. occidentale* may be less closely related to the other Sphaeria than usually regarded? Another good example of physiological isolation of species is seen in the group of *Pisidium rotundatum*. In this group *P. ferrugineum* and *P. vesiculare* are both found between pH 7.2 and 8.2 and a fixed carbon dioxide content between 11 and 22.5 parts per million. In direct contrast, *P. rotundatum* is found between pH 5.8 and 6.2 and from a fixed carbon dioxide content of 2.0 to 9.0 parts per million.

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The lakes that are intermediate in hardness (10.0-20.0 p.p.m.  
fixed carbon dioxide, and a pH of 7.0-7.6) harbor the greatest  
number of species. As would be expected, the hardest lakes  
examined contain the greatest abundance of individuals.

Stream conditions are chemically rather uniform in the dis-  
trict, paralleling the intermediate lakes in character (Fig. 127).  
Chemical factors are thus not a limiting factor for molluscs in  
the streams. Geographic distribution and size and flow of the  
streams do seem to be important.

The number of species of Unionids in the small headwater  
streams of the Lake Superior and Green Bay (Lake Michigan)  
drainages is about one-half that found in similar streams, un-  
der comparable conditions, in the headwaters of the Flambeau,  
Tomahawk, and Wisconsin drainages.

The Wisconsin River, examined at various places from its  
source to a point in northern Oneida County, shows remarkably  
well the variation and increase of the molluscan fauna in co-  
ordination with the increase in size of the stream, as noted by  
Adams, Ortmann, Grier, and Baker.

In this northern lake region, where some streams are ponded  
for mile after mile, with swampy or bog margins, and others  
are rapid, with sand or gravel beds, the molluscan fauna of the  
streams shows a corresponding difference. For example,  
*Sphaerium fallax* and *S. rhomboideum* are found in the swampy  
margins of ponded streams, while *S. stamineum* and *S. emargi-*  
*atum* are characteristic of streams with a good current over  
sandy bottom.

In all, some ninety-six lakes and thirty-eight stream localities  
have been examined, included in Vilas County and the adjoining  
portions of Iron, Price, Oneida, and Forest Counties. A  
total of one hundred twenty-nine forms of molluscan life are  
here recorded from the area. These are distributed as follows  
in the major groups:

Gill-breathing univalves .....	11
Lung-breathing univalves .....	51
Unionidae (bivalves) .....	26
Sphaeriidae (bivalves) .....	41
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Total .....	129

Three forms are added to those known to occur in the state, namely: *Pseudosuccinea columella chalybea* (Gould), *Pisidium fallax septentrionale* Sterki, *Pisidium punctatum* Sterki.

The system of classification followed in this report is that of Baker's Monograph. For further references, the reader is referred to that publication.

#### SYSTEMATIC CATALOGUE OF SPECIES

In the following list the name of each species or variety is followed by a record of the localities where it is known to occur, listed according to drainage areas. Except where the authority for the record is otherwise stated, the records are those of the 1929-1930 collections of the Wisconsin Geological and Natural History Survey.

The area included in this brief report has not been exhaustively explored: there are about a thousand lakes in the entire district! Any additions and corrections will be gratefully received by the author.

#### Class GASTROPODA.

Subclass STREPTONEURA Spengel.

Order CTENOBRANCHIATA Schweigger.

Suborder PLATYPODA Lamarck.

Superfamily TAENIGLOSSA Bouvier.

Family VALVATIDAE Gray.

#### Genus *Valvata* Müller.

##### *Valvata tricarinata* (Say).

pH=7.16-8.37; fixed carbon dioxide=8.16-30.56 p.p.m. (Fig. 1).

Lake Superior Drainage: Palmer Lake.

Flambeau Drainage: Allequash L.; Lake Laura; Mann L.; Silver L.; Trout L.; White Sand L.; Wildcat Lake.

Tomahawk Drainage: Kawaguesaga L.; Little Arbor Vitae Lake (Winslow, Baker).

Wisconsin Drainage: Plum L.; Razorback L.; Star Lake.

##### *Valvata sincera nylanderi* Dall.

pH=7.6; fixed carbon dioxide=22.5 p.p.m. (Fig. 2).

Tomahawk Drainage: Little Arbor Vitae Lake (Winslow, Baker).

##### *Valvata lewisii* (Currier).

pH=7.35-7.7; fixed carbon dioxide=10.65-22.1 p.p.m. (Fig. 3).



- Lake Superior Drainage: Palmer Lake.  
 Flambeau Drainage: Papoose L.; Trout L.; Upper Gresham L.;  
 Whitefish L.; White Sand Lake.  
 Tomahawk Drainage: Brandy Lake.  
 Wisconsin Drainage: Plum Lake.

Family VIVIPARIDAE (Gray) Gill.  
 Subfamily LIOPLACINAE (Gill) Baker.

Genus *Campeloma* Rafinesque.

*Campeloma decisum* (Say).

- pH=5.68-8.37; fixed carbon dioxide=1.2-25.75 p.p.m. (Fig. 4).  
 Lake Superior Drainage: South Branch, Presque Isle River, at  
 Winegar.  
 Green Bay Drainage: Butternut Lake.  
 Flambeau Drainage: Big L.; Diamond L.; Fishtrap L.; Helen L.;  
 High L.; Inlet of Trout L.; Little Long L.; Manitowish River, at  
 Boulder Junction and 4 mi. southwest; Mann L. Outlet; Marion  
 L.; Rest L.; South Fork, Flambeau River, at Fifield; Trout L.;  
 Trout River, at Trout L.; Turtle River, below Lake of the Falls;  
 White Sand Lake inlet.  
 Tomahawk Drainage: Little Star Lake.  
 Wisconsin Drainage: Gilmore Creek and Wisconsin River, north-  
 east of Lake Tomahawk (Baker); Deerskin River, 6 mi. south of  
 Phelps; Finley L.; Plum L.; Wisconsin River, at Lac Vieux Des-  
 ert, at Otter Rapids, 5 mi. west of Eagle River, and at Rainbow  
 Rapids, southeast of Lake Tomahawk.

*Campeloma milesii* (Lea).

- pH=5.86-8.0; fixed carbon dioxide=1.1-24.73 p.p.m. (Fig. 5).  
 Lake Superior Drainage: Anna L.; Carlin L.; Palmer L.; Katinka  
 L.; Presque Isle Lake.  
 Flambeau Drainage: Big Muskellunge and White Sand Lakes (Cahn,  
 Baker); Lower Gresham Lake (Juday, Baker); Big Muskellunge  
 L.; Boulder L.; Crooked L.; Ike Walton L.; Inlet of White Sand  
 L.; Irving L. Outlet; L. Constance; Little White Birch L.; Lost  
 Canoe L.; Mary L.; Trout L.; Turtle River, at Winchester; White-  
 fish L.; White Sand Lake.  
 Tomahawk Drainage: Tomahawk Lake (Baker); Brandy L.; John-  
 son L.; Skunk L.; Tomahawk River, 4 mi. west of Minoqua; Web-  
 er Lake.  
 Wisconsin Drainage: Plum Lake (Cahn, Baker); Crescent L.; Plum  
 L.; Razorback L.; Star L.; Sterrett L.; Wisconsin River, 5 mi. be-  
 low Lac Vieux Desert.

Family AMNICOLIDAE (Tryon) Gill.

Subfamily AMNICOLINAE Gill.

Genus *Amnicola* Gould and Haldeman.

*Amnicola limosa* (Say).

pH=7.95; fixed carbon dioxide=30.56 p.p.m. (Fig. 6).

Flambeau Drainage: Wildcat Lake.

*Amnicola limosa porata* (Say).

pH=5.68-8.37; fixed carbon dioxide=1.2-30.56 p.p.m. (Fig. 7).

Lake Superior Drainage: Harris L.; Montreal River, at Pine L.; Palmer L.; Presque Isle L.; South Branch, Presque Isle River, at Winegar.

Flambeau Drainage: Allequash L.; Big Lake Outlet; Big Muskellunge L.; Boulder L.; Catfish L.; Clear Crooked L.; Dead Pike L.; Diamond L.; Fishtrap L.; Harvey L.; Helen L.; High L.; Ike Walton L.; Inlet of White Sand L.; Inlet of Trout L.; L. Laura; Little Crooked L.; Little White Birch L.; Lost Canoe L.; Mann L.; Mann Lake Outlet; Nebish L.; Nixon Lake Outlet; Papoose L.; Partridge L.; Trout L.; Whitefish L.; White Sand L.; Whitney L.; Wildcat L.; Wolf Lake.

Tomahawk Drainage: Little Arbor Vitae Lake (Winslow, Baker); Tomahawk Lake (Baker); Blue L.; Brandy L.; Carroll L.; Clear L.; Kawagesaga Lake.

Wisconsin Drainage: Bragonier L.; Crescent L.; Plum L.; Razorback L.; Star L.; Wisconsin River, at Rainbow Rapids, southeast of Lake Tomahawk.

*Amnicola limosa parva* (Lea).

pH=7.64; fixed carbon dioxide=18.87 p.p.m. (Fig. 8).

Flambeau Drainage: Trout Lake.

*Amnicola lustrica decepta* Baker.

pH=6.55-8.37; fixed carbon dioxide=9.3-30.56 p.p.m. (Fig. 9).

Lake Superior Drainage: Ontonagon River, Mich., 3 mi. north of Tenderfoot L.; Palmer L.; Presque Isle Lake.

Flambeau Drainage: Big Muskellunge L.; Boulder L.; High L.; Lake Laura; Little Crooked L.; Little Rice L.; Little White Birch L.; Mann L.; Trout L.; Upper Gresham L.; Whitefish L.; White Sand L.; Whitney L.; Wildcat L.; Wolf Lake.

Tomahawk Drainage: Little Arbor Vitae Lake (Winslow, Baker).

Wisconsin Drainage: Plum Lake (Cahn, Baker); Crescent L.; Plum L.; Star Lake.

*Amnicola walkeri* Pilsbry.

pH=7.16-7.64; fixed carbon dioxide=8.16-22.5 p.p.m. (Fig. 10).

Flambeau Drainage: Big Muskellunge Lake (Cahn, Baker); Fishtrap L.; Trout River, at Trout Lake.

Tomahawk Drainage: Little Arbor Vitae Lake (Winslow, Baker).

Wisconsin Drainage: Razorback Lake.

Subfamily LITHOGLYPHINAE Fisher.

Genus *Somatogyrus* Gill.

*Somatogyrus tryoni* Pilsbry and Baker.

pH=7.0; fixed carbon dioxide=13.0 p.p.m. (Fig. 11).

Wisconsin Drainage: Wisconsin River, at Otter Rapids, 5 mi. west of Eagle River, and at Rainbow Rapids, southeast of Lake Tomahawk.

Subclass EUTHYNEURA Spengel.

Order PULMONATA Cuvier.

Suborder BASOMMATOPHORA A. Schmidt.

Superfamily LIMNOPHILA.

Family LYMNAEIDAE (Broderip) Baker.

Genus *Lymnaea* Lamarck.

*Lymnaea stagnalis jugularis* Say.

pH=7.6-8.16; fixed carbon dioxide=15.8-23.0 p.p.m. (Fig. 12).

Flambeau Drainage: Inlet stream, Trout Lake; Outlet of Big Lake. Tomahawk Drainage: Tomahawk Lake (Baker); Brandy L.; Carroll L.; Johnson Lake.

Wisconsin Drainage: Plum Lake; Plum Creek.

*Lymnaea stagnalis lillianae* F. C. Baker.

pH=7.2-8.02; fixed carbon dioxide=14.9-30.56 p.p.m. (Fig. 13).

Lake Superior Drainage: Ontonagon River, Mich., 3 mi. north of Tenderfoot Lake.

Flambeau Drainage: Big L.; Fishtrap L.; High L.; Trout L.; Trout River at Trout Lake; Wildcat Lake.

Tomahawk Drainage: Tomahawk Lake (Baker).

Wisconsin Drainage: Star Lake.

*Lymnaea stagnalis sanctamariae* Walker.

pH=7.35-8.0; fixed carbon dioxide=16.45-24.73 p.p.m. (Fig. 14).

Lake Superior Drainage: Presque Isle Lake.

Green Bay Drainage: Butternut Lake.

Tomahawk Drainage: Little Arbor Vitae Lake (Juday, Winslow, Baker); Ponds and Stream at State Fish Hatchery, Woodruff.

Genus *Stagnicola* (Leach) Jeffreys.

*Stagnicola palustris elodes* (Say).

pH=7.4; fixed carbon dioxide=21.0 p.p.m. (Fig. 15).

Lake Superior Drainage: Pond near South Branch, Presque Isle River, at Winegar.

Flambeau Drainage: Stream at Fish Hatchery, Woodruff.

*Stagnicola exilis* (Lea).

pH=5.9-7.74; fixed carbon dioxide=7.5-22.56 p.p.m. (Fig. 16).  
Flambeau Drainage: Fishtrap L.; Forest Ponds, 10 mi. northeast  
of Boulder Junction; High L.; Turtle River, below Lake of the  
Falls.

Tomahawk Drainage: Little Star Lake.

*Stagnicola lanceata* (Gould).

pH=6.95-7.7; fixed carbon dioxide=7.5-22.56 p.p.m. (Fig. 17).

Lake Superior Drainage: Armour Lake.

Flambeau Drainage: High Lake.

Tomahawk Drainage: Tomahawk Lake (Baker); Little Rice River.

Wisconsin Drainage: Plum Lake (Cahn, Baker).

*Stagnicola emarginata* (Say).

pH=7.5-8.0; fixed carbon dioxide=14.3-24.73 p.p.m. (Fig. 18).

Lake Superior Drainage: Presque Isle Lake.

Flambeau Drainage: Rest Lake.

Tomahawk Drainage: Kawaguesaga Lake.

Wisconsin Drainage: Plum Lake (Cahn, Baker); Plum Creek and  
Lake.

*Stagnicola emarginata vilasensis* F. C. Baker.

pH=7.21; fixed carbon dioxide=9.59 p.p.m. (Fig. 19).

Flambeau Drainage: Big Muskellunge Lake (Cahn, Baker).

*Stagnicola emarginata wisconsinensis* F. C. Baker.

pH=7.21; fixed carbon dioxide=16.7-22.5 p.p.m. (Fig. 20).

Tomahawk Drainage: Little Arbor Vitae Lake (Winslow, Baker);

Tomahawk Lake (Baker).

*Stagnicola catascopium* (Say).

pH=7.64; fixed carbon dioxide=18.87 p.p.m. (Fig. 21).

Flambeau Drainage: Trout Lake.

Genus *Acella* Haldeman.

*Acella haldemani* ("Desh." Binney).

pH=7.36-7.7; fixed carbon dioxide=17.0-22.56 p.p.m. (Fig. 22).

Lake Superior Drainage: Harris Lake.

Flambeau Drainage: Fishtrap Lake; Channel between Fishtrap and  
High Lakes; High Lake.

Genus *Pseudosuccinea* Baker.

*Pseudosuccinea columella* (Say).

pH=6.13-7.6; fixed carbon dioxide=2.75-16.7 p.p.m. (Fig. 23).

Lake Superior Drainage: Anna Lake.

Flambeau Drainage: Channel between Fishtrap and High Lakes.

Tomahawk Drainage: Tomahawk Lake (Baker); Clear Lake.



*Pseudosuccinea columella chalybea* (Gould).

pH=6.06-7.8; fixed carbon dioxide=3.06-18.36 p.p.m. (Fig. 24).  
Flambeau Drainage: Catfish L.; Fishtrap L.; Helen Lake.

Genus *Bulimnaea* Haldeman.

*Bulimnaea megasoma* (Say).

pH=6.6-8.37; fixed carbon dioxide=9.3-25.75 p.p.m. (Fig. 25).  
Lake Superior Drainage: Pond near South Branch, Presque Isle River, at Winegar.  
Flambeau Drainage: Duck L.; Fishtrap L.; Channel between Fishtrap and High Lakes; High L.; Little Rice L.; Mann L. Outlet; Pike L. inlet; Trout L.; Turtle River, below Lake of the Falls; White Sand Lake.  
Tomahawk Drainage: Tomahawk Lake (Baker).  
Wisconsin Drainage: Plum Lake (Cahn, Baker); Slough along Wisconsin River, northeast of Lake Tomahawk (Baker).

Genus *Fossaria* Westerlund.

*Fossaria modicella* (Say).

pH=7.0; fixed carbon dioxide=13.0 p.p.m. (Fig. 26).  
Wisconsin Drainage: Wisconsin River, northeast of Lake Tomahawk (Baker).

*Fossaria obrussa* (Say).

pH=5.86-8.37; fixed carbon dioxide=1.26-25.75 p.p.m. (Fig. 27).  
Flambeau Drainage: Ike Walton L.; Little Rice L.; Mann L. Outlet; Pond along Mann L. Outlet; Trout Lake.  
Tomahawk Drainage: Tomahawk Lake (Baker).  
Wisconsin Drainage: Found Lake (Cahn, Baker); Star Lake.

*Fossaria obrussa decampi* (Streng).

pH=7.42-7.7; fixed carbon dioxide=10.65-18.87 p.p.m. (Fig. 28).  
Flambeau Drainage: Upper Gresham Lake (Juday, Baker); Little White Birch L.; Trout L.; Whitefish Lake.  
Wisconsin Drainage: Plum Lake.

*Fossaria exigua* (Lea).

pH=7.7-8.37; fixed carbon dioxide=13.0-25.75 p.p.m. (Fig. 29).  
Lake Superior Drainage: Montreal River, at Pine Lake.  
Flambeau Drainage: Mann Lake.

Family PLANORBIDAE H. & A. Adams.

Genus *Helisoma* Swainson.

*Helisoma antrosa* (Conrad)

pH=6.03-8.02; fixed carbon dioxide=2.66-30.56 p.p.m. (Fig. 30).  
Lake Superior Drainage: Montreal River, at Pine Lake; Palmer L.; Presque Isle Lake.

Green Bay Drainage: Butternut Lake.  
Flambeau Drainage: Big L.; Big Muskellunge L.; Boulder L.; Helen L.; High L.; L. George; Lost Canoe L.; Manitowish River, 4 mi. southwest of Boulder Junction; Outlet of Big L.; Rest L.; Trout L.; Trout River, at Trout L.; Whitefish L.; Wildcat Lake.  
Tomahawk Drainage: Brandy L.; Little Star L.; Skunk L.; Stream, 10 mi. southwest of Hazelhurst; Willow River Flowage, 14 mi. southwest of Hazelhurst.  
Wisconsin Drainage: Crescent L.; Deerskin River, 6 mi. south of Phelps; Plum L.; St. Germaine River; Star L.; Wisconsin River, at Rainbow Rapids, southeast of Lake Tomahawk.

*Helisoma antrosa unicarinata* (Haldeman).

pH=6.05-7.85; fixed carbon dioxide=1.1-18.36 p.p.m. (Fig. 31).

Green Bay Drainage: Kentuck Lake.

Flambeau Drainage: Big Muskellunge L.; Fishtrap L.; Channel between Fishtrap and High Lakes; Mary L.; Nixon L. Outlet; White Sand L. Inlet.

Tomahawk Drainage: Tomahawk Lake (Baker); Little Rice River; Pond near State Fish Hatchery Ponds, at Woodruff; Weber Lake.

Wisconsin Drainage: Razorback L.; Star Lake.

*Helisoma antrosa sayi* F. C. Baker.

pH=7.13-8.37; fixed carbon dioxide=9.59-25.75 p.p.m. (Fig. 32).

Flambeau Drainage: Big Muskellunge L.; Nixon Lake (Cahn, Baker); Fishtrap L.; Mann L.; Outlet of Mann L.; White Sand Lake.

Tomahawk Drainage: Little Arbor Vitae Lake (Winslow, Baker); Tomahawk Lake (Baker).

Wisconsin Drainage: Plum L.; Found Lake (Cahn, Baker).

*Helisoma antrosa cahni* F. C. Baker

pH=6.13-8.0; fixed carbon dioxide=2.75-24.73 p.p.m. (Fig. 33).

Lake Superior Drainage: Anna L.; Armour L.; Presque Isle Lake.

Flambeau Drainage: Big Muskellunge Lake (Baker); Silver Lake.

*Helisoma trivolvis* (Say).

pH=6.6-8.37; fixed carbon dioxide=7.5-30.56 p.p.m. (Fig. 34).

Lake Superior Drainage: Black Oak L.; Palmer Lake.

Flambeau Drainage: Allequash L.; Duck L.; Fishtrap L.; High L.; Inlet of Trout L.; Inlet of White Sand L.; Irving L. Outlet; Little Rice L.; Mann L.; Outlet of Mann L.; Outlet of Nixon L.; Pike L.; Trout L.; Trout River, at Trout L.; Turtle River, below Lake of the Falls; White Sand L.; Wildcat Lake.

Tomahawk Drainage: Tomahawk Lake (Baker); Willow River Flowage, 14 mi. southwest of Hazelhurst.

Wisconsin Drainage: Crescent L.; Deerskin River, 6 mi. south of Phelps; Plum L.; Rice Creek, near Plum Lake.

*Helisoma trivolvis pilsbryi* (F. C. Baker).

pH=7.2-8.37; fixed carbon dioxide=13.3-25.75 p.p.m. (Fig. 35).

Arts, and Letters.

- Lake Superior Drainage: Ontonagon River, Mich., 3 mi. north of Tenderfoot Lake.  
 Flambeau Drainage: Boulder L.; Fishtrap L.; High L.; Mann Lake.  
 Tomahawk Drainage: Tomahawk Lake (Baker); Brandy Lake.
- Helisoma trivolvis winslowi* (F. C. Baker).  
 pH=7.6-7.65; fixed carbon dioxide=22.5-22.6 p.p.m. (Fig. 36).  
 Flambeau Drainage: Manitowish River (Winslow, Baker).  
 Tomahawk Drainage: Big and Little Arbor Vitae Lakes (Winslow, Baker).
- Helisoma pseudotrivolvis* (F. C. Baker).  
 pH=7.23; fixed carbon dioxide=10.8 p.p.m. (Fig. 37).  
 Flambeau Drainage: Lake Laura.
- Helisoma campanulata* (Say).  
 pH=6.6-8.16; fixed carbon dioxide=7.5-30.56 p.p.m. (Fig. 38).  
 Lake Superior Drainage: Palmer Lake.  
 Green Bay Drainage: Butternut L.; Kentuck Lake.  
 Flambeau Drainage: Allequash L.; Big L.; Big Muskellunge L.; Boulder L.; Fishtrap L.; High L.; Papoose L.; Trout L.; Whitefish L.; Wildcat L.; Wolf Lake.  
 Tomahawk Drainage: Brandy L.; Carroll L.; Johnson L.; Kawaguesaga L.; Little Star L.; Willow River Flowage, 14 mi. southwest of Hazelhurst.  
 Wisconsin Drainage: Crescent L.; Plum L.; Razorback L.; Star Lake.
- Helisoma campanulata minor* (Dunker).  
 pH=6.6-7.85; fixed carbon dioxide=9.59-18.87 p.p.m. (Fig. 39).  
 Lake Superior Drainage: Ontonagon River, Mich., 3 mi. north of Tenderfoot Lake.  
 Flambeau Drainage: Big Muskellunge L.; Catfish L.; Inlet of White Sand L.; Outlet of Nixon L.; Trout Lake.  
 Wisconsin Drainage: Plum L.; Star Lake.
- Helisoma campanulata ferrissii* (F. C. Baker).  
 pH=7.05; fixed carbon dioxide=13.7 p.p.m. (Fig. 40).  
 Flambeau Drainage: Island Lake.
- Helisoma campanulata wisconsinensis* (Winslow).  
 pH=6.95-8.37; fixed carbon dioxide=7.5-25.75 p.p.m. (Fig. 41).  
 Lake Superior Drainage: Armour L.; Harris L.; Presque Isle Lake.  
 Flambeau Drainage: Big Muskellunge L.; Nixon L.; White Sand Lake (Cahn, Baker); Allequash L.; Big Muskellunge L.; High L.; Lost Canoe L.; Mann L.; Turtle River, below Lake of the Falls; White Sand Lake.  
 Tomahawk Drainage: Big Arbor Vitae L.; Little Arbor Vitae L.; Tomahawk L.; Madeline Creek, near Woodruff (Winslow, Baker); Little Arbor Vitae Lake (Cahn, Baker); Tomahawk Lake (Baker).  
 Wisconsin Drainage: Found L.; Plum Lake (Cahn, Baker); St. Germaine Lakes (Winslow, Baker).

Muskellunge L.; Boulder L.;  
 Canoe L.; Manitowish River  
 Outlet of Big L.; Rest L.  
 Whitefish L.; Wildcat Lake.  
 Star L.; Skunk L.; Stream  
 Willow River Flowage, 14 mi.  
 Deerskin River, 6 mi. south of  
 r; Star L.; Wisconsin River  
 ke Tomahawk.  
 man).  
 -18.36 p.p.m. (Fig. 31).  
 L.; Fishtrap L.; Channel  
 ry L.; Nixon L. Outlet; White  
 e (Baker); Little Rice River  
 ds, at Woodruff; Weber Lake  
 Star Lake.  
 9.59-25.75 p.p.m. (Fig. 32).  
 e L.; Nixon Lake (Cahn, Baker);  
 of Mann L.; White Sand Lake  
 Vitae Lake (Winslow, Baker);  
 d Lake (Cahn, Baker).  
 7.5-24.73 p.p.m. (Fig. 33).  
 Armour L.; Presque Isle Lake;  
 ge Lake (Baker); Silver Lake.  
 5-30.56 p.p.m. (Fig. 34).  
 k L.; Palmer Lake.  
 ; Duck L.; Fishtrap L.; High  
 hite Sand L.; Irving L. Outlet;  
 f Mann L.; Outlet of Nixon L.;  
 t Trout L.; Turtle River, below  
 ; Wildcat Lake.  
 ke (Baker); Willow River Flow-  
 rst.  
 Deerskin River, 6 mi. south of  
 r Plum Lake.  
 Baker).  
 13.3-25.75 p.p.m. (Fig. 35).

Genus *Planorbula* Haldeman.

*Planorbula armigera* (Say).

pH=6.6-7.6; fixed carbon dioxide=7.5-16.7 p.p.m. (Fig. 42).

Tomahawk Drainage: Tomahawk Lake and swamp ponds in vicinity (Baker); Willow River Flowage, 14 mi. southwest of Hazelhurst.

Wisconsin Drainage: Ponds in swamp along Wisconsin River, 4 mi. northeast of Tomahawk Lake (Baker).

Genus *Menetus* H. & A. Adams.

*Menetus exacuus* (Say).

pH=7.0-7.64; fixed carbon dioxide=9.3-22.5 p.p.m. (Fig. 43).

Lake Superior Drainage: Palmer Lake.

Flambeau Drainage: Fishtrap L.; Little Rice L.; Manitowish River, 4 mi. southwest of Boulder Junction; Pond along outlet of Mann L.; Trout Lake.

Tomahawk Drainage: Little Arbor Vitae Lake (Winslow, Baker).

Wisconsin Drainage: Crescent Lake.

*Menetus exacuus megas* (Dall).

pH=7.1-8.37; fixed carbon dioxide=9.59-25.75 p.p.m. (Fig. 44).

Flambeau Drainage: Big Muskellunge Lake (Cahn, Baker); Big Muskellunge L.; Mann L.; Outlet of Nixon L.; Trout Lake.

Tomahawk Drainage: Kawaguesaga Lake.

Genus *Gyraulus* Charpentier.

*Gyraulus hirsutus* (Gould).

pH=7.1-7.95; fixed carbon dioxide=9.5-30.56 p.p.m. (Fig. 45).

Flambeau Drainage: Boulder L.; Little White Birch L.; Nelson L.; Partridge L.; Trout L.; Wildcat Lake.

Tomahawk Drainage: Little Arbor Vitae Lake (Winslow, Baker); Tomahawk Lake (Baker).

Wisconsin Drainage: Found L.; Plum Lake (Cahn, Baker); Plum L.; Star Lake.

*Gyraulus deflectus* (Say).

pH=6.2-8.37; fixed carbon dioxide=2.1-30.56 p.p.m. (Fig. 46).

Lake Superior Drainage: Armour Lake.

Flambeau Drainage: Allequash L.; Dead Pike L.; Fishtrap L.; High L.; Inlet of Trout L.; Outlet of Mann L.; Pond along Mann L. Outlet; Whitefish L.; Wildcat Lake.

Tomahawk Drainage: Clear L.; Little Rice River; Willow River Flowage, 14 mi. southwest of Hazelhurst.

Wisconsin Drainage: Bragonier Lake.

*Gyraulus deflectus obliquus* (DeKay).

pH=6.4-8.37; fixed carbon dioxide=8.16-30.56 p.p.m. (Fig. 47).

Lake Superior Drainage: Montreal River, at Pine L.; Palmer L.; Presque Isle Lake.



Flambeau Drainage: Fishtrap L.; Inlet of Trout Lake; Mann L.; Pappoose L.; Trout L.; Whitefish L.; White Sand L.; Wolf Lake.  
 Tomahawk Drainage: Little Arbor Vitae Lake (Winslow, Baker); Brandy L.; Carroll L.; Johnson L.; Pond near State Fish Hatchery, at Woodruff.  
 Wisconsin Drainage: Plum Lake (Cahn, Baker); Shore pools, Wisconsin River, 4 mi. northeast of Tomahawk Lake (Baker); Crescent L.; Razorback Lake.

*Gyraulus parvus* (Say).

pH=7.0-8.16; fixed carbon dioxide=8.16-30.56 p.p.m. (Fig. 48).  
 Lake Superior Drainage: Montreal River, at Pine L.; Ontonagon River, Mich., 3 mi. north of Tenderfoot L.; Pond, near South Branch, Presque Isle River, Winegar; Presque Isle Lake.  
 Flambeau Drainage: Big Muskellunge Lake (Cahn, Baker); Big Muskellunge L.; Boulder L.; Inlet of Trout L.; Lake Laura; Little Rice L.; Little White Birch L.; Outlet of Big L.; Outlet of Nixon L.; Silver L.; Trout L.; Upper Gresham L.; Whitefish L.; White Sand L.; Wildcat Lake.  
 Tomahawk Drainage: Tomahawk Lake and kettle hole ponds in vicinity (Baker); Carroll L.; Stream, 10 mi. southwest of Hazelhurst.  
 Wisconsin Drainage: Plum Lake (Cahn, Baker); Razorback Lake.

*Gyraulus circumstriatus* (Tryon).

pH=5.9-7.7; fixed carbon dioxide=2.9-18.87 p.p.m. (Fig. 49).  
 Flambeau Drainage: Forest Ponds, 10 mi. northeast of Boulder Junction; Trout L.; Whitefish Lake.  
 Tomahawk Drainage: Clear Lake.  
 Wisconsin Drainage: Plum Lake.

*Gyraulus arcticus* ("Beck" Möller).

pH=8.37; fixed carbon dioxide=25.75 p.p.m. (Fig. 50).  
 Flambeau Drainage: Mann Lake.

Family ANCYLIDAE Menke.

Subfamily FERRISSINAE Walker.

Genus *Ferrissia* Walker.

*Ferrissia parallela* (Haldeman).

pH=6.95-8.37; fixed carbon dioxide=2.75-25.75 p.p.m. (Fig. 51).  
 Lake Superior Drainage: Ontonagon River, Mich., 3 mi. north of Tenderfoot L.; Palmer Lake.  
 Flambeau Drainage: Boulder L.; Fishtrap L.; High L.; Mary L.; Mud L.; Outlet of Mann L.; Turtle River, below Lake of the Falls.  
 Tomahawk Drainage: Tomahawk Lake, and kettle hole ponds in the vicinity (Baker); Stream, 10 mi. southwest of Hazelhurst.  
 Wisconsin Drainage: Deerskin River, 6 mi. south of Phelps; Plum L.; Razorback Lake.



m. (Fig. 52).  
4 mi. west of Minocqua

n. (Fig. 53).

o. (Fig. 54).  
Lake (Winslow, Baker)

all.

naud.

73 p.p.m. (Fig. 55).  
arris L.; Montreal River,  
i. north of Tenderfoot

Lost Canoe L.; White

L.; Pond near State F.

consin River, at Rainbo

5 p.p.m. (Fig. 56).

Nixon Lake (Cahn, Baker);  
skellunge L.; Catfish L.;  
Fishtrap L.; Harvey L.;  
iver, 4 mi. southwest of

Lake (Cahn, Winslow);  
y L.; Johnson Lake;  
aker); Deerskin River,  
; Star Lake.

(Fig. 57).  
northwest of Winchester

p.p.m. (Fig. 58).

e.  
vest of Hazelhurst,  
River, 4 mi. northeast  
near Plum Lake.

*Pyrgina elliptica* Lea.

pH=7.64; fixed carbon dioxide=18.87 p.p.m. (Fig. 59).

Flambeau Drainage: Trout Lake.

*Pyrgina integra* Haldeman.

pH=8.0; fixed carbon dioxide=24.73 p.p.m. (Fig. 60).

Flambeau Drainage: South Branch, Presque Isle River, at Wine-

*Pyrgina michiganensis* Clench.

pH=8.02; fixed carbon dioxide=23.0 p.p.m. (Fig. 61).

Flambeau Drainage: Outlet of Big Lake.

Genus *Aplexa* Fleming.

*Aplexa hypnorum* (L.).

No chemical data.

Wisconsin Drainage: Pools in swamp along Wisconsin River, 4 mi. northeast of Tomahawk Lake (Baker).

Class PELECYPODA Goldfuss.

Order PRIONODESMACEA Dall.

Superfamily NAIADACEA Menke.

Family UNIONIDAE (d'Orbigny) Ortmann.

Subfamily UNIONINAE (Swainson) Ortmann.

Genus *Fusconaia* Simpson.

*Fusconaia flava* (Rafinesque).

pH=7.1-8.02; fixed carbon dioxide=12.07-23.0 p.p.m. (Fig. 62).

Flambeau Drainage: Inlet of White Sand L.; Manitowish River, at Boulder Junction, and 4 mi. southwest; Outlet of Big L.; South Fork, Flambeau River, at Fifield, and 2 mi. east; Turtle L.; Turtle River, below Lake of the Falls.

Tomahawk Drainage: Tomahawk River, 4 mi. west of Minocqua.

Wisconsin Drainage: Clear Water Lake (Chadwick, Baker); St. Germaine River; Wisconsin River, at Lac Vieux Desert, and 5 mi. below.

Genus *Amblyma* Rafinesque.

*Amblyma costata* Rafinesque.

pH=7.1-7.7; fixed carbon dioxide=12.07-18.87 p.p.m. (Fig. 63).

Flambeau Drainage: Manitowish River, at Boulder Junction; Trout River, at Trout L.; Turtle River, at Winchester, and below Lake of the Falls.

Wisconsin Drainage: Clear Water Lake (Chadwick, Baker); Wisconsin River, 4 mi. northeast of Tomahawk Lake (Baker); Wisconsin River, 5 mi. below Lac Vieux Desert, and at Otter Rapids, 5 mi. west of Eagle River.

Genus *Pleurobema* (Rafinesque) Agassiz.

*Pleurobema coccineum* (Conrad).

pH=7.15-7.63; fixed carbon dioxide=12.07-20.1 p.p.m. (Fig. 64).  
Flambeau Drainage: Manitowish River, at Boulder Junction; Turtle River, at Winchester.  
Tomahawk Drainage: Tomahawk River, 4 mi. west of Minocqua.  
Wisconsin Drainage: Wisconsin River, 5 mi. below Lac Vieux Desert.

Genus *Elliptio* Rafinesque.

*Elliptio dilatatus* (Rafinesque).

pH=7.3-7.5; fixed carbon dioxide=13.3-14.0 p.p.m. (Fig. 65).  
Flambeau Drainage: Manitowish River, at Boulder Junction.  
Wisconsin Drainage: Wisconsin River, 5 mi. below Lac Vieux Desert.

*Elliptio dilatatus delicatus* (Simpson).

pH=7.1-8.02; fixed carbon dioxide=12.07-23.0 p.p.m. (Fig. 66).  
Flambeau Drainage: Manitowish River, 4 mi. southwest of Boulder Junction; Outlet of Big L.; South Fork, Flambeau River, at Fifield, and 2 mi. east; Turtle River, at Winchester, and below Lake of the Falls.

Tomahawk Drainage: Tomahawk River, 4 mi. west of Minocqua.

*Elliptio dilatatus sterkii* Grier.

pH=7.15; fixed carbon dioxide=12.07 p.p.m. (Fig. 67).  
Flambeau Drainage: Turtle Lake.

Subfamily ANODONTINAE Ortman.

Genus *Lasmigona* Rafinesque.

*Lasmigona compressa* (Lea).

pH=7.1-8.02; fixed carbon dioxide=12.07-24.73 p.p.m. (Fig. 68).  
Lake Superior Drainage: Montreal River, at Pine L.; Ontonagon River, Mich., 3 mi. north of Tenderfoot L.; South Branch, Presque Isle River, at Winegar.

Flambeau Drainage: Inlet of White Sand L.; Manitowish River, 4 mi. southwest of Boulder Junction; Outlet of Big L.; South Fork, Flambeau River, at Fifield; Trout River, at Trout L.; Turtle L.; Turtle River, at Winchester.

Tomahawk Drainage: Tomahawk River, 4 mi. west of Minocqua.  
Wisconsin Drainage: Gilmore Creek (Baker); Wisconsin River, at Lac Vieux Desert, and 5 mi. below.

*Lasmigona costata* (Rafinesque).

pH=7.1-8.14; fixed carbon dioxide=12.07-23.0 p.p.m. (Fig. 69).  
Flambeau Drainage: Inlet of Trout L.; Inlet of White Sand L.; Outlet of Big L.; Manitowish River, at Boulder Junction, and 4



mi. southwest; South Fork, Flambeau River, at Fifield, and 2 mi. east; Trout River, at Trout L.; Turtle River, at Winchester, and below Lake of the Falls.

Tomahawk Drainage: Tomahawk River, 4 mi. west of Minocqua.

Wisconsin Drainage: Gilmore Creek (Baker); Little St. Germaine River; Plum Creek; St. Germaine River; Wisconsin River, 5 mi. below Lac Vieux Desert, and at Otter Rapids, 5 mi. west of Eagle River.

*Amigona complanata* (Barnes).

pH=7.3-8.14; fixed carbon dioxide=13.4-16.95 p.p.m. (Fig. 70).

Wisconsin Drainage: Little St. Germaine River; Plum L.; St. Germaine River; Wisconsin River, at Lac Vieux Desert, 5 mi. below Lac Vieux Desert, and at Otter Rapids, 5 mi. west of Eagle River.

Genus *Anodonta* Lamarck.

*Anodonta grandis plana* Lea.

pH=6.9-8.37; fixed carbon dioxide=9.3-25.75 p.p.m. (Fig. 71).

Lake Superior Drainage: Montreal River, at Pine L.; South Branch, Presque Isle River, at Winegar.

Flambeau Drainage: Inlet and outlet of Big L.; Inlet of White Sand L.; Little Rice L.; Manitowish River, at Boulder Junction; Outlet of Irving L.; Outlet of Mann L.; Outlet of Tamarac L.; Trout River, at Trout Lake; Turtle River, at Winchester, and below Lake of the Falls.

Tomahawk Drainage: Stream at State Fish Hatchery, near Woodruff.

Wisconsin Drainage: Gilmore Creek (Baker); Deerskin River, 6 mi. south of Phelps; Plum Creek; St. Germaine River; Wisconsin River, at Lac Vieux Desert, 5 mi. below Lac Vieux Desert, and at Otter Rapids, 5 mi. west of Eagle River.

*Anodonta grandis footiana* Lea.

pH=6.7-8.02; fixed carbon dioxide=3.2-30.56 p.p.m. (Fig. 72).

Lake Superior Drainage: Presque Isle Lake.

Flambeau Drainage: Adelaide L.; Big L.; Fishtrap L.; Little Long L.; Lost Canoe L.; Trout L.; Turtle L.; Whitefish L.; Wildcat Lake.

Tomahawk Drainage: Tomahawk Lake (Baker); Brandy L.; Johnson L.; Little Star Lake.

Wisconsin Drainage: Found Lake (Cahn, Baker); Plum Lake.

*Anodonta kenicottii* Lea.

pH=7.35-8.0; fixed carbon dioxide=15.46-24.73 p.p.m. (Fig. 73).

Lake Superior Drainage: Palmer L.; Presque Isle Lake.

Flambeau Drainage: High L.; Silver L.; Trout Lake.

*Anodonta marginata* Say.

pH=6.03-8.37; fixed carbon dioxide=2.6-30.56 p.p.m. (Fig. 74).

Lake Superior Drainage: Anna L.; Armour L.; Horsehead L.; Mon-

trear River, at Pine L.; Ontonagon River, 3 mi. north of Tendersfoot L.; Presque Isle Lake.

Green Bay Drainage: Butternut L.; Kentucky Lake.

Flambeau Drainage: Adelaide L.; Allequash L.; Big Muskellunge L.; Big L. Outlet; Big L.; Cranberry L.; Favil L.; Fishtrap L.; High L.; Inlet of Trout L.; Inlet of White Sand L.; Irving L. Outlet; L. Constance; L. George; L. Laura; Little Long L.; Little Rice L.; Little White Birch L.; Lost Canoe L.; Manitowish River, at Boulder Junction, and 4 mi. southwest; Mann L.; Marion L.; Outlet of Mann L.; Outlet of Nixon L.; Outlet of Tamarac L.; Silver L.; Trout L.; Trout River, at Trout L.; Turtle L.; Turtle River, at Winchester; Wildcat Lake.

Tomahawk Drainage: Tomahawk Lake (Baker); Brandy L.; Clear L.; Johnson L.; Stream at State Fish Hatchery, near Woodruff.

Wisconsin Drainage: Gilmore Creek (Baker); Crescent L.; Deerskin River, 6 mi. south of Phelps; Little St. Germaine River; Plum L.; St. Germaine River; Razorback L.; Star L.; Wisconsin River, at Lac Vieux Desert.

Genus *Utterbackia* F. C. Baker.

*Utterbackia imbecillis* (Say).

pH=7.1; fixed carbon dioxide=17.3 p.p.m. (Fig. 75).

Flambeau Drainage: Inlet of White Sand L.; Manitowish River, at Boulder Junction; Turtle River, below Lake of the Falls.

Genus *Anodontoides* Simpson.

*Anodontoides ferussacianus* (Lea).

pH=7.0; fixed carbon dioxide=9.3 p.p.m. (Fig. 76).

Flambeau Drainage: Little Rice Lake.

*Anodontoides ferussacianus subcylindraceus* (Lea).

pH=6.9-8.37; fixed carbon dioxide=10.65-30.56 p.p.m. (Fig. 77).

Lake Superior Drainage: Montreal River, at Pine Lake.

Flambeau Drainage: Fishtrap L.; High L.; Inlet of White Sand L.; Irving L. Outlet; Manitowish River, 4 mi. southwest of Boulder Junction; Mann L.; Silver L.; Trout River, at Trout L.; Turtle River, at Winchester; Whitefish L.; Wildcat Lake.

Tomahawk Drainage: Brandy L.; Tomahawk River, 4 mi. west of Minocqua.

Wisconsin Drainage: Deerskin River, 6 mi. south of Phelps; Plum L.; Wisconsin River, at Lac Vieux Desert, and 5 mi. below.

*Anodontoides birgei* F. C. Baker.

pH=8.0; fixed carbon dioxide=24.73 p.p.m. (Fig. 78).

Lake Superior Drainage: South Branch, Presque Isle River, at Winegar.

Genus *Alasmidonta* Say.

*Alasmidonta marginata variabilis* F. C. Baker.

pH=7.1-8.14; fixed carbon dioxide=13.3-20.1 p.p.m. (Fig. 79).  
Flambeau Drainage: Manitowish River, 4 mi. southwest of Boulder Junction; South Fork, Flambeau River, at Fifield, and 2 mi. east.  
Tomahawk Drainage: Tomahawk River, 4 mi. west of Minocqua.  
Wisconsin Drainage: Little St. Germaine River; Wisconsin River, at Otter Rapids, 5 mi. west of Eagle River.

Genus *Strophitus* Rafinesque.

*Strophitus rugosus pavonius* (Lea).

pH=7.1-8.14; fixed carbon dioxide=12.07-23.0 p.p.m. (Fig. 80).  
Flambeau Drainage: Big L. Outlet; Inlet of Trout Lake; Inlet of White Sand L.; Manitowish River, 4 mi. southwest of Boulder Junction; South Fork, Flambeau River, at Fifield; Trout River, at Trout L.; Turtle River, at Winchester, and Below Lake of the Falls.  
Tomahawk Drainage: Tomahawk River, 4 mi. west of Minocqua.  
Wisconsin Drainage: Gilmore Creek (Baker); Little St. Germaine River; Plum Creek; St. Germaine River; Wisconsin River, at Lac Vieux Desert.

Subfamily LAMPSILINAE Ortmann.

Genus *Actinonaias* Fischer & Crosse.

*Actinonaias carinata* (Barnes).

pH=7.0-8.14; fixed carbon dioxide=12.07-23.0 p.p.m. (Fig. 81).  
Flambeau Drainage: Inlet of Trout L.; Outlet of Big L.; South Fork, Flambeau River, at Fifield; Turtle River, at Winchester, and below Lake of the Falls.  
Tomahawk Drainage: Tomahawk River, 4 mi. west of Minocqua.  
Wisconsin Drainage: Clear Water Lake Creek (Chadwick, Baker); Gilmore Creek, and Wisconsin River, 4 mi. northeast of Tomahawk Lake (Baker); Little St. Germaine River; St. Germaine River; Wisconsin River, at Lac Vieux Desert, 5 mi. below Lac Vieux Desert, at Otter Rapids, 5 mi. west of Eagle River, and at Rainbow Rapids, southeast of Lake Tomahawk.

Genus *Ligumia* Swainson.

*Ligumia recta* (Lamarck).

pH=7.15; fixed carbon dioxide=12.07 p.p.m. (Fig. 82).  
Flambeau Drainage: Turtle Lake.

*Ligumia recta latissima* (Rafinesque).

pH=7.1-8.14; fixed carbon dioxide=12.07-20.1 p.p.m. (Fig. 83).  
Flambeau Drainage: Manitowish River, at Boulder Junction, and 4 mi. southwest; South Fork, Flambeau River, at Fifield, and 2 mi.

east; Turtle River, at Winchester, and below Lake of the Falls.  
Tomahawk Drainage: Tomahawk River, 4 mi. west of Minocqua.  
Wisconsin Drainage: Wisconsin River, 4 mi. northeast of Tomahawk Lake (Baker); Little St. Germaine River; Wisconsin River, at Otter Rapids, 5 mi. west of Eagle River.

Genus *Lampsilis* Rafinesque.

*Lampsilis siliquoides* (Barnes).

pH=6.9-8.14; fixed carbon dioxide=9.3-24.73 p.p.m. (Fig. 84).

Lake Superior Drainage: Ontonagon River, Mich., 3 mi. north of Tenderfoot L.; South Branch, Presque Isle River, at Winegar.

Flambeau Drainage: Inlet and Outlet of Big L.; Inlet of Trout L.; Little Rice L.; Manitowish River, at Boulder Junction, and 4 mi. southwest; Outlet of Tamarac L.; South Fork, Flambeau River, at Fifield, and 2 mi. east; Trout River, at Trout L.; Turtle River, at Winchester, and below Lake of the Falls.

Tomahawk Drainage: Stream at State Fish Hatchery, near Woodruff.

Wisconsin Drainage: Clear Water Creek (Chadwick, Baker); Gilmore Creek, and Wisconsin River, 4 mi. northeast of Tomahawk Lake (Baker); Deerskin River, 6 mi. south of Phelps; Little St. Germaine River; St. Germaine River; Wisconsin River, at Lac Vieux Desert, 5 mi. below Lac Vieux Desert, at Otter Rapids, 5 mi. west of Eagle River, and at Rainbow Rapids, southeast of Lake Tomahawk.

*Lampsilis siliquoides rosacea* (DeKay).

pH=6.95-8.37; fixed carbon dioxide=7.5-30.56 p.p.m. (Fig. 85).

Lake Superior Drainage: Armour L.; Horsehead L.; Presque Isle Lake.

Flambeau Drainage: Allequash L.; Big L.; Boulder L.; Fishtrap L.; High L.; Mann L.; Trout L.; Turtle L.; Whitefish L.; White Sand L.; Wildcat Lake.

Tomahawk Drainage: Tomahawk Lake (Baker); Brandy Lake.

Wisconsin Drainage: Plum Lake; Plum Creek.

*Lampsilis ventricosa occidens* (Lea).

pH=7.0-8.14; fixed carbon dioxide=12.07-23.0 p.p.m. (Fig. 86).

Flambeau Drainage: Inlet and Outlet of Big L.; Manitowish River, at Boulder Junction, and 4 mi. southwest; South Fork, Flambeau River, at Fifield, and 2 mi. east; Trout River, at Trout L.; Turtle River, at Winchester, and below Lake of the Falls.

Tomahawk Drainage: Tomahawk River, 4 mi. west of Minocqua.

Wisconsin Drainage: Clear Water Creek (Chadwick, Baker); Gilmore Creek, and Wisconsin River, 4 mi. northeast of Lake Tomahawk (Baker); Little St. Germaine River; St. Germaine River; Wisconsin River, at Lac Vieux Desert, 5 mi. below Lac Vieux Desert, at Otter Rapids, 5 mi. west of Eagle River, and at Rainbow Rapids, southeast of Lake Tomahawk.



Arts, and Letters.  
 and below Lake of the Falls.  
 4 mi. west of Minocqua  
 4 mi. northeast of T.  
 St. Germaine River; Wisconsin R.  
 River.

inesque.  
 -24.78 p.p.m. (Fig. 84).  
 River, Mich., 3 mi. north  
 ue Isle River, at Winegar  
 of Big L.; Inlet of Trout L.  
 Boulder Junction, and 4  
 South Fork, Flambeau River,  
 er, at Trout L.; Turtle River  
 ie Falls.  
 e Fish Hatchery, near W.

reek (Chadwick, Baker); G.  
 mi. northeast of Tomahawk  
 i. south of Phelps; Little S.  
 ar; Wisconsin River, at Lac  
 Desert, at Otter Rapids, 5 mi.  
 w Rapids, southeast of Lac

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 g L.; Boulder L.; Fishtrap L.  
 L.; Whitefish L.; White Sand  
 e (Baker); Brandy Lake.  
 im Creek.

7-23.0 p.p.m. (Fig. 86).  
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 River; St. Germaine River;  
 ; 5 mi. below Lac Vieux Des-  
 Eagle River, and at Rainbow

*Spis ventricosa lurida* Simpson.  
 pH=7.15-8.02; fixed carbon dioxide=12.07-23.0 p.p.m. (Fig. 87).  
 Flambeau Drainage: Big L.; Fishtrap L.; High L.; Inlet of Trout  
 L.; Trout Lake.

Order TELEODESMACEA Dall.  
 Superfamily CYRENACEA Tryon.  
 Family SPHAERIIDAE Dall.  
 Subfamily SPHAERIINAE F. C. Baker.

Genus *Sphaerium* Scopoli.

*Sphaerium sulcatum* (Lamarck).  
 pH=6.9-8.37; fixed carbon dioxide=9.3-25.75 p.p.m. (Fig. 88).  
 Flambeau Drainage: Big L.; Big Muskellunge L.; Fishtrap L.; Irv-  
 ing L. Outlet; Little Rice L.; Outlet of Mann L.; Outlet of Nixon  
 L.; Trout L. Inlet.  
 Tomahawk Drainage: Tomahawk Lake (Baker).  
 Wisconsin Drainage: Deerskin River, 6 mi. south of Phelps; Plum  
 L.; Rice Creek, near Plum Lake.

*Sphaerium crassum* Sterki.  
 pH=7.1; fixed carbon dioxide=17.3 (Fig. 89).  
 Flambeau Drainage: Turtle River, below Lake of the Falls.  
 Wisconsin Drainage: Wisconsin River, at Otter Rapids, 5 mi. west  
 of Eagle River.

*Sphaerium fallax* Sterki.  
 pH=6.85-8.37; fixed carbon dioxide=11.75-30.56 p.p.m. (Fig. 90).  
 Lake Superior Drainage: Ontonagon River, Mich., 3 mi. north of  
 Tenderfoot L.; Palmer L.; Presque Isle Lake.  
 Flambeau Drainage: High L.; Island L.; Marion L.; Outlet of Mann  
 L.; Outlet of Tamarac L.; Turtle River, at Winchester; Wildcat  
 Lake.  
 Wisconsin Drainage: Wisconsin River, at Lac Vieux Desert.

*Sphaerium solidulum* (Prime).  
 pH=7.7; fixed carbon dioxide=16.95 p.p.m. (Fig. 91).  
 Wisconsin Drainage: Plum Creek.

*Sphaerium stamineum* (Conrad)  
 pH=6.9-8.37; fixed carbon dioxide=13.0-25.75 p.p.m. (Fig. 92).  
 Lake Superior Drainage: Ontonagon River, Mich., 3 mi. north of  
 Tenderfoot L.; South Branch, Presque Isle River, at Winegar.  
 Flambeau Drainage: Inlet of Trout L.; Manitowish River, at Boul-  
 der Junction; Mann L. Outlet; Outlet of Big L.; Trout River, at  
 Trout Lake.  
 Tomahawk Drainage: Tomahawk River, 4 mi. west of Minocqua.  
 Wisconsin Drainage: Deerskin River, 6 mi. south of Phelps; Wiscon-

sin River, 5 mi. below Lac Vieux Desert, at Otter Rapids, 5 mi. west of Eagle River, and at Rainbow Rapids, southeast of Lake Tomahawk.

*Sphaerium emarginatum* (Prime).

pH=7.1-7.95; fixed carbon dioxide=15.5-17.3 p.p.m. (Fig. 93).

Flambeau Drainage: Inlet of Trout L.; Inlet of White Sand L. Manitowish River, at Boulder Junction; South Fork, Flambeau River, at Fifield; Turtle River, below Lake of the Falls.

*Sphaerium bakeri* Sterki.

pH=7.7; fixed carbon dioxide=16.95 p.p.m. (Fig. 94).

Wisconsin Drainage: Plum Creek.

*Sphaerium striatinum* (Lamarck).

pH=7.1; fixed carbon dioxide=17.3 p.p.m. (Fig. 95).

Flambeau Drainage: Turtle River, below Lake of the Falls.

Wisconsin Drainage: Wisconsin River, 4 mi. northeast of Tomahawk Lake (Baker).

*Sphaerium rhomboideum* (Say).

pH=7.1-7.36; fixed carbon dioxide=14.0-18.5 p.p.m. (Fig. 96).

Lake Superior Drainage: Ontonagon River, Mich., 3 mi. north of Tenderfoot Lake.

Flambeau Drainage: Fishtrap L.; Outlet of Nixon Lake.

*Sphaerium occidentale* Prime.

pH=5.8-5.9; fixed carbon dioxide=5.5-7.5 p.p.m. (Fig. 97).

Green Bay Drainage: Pools in lumber slashings, 4 mi. east of Bernut Lake.

Flambeau Drainage: Forest Ponds, 10 mi. northeast of Boulder Junction.

Wisconsin Drainage: Swamp along Wisconsin River, 4 mi. northeast of Tomahawk Lake (Baker).

Genus *Musculium* Link.

*Musculium jayense* (Prime).

pH=7.1-7.23; fixed carbon dioxide=10.3-13.0 p.p.m. (Fig. 98).

Flambeau Drainage: L. Laura; Outlet of Tamarac Lake.

*Musculium partuncium* (Say).

No chemical data.

Wisconsin Drainage: Small Ponds in swamp along Wisconsin River, 4 mi. northeast of Tomahawk Lake (Baker).

*Musculium truncatum* (Linsley).

pH=6.05-8.37; fixed carbon dioxide=2.75-25.75 p.p.m. (Fig. 99).

Flambeau Drainage: Catfish L.; Fishtrap L.; Harvey L.; L. Laura; Mary L.; Outlet of Mann Lake.

Tomahawk Drainage: Little Rice River.

*Musculium rosaceum* (Prime).

pH=6.4-7.64; fixed carbon dioxide=9.3-18.87 p.p.m. (Fig. 100).  
 Flambeau Drainage: Big Muskellunge L.; Little Rice L.; Outlet of Nixon L.; Trout Lake.  
 Tomahawk Drainage: Pond, near State Fish Hatchery ponds, near Woodruff.

*Musculium ryckholti* (Normand).

No chemical data.  
 Tomahawk Drainage: Small Kettle-hole Pools near Tomahawk Lake (Baker).

*Musculium securis* (Prime).

pH=5.9-8.37; fixed carbon dioxide=2.75-25.75 p.p.m. (Fig. 101).  
 Lake Superior Drainage: Black Oak Lake.  
 Flambeau Drainage: Allequash L.; Forest ponds, 10 mi. northeast of Boulder Junction; Helen L.; Little Long L.; Mary L.; Outlet of Mann L.; Pond along Mann L. Outlet.  
 Tomahawk Drainage: Pond near Tomahawk Lake, and Tomahawk Lake (Baker); Pond, near State Fish Hatchery ponds, at Woodruff.  
 Wisconsin Drainage: Wisconsin River, at Rainbow Rapids, southeast of Lake Tomahawk.

*Musculium steinii* (A. Schmidt).

pH=6.6; fixed carbon dioxide=12.9 p.p.m. (Fig. 102).  
 Flambeau Drainage: Inlet of White Sand Lake.

Subfamily PISIDIINAE F. C. Baker.

Genus *Pisidium* C. Pfeiffer.

*Pisidium virginicum* (Gmelin).

pH=7.0-7.7; fixed carbon dioxide=13.0-16.95 p.p.m. (Fig. 103).  
 Wisconsin Drainage: Wisconsin River, 4 mi. northeast of Tomahawk Lake (Baker); Plum L.; Wisconsin River, at Rainbow Rapids, southeast of Lake Tomahawk, and ½ mi. below.

*Pisidium idahoense* Roper.

pH=5.8; fixed carbon dioxide=1.5 p.p.m. (Fig. 104).  
 Tomahawk Drainage: Walker Lake.

*Pisidium compressum* Prime.

pH=7.0-8.37; fixed carbon dioxide=9.3-30.56 p.p.m. (Fig. 105).  
 Lake Superior Drainage: Palmer L.; Presque Isle L.; South Branch, Presque Isle River, at Winegar.  
 Flambeau Drainage: Big L. Outlet; Big Muskellunge L.; Boulder L.; Inlet of Trout L.; Irving L. Outlet; Little Rice L.; Little White Birch L.; Lost Canoe L.; Mann L. Outlet; Trout L.; Upper Gresham L.; Whitefish L.; White Sand L.; Wildcat Lake.  
 Tomahawk Drainage: Brandy L.; Kawaguesaga Lake.

Wisconsin Drainage: Little St. Germaine River; Plum L.; Star L.; Wisconsin River, at Lac Vieux Desert, at Rainbow Rapids, south-east of Lake Tomahawk, and ½ mi. below.

*Pisidium fallax septentrionale* Sterki.

pH=7.95; fixed carbon dioxide=16.6 p.p.m. (Fig. 106).

Flambeau Drainage: Inlet of Trout L.; Inlet of White Sand Lake.

*Pisidium punctatum* Sterki.

pH=7.0; fixed carbon dioxide=13.0 p.p.m. (Fig. 107).

Wisconsin Drainage: Wisconsin River, at Rainbow Rapids, south-east of Lake Tomahawk.

*Pisidium variabile* Prime.

pH=5.72-8.37; fixed carbon dioxide=1.72-30.56 p.p.m. (Fig. 108).

Lake Superior Drainage: Ontonagon River, Mich., 3 mi. north of Tenderfoot L.; Palmer L.; Presque Isle Lake.

Flambeau Drainage: Big Muskellunge L.; Boulder L.; Clear Crooked L.; Dead Pike L.; Fishtrap L.; Little Rice L.; Mann L.; Outlet of Mann L.; Outlet of Nixon L.; Outlet of Tamarac L.; Pauto L.; Trout L.; Upper Gresham L.; Whitefish L.; White Sand L.; Wildcat Lake.

Tomahawk Drainage: Brandy L.; Kawaguesaga L.; Trilby Lake.

Wisconsin Drainage: Crescent L.; Plum L.; Razorback L.; Star L.; Wisconsin River, at Rainbow Rapids, southeast of Lake Tomahawk.

*Pisidium minusculum* Sterki.

pH=7.48-7.64; fixed carbon dioxide=12.96-18.87 p.p.m. (Fig. 109).

Flambeau Drainage: Little White Birch L.; Trout Lake.

*Pisidium adamsi* Prime.

pH=6.05-7.7; fixed carbon dioxide=2.75-18.36 p.p.m. (Fig. 110).

Flambeau Drainage: Fishtrap L.; Irving L. Outlet; Mary Lake.

Wisconsin Drainage: Plum Lake.

*Pisidium sargenti* Sterki.

pH=6.05-8.14; fixed carbon dioxide=2.75-23.0 p.p.m. (Fig. 111).

Lake Superior Drainage: Palmer Lake.

Flambeau Drainage: Big L. Outlet; Little White Birch L.; Manitowish River, at Boulder Junction; Mary L.; Trout L.; Trout River, at Trout L.; Whitefish Lake.

Tomahawk Drainage: Clear Lake.

Wisconsin Drainage: Crescent L.; Little St. Germaine River; Plum L.; Star L.; Wisconsin River at Lac Vieux Desert, and at Rainbow Rapids, southeast of Lake Tomahawk.

*Pisidium neglectum* Sterki.

pH=6.66-7.1; fixed carbon dioxide=2.9-14.0 p.p.m. (Fig. 112).

Flambeau Drainage: Outlet of Nixon Lake.

Tomahawk Drainage: Clear Lake.



*Psidium lilljeborgi* Clessin. (= *scutellatum* Sterki.)

pH=6.16-8.02; fixed carbon dioxide=1.97-23.0 p.p.m. (Fig. 113).  
 Lake Superior Drainage: Katinka Lake.  
 Flambeau Drainage: Big L. Outlet; Boulder L.; Little White Birch L.; Trout L.; Whitefish Lake.  
 Tomahawk Drainage: Little Arbor Vitae Lake (Winslow, Baker).  
 Wisconsin Drainage: Crescent L.; Plum L.; Star Lake.

*Psidium lilljeborgi cristatum* Sterki.

pH=7.35-7.64; fixed carbon dioxide=18.87-19.5 p.p.m. (Fig. 114).  
 Lake Superior Drainage: Palmer Lake.  
 Flambeau Drainage: Trout Lake.

*Psidium roperi* Sterki.

pH=5.8-6.4; fixed carbon dioxide=5.5-9.5 p.p.m. (Fig. 115).  
 Green Bay Drainage: Pools in lumber slashings, 4 mi. east of Butternut Lake.  
 Flambeau Drainage: Forest ponds, 10 mi. northeast of Boulder Junction.  
 Tomahawk Drainage: Kettle-hole pools near Tomahawk Lake (Baker); Pond, near State Fish Hatchery ponds, near Woodruff.

*Psidium strengi* Sterki.

pH=5.84-7.95; fixed carbon dioxide=2.13-30.56 p.p.m. (Fig. 116).  
 Flambeau Drainage: Wildcat Lake.  
 Tomahawk Drainage: Trilby Lake.  
 Wisconsin Drainage: Finley Lake.

*Psidium abditum* Haldeman.

pH=7.6; fixed carbon dioxide=16.7 p.p.m. (Fig. 117).  
 Tomahawk Drainage: Tomahawk Lake and kettle-hole pools in vicinity (Baker).

*Psidium subrotundatum* Sterki.

No theoretical data.  
 Wisconsin Drainage: Wisconsin River, swampy places, 4 mi. northeast of Tomahawk Lake (Baker).

*Psidium splendidulum* Sterki.

pH=6.32; fixed carbon dioxide=1.98 p.p.m. (Fig. 118).  
 Wisconsin Drainage: Sterrett Lake.

*Psidium levissimum* Sterki.

pH=7.64; fixed carbon dioxide=18.87 p.p.m. (Fig. 119).  
 Flambeau Drainage: Trout Lake.

*Psidium pauperculum* Sterki.

pH=7.0-8.0; fixed carbon dioxide=9.3-24.73 p.p.m. (Fig. 120).  
 Lake Superior Drainage: Palmer L.; Presque Isle Lake.  
 Flambeau Drainage: Big Muskellunge L.; Boulder L.; L. Laura; Little Rice L.; Trout Lake.

Tomahawk Drainage: Brandy Lake.

Wisconsin Drainage: Crescent L.; Plum L.; Star L.; Wisconsin River, at Rainbow Rapids, southeast of Lake Tomahawk.

*Pisidium rotundatum* Prime.

pH=5.8-6.2; fixed carbon dioxide=1.97-9.0 p.p.m. (Fig. 121).

Lake Superior Drainage: Katinka Lake.

Green Bay Drainage: Pools in lumber slashings, 4 mi. east of Butternut Lake.

Flambeau Drainage: Forest pond, 10 mi. northeast of Boulder Junction.

*Pisidium vesiculare* Sterki.

pH=7.64; fixed carbon dioxide=18.87 p.p.m. (Fig. 122).

Flambeau Drainage: Trout Lake.

*Pisidium ferrugineum* Prime.

pH=7.23-8.14; fixed carbon dioxide=10.8-22.5 p.p.m. (Fig. 123).

Flambeau Drainage: L. Laura; Trout Lake.

Tomahawk Drainage: Little Arbor Vitae Lake (Winslow, Baker).

Wisconsin Drainage: Crescent L.; Little St. Germaine River; Star Lake.

*Pisidium concinnulum* Sterki.

pH=5.72-7.48; fixed carbon dioxide=1.72-15.46 p.p.m. (Fig. 124).

Green Bay Drainage: Pools in lumber slashings, 4 mi. east of Butternut Lake.

Flambeau Drainage: Forest ponds, 10 mi. northeast of Boulder Junction; Pauto L.; Silver L.; Springs in Tamarack bog north of Trout Lake.

*Pisidium pusillum* (Gmelin) Jenyus.

No chemical data.

Flambeau Drainage: Pool along Mann Lake Outlet.

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Arts and Letters.

Plum L.; Star L.; Wisconsin of Lake Tomahawk.

7-9.0 p.p.m. (Fig. 121).  
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r slashings, 4 mi. east of Boulder  
mi. northeast of Boulder Junction

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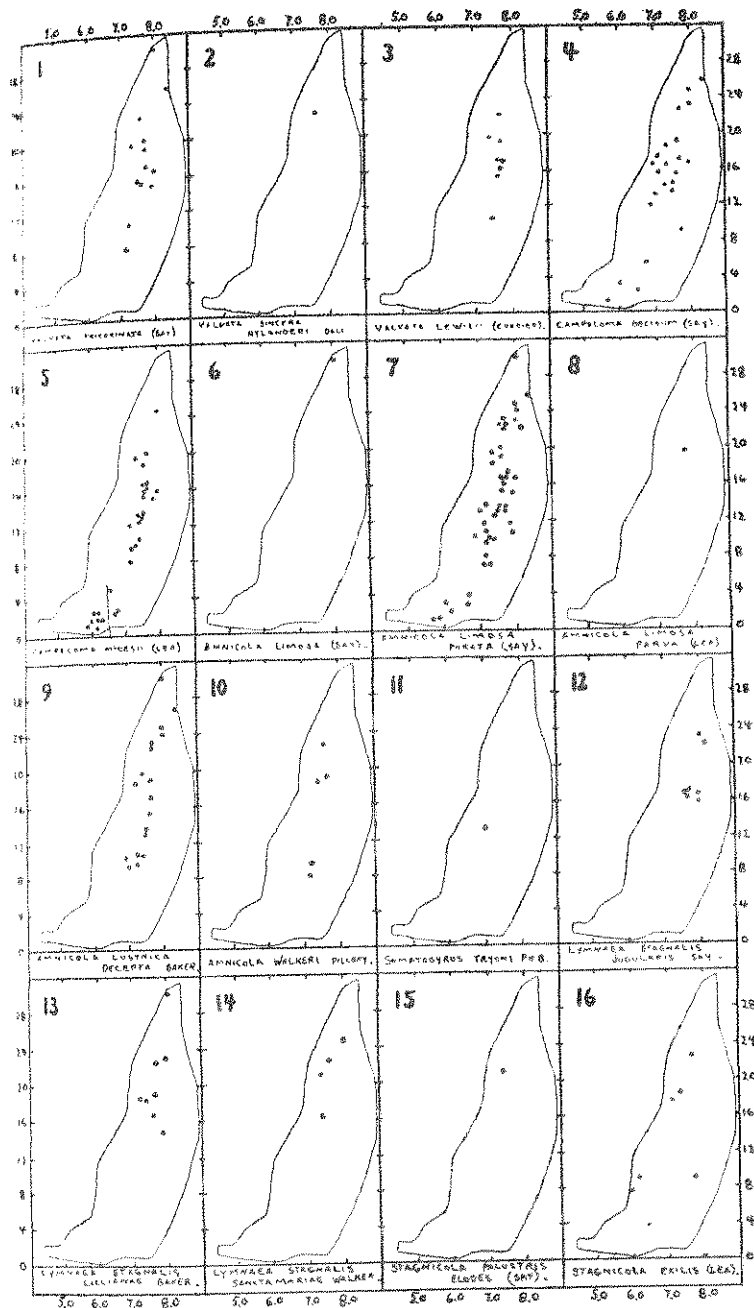
0.8-22.5 p.p.m. (Fig. 123).  
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shells. Nautilus, XIX, pp. 57-60.  
anorbis campanulatus Say. Occ.  
80, pp. 1-9, pl. i, ii.



FIGS. 1-16. The pH and fixed carbon dioxide ranges of various mollusks. Ordinates indicate fixed carbon dioxide in parts per million; abscissae indicate pH. The circumscribed area presents for comparison the total range of these factors in all the lakes of the Highland Lake District for which data are available.

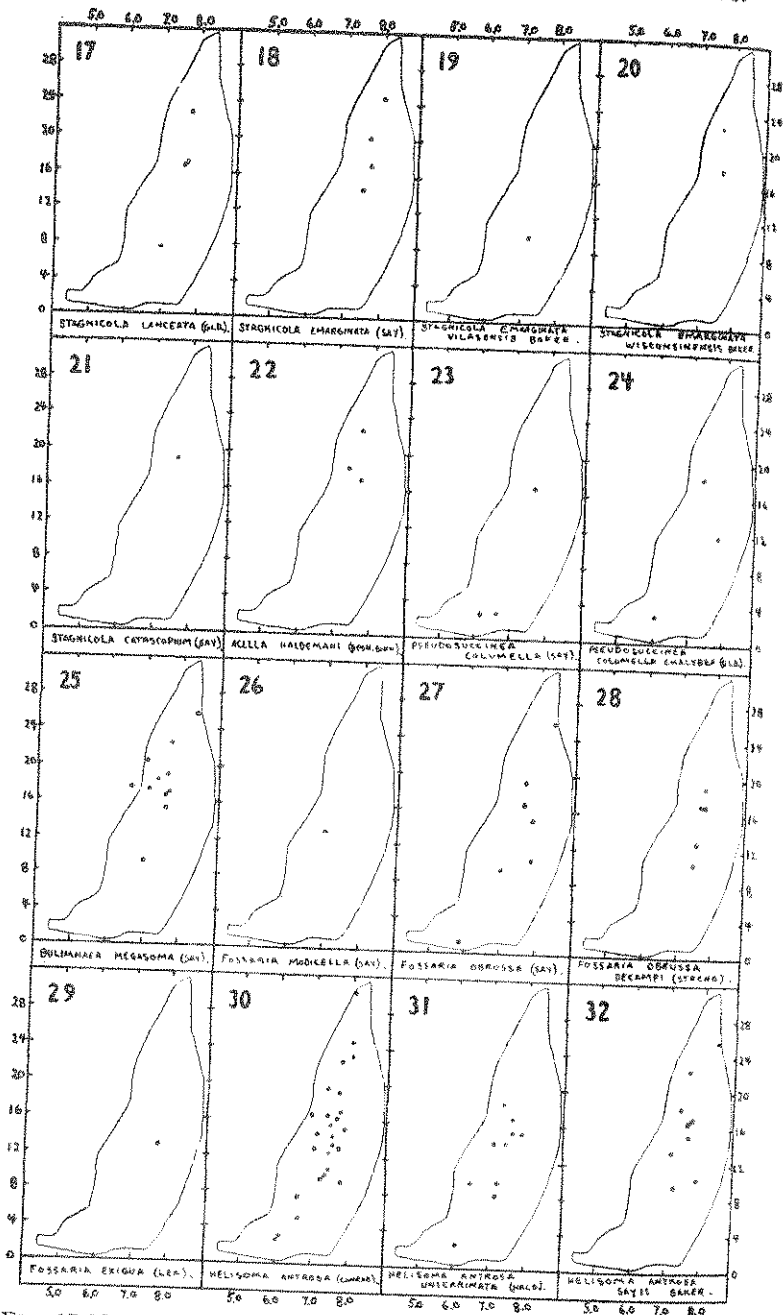
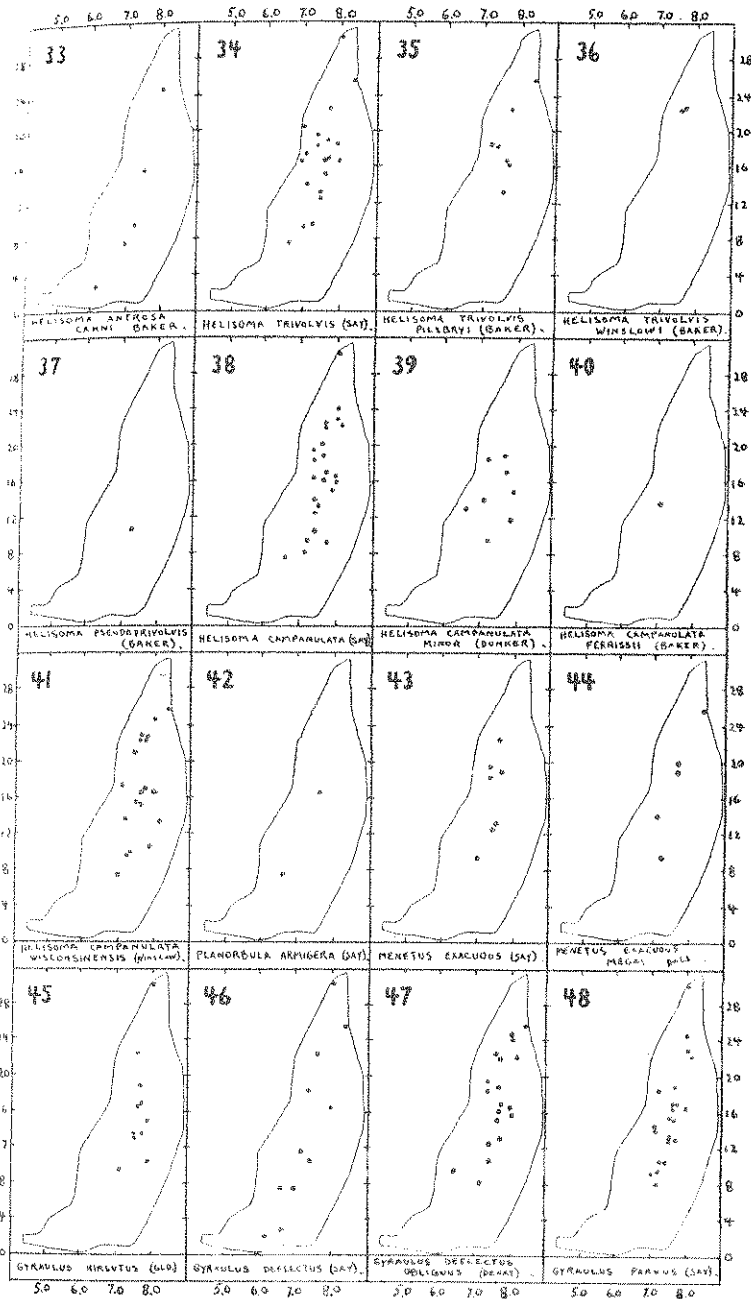
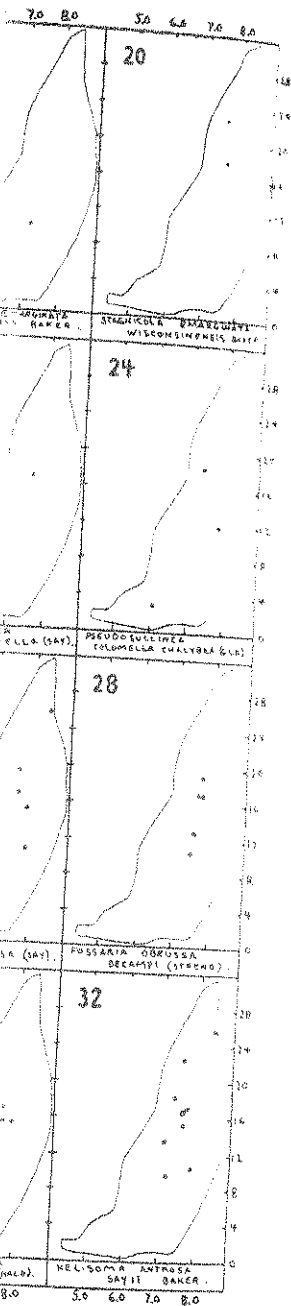


FIG. 17-32. The pH and fixed carbon dioxide ranges of various mollusks. Ordinates indicate fixed carbon dioxide in parts per million; abscissae indicate pH. The circumscribed area presents for comparison the total range of these factors in all the lakes of the Highland Lake District for which data are available.

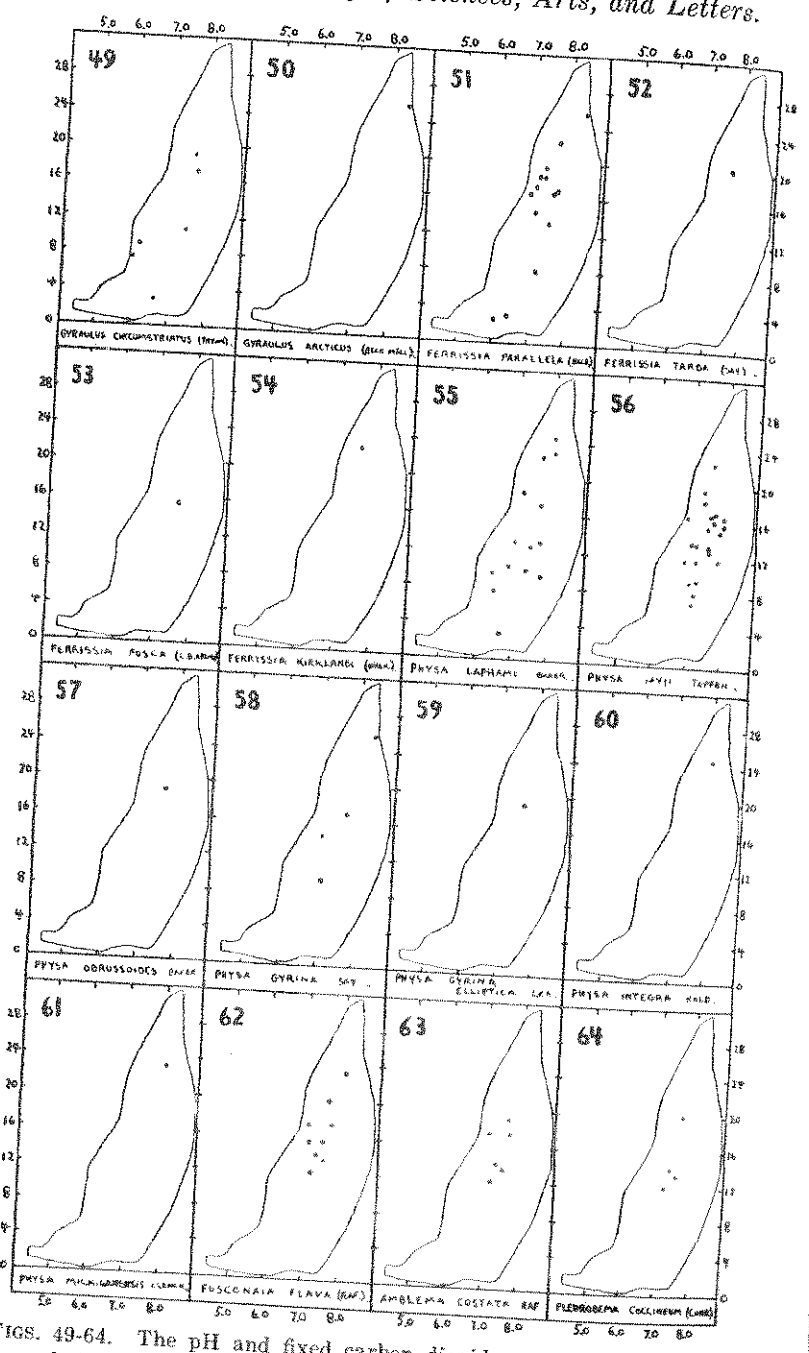
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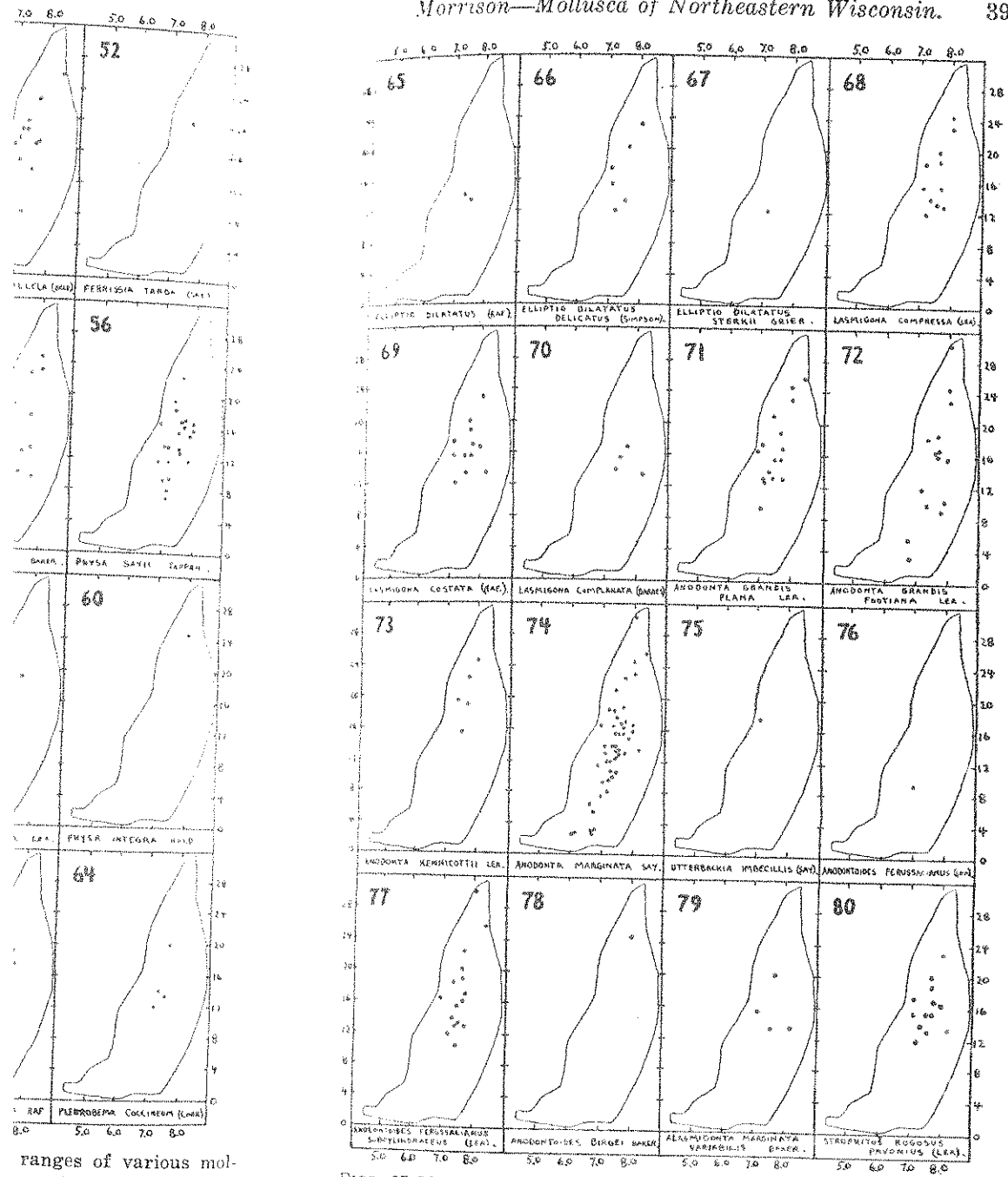
FIGS. 33-48. The pH and fixed carbon dioxide ranges of various mollusks. Ordinates indicate fixed carbon dioxide in parts per million; abscissae indicate pH. The circumscribed area presents for comparison the total range of these factors in all the lakes of the Highland Lake District for which data are available.

ranges of various mollusks; abscissae indicate pH; ordinates indicate fixed carbon dioxide in parts per million; the circumscribed area presents for comparison the total range of these factors in all the lakes of the Highland Lake District for which data are available.



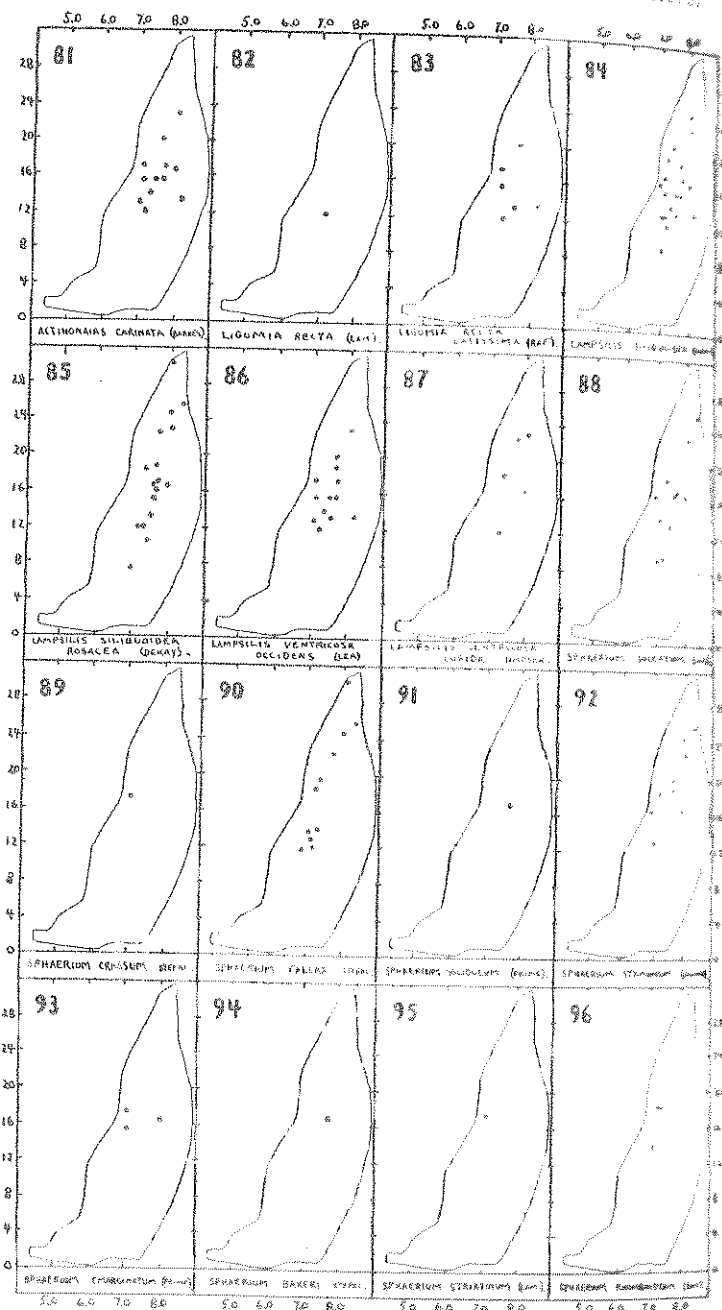
FIGS. 49-64. The pH and fixed carbon dioxide ranges of various mollusks. Ordinates indicate fixed carbon dioxide in parts per million; abscissae indicate pH. The circumscribed area presents for comparison the total range of these factors in all the lakes of the Highland Lake District for which data are available.

FIGS. 65-70. Mollusks. (Abscissae indicate pH; ordinates indicate total range of these factors in the Highland Lake District for which data are available.)



FIGS. 65-80. The pH and fixed carbon dioxide ranges of various mollusks. Ordinates indicate fixed carbon dioxide in parts per million; abscissae indicate pH. The circumscribed area presents for comparison the total range of these factors in all the lakes of the Highland Lake District for which data are available.

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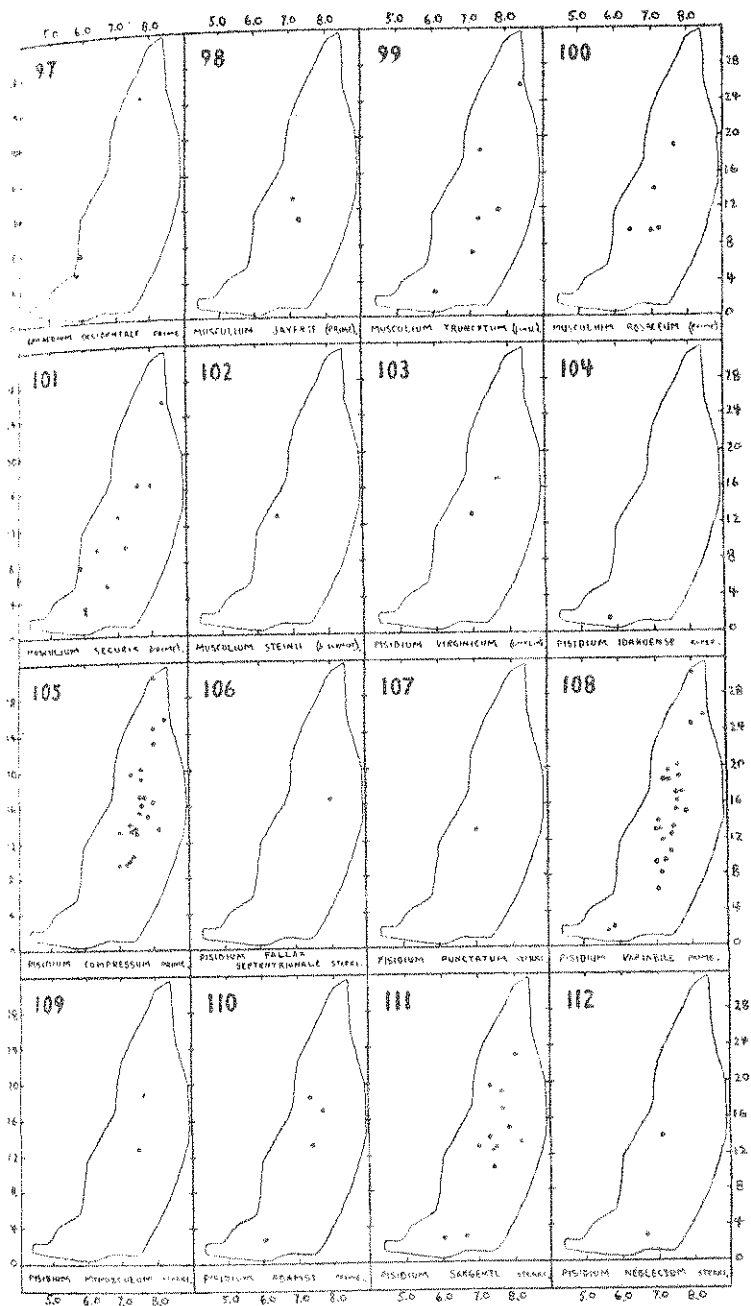
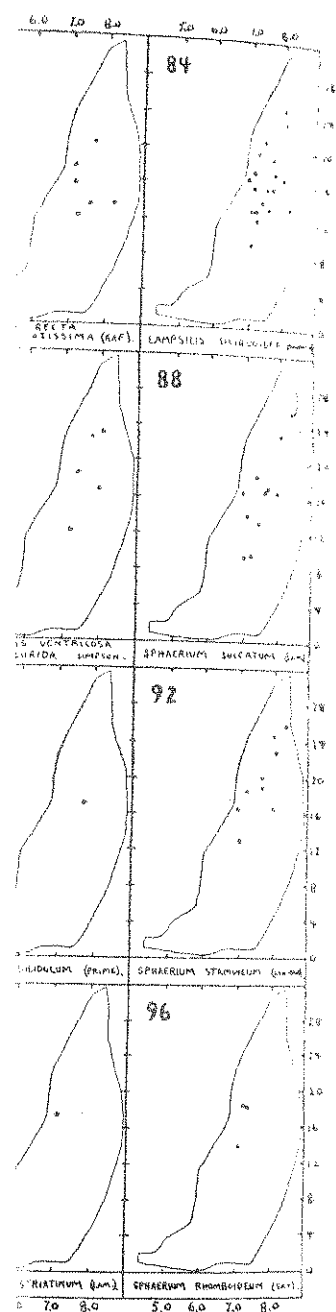
FIGS. 81-96. The pH and fixed carbon dioxide ranges of various mollusks. Ordinates indicate fixed carbon dioxide in parts per million; abscissae indicate pH. The circumscribed area presents for comparison the total range of these factors in all the lakes of the Highland Lake District for which data are available.

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103  
104

FIGS.  
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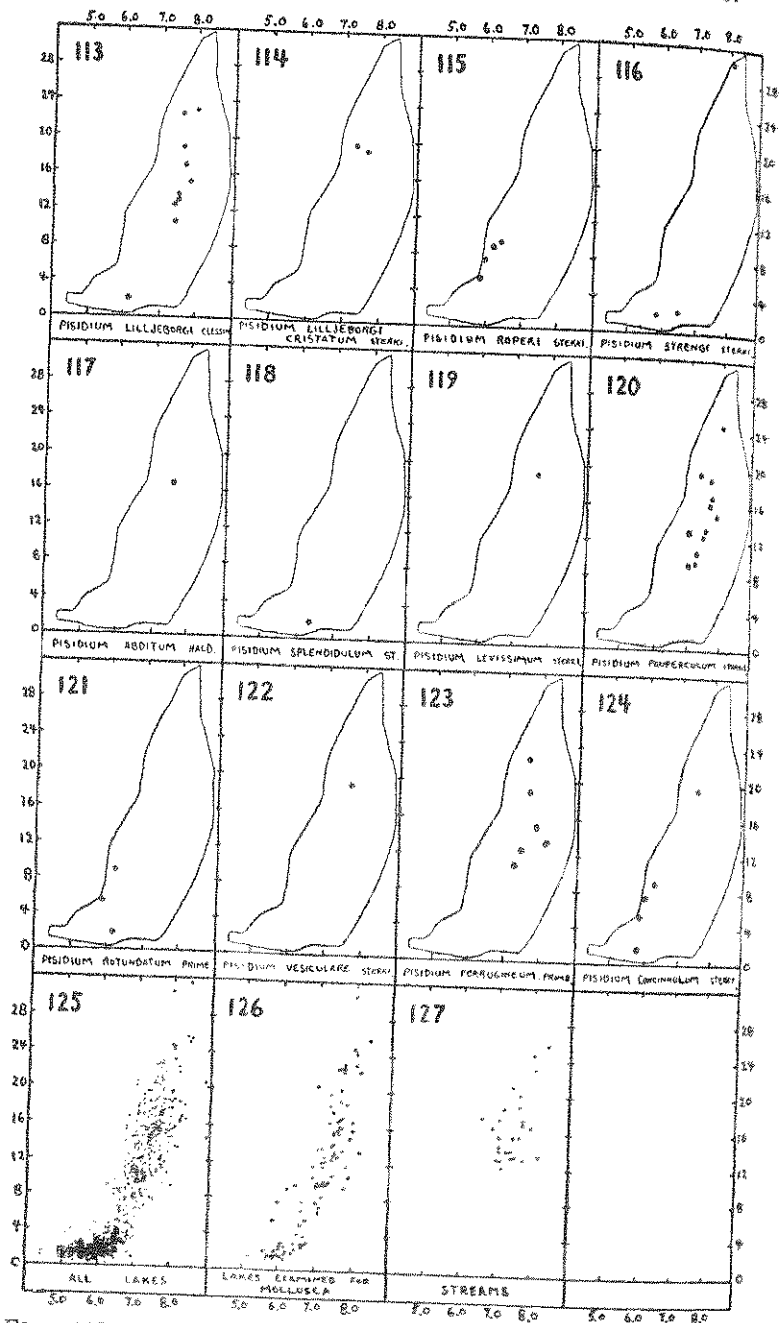


ces, Arts, and Letters.



FIGS. 97-112. The pH and fixed carbon dioxide ranges of various mollusks. Ordinates indicate fixed carbon dioxide in parts per million; abscissae indicate pH. The circumscribed area presents for comparison the total range of these factors in all the lakes of the Highland Lake District for which data are available.

oxide ranges of various mollusks. Ordinates indicate fixed carbon dioxide in parts per million; abscissae indicate pH. The circumscribed area presents for comparison the total range of these factors in all the lakes of the Highland Lake District for which data are available.



FIGS. 113-127. pH and fixed carbon dioxide ranges: (113-124) for various mollusks, (125) for all the lakes of the Highland Lake District for which records are available, (126) for all lakes in which mollusks were found, and (127) for stream localities found to harbor mollusks. Ordinates represent fixed carbon dioxide; abscissae indicate pH.

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