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597–99.

PLEISTOCENE MOLLUSCA FROM INDIANA AND OHIO[1]

FRANK COLLINS BAKER
Curator, Museum of Natural History, University of Illinois

Two very interesting and valuable collections of Pleistocene material have recently been placed in the hands of the writer for study. These contain a number of species not previously reported from fossiliferous beds, which add largely to our knowledge of the distribution of this group of animals during the great Ice Age. These deposits will be discussed separately and their biotic content compared.

I am indebted to Dr. Morris M. Leighton, of the department of geology, University of Illinois, for the opportunity of studying the Ohio deposit, and to Rev. W. H. Fluck, of Hope, Indiana, for the material from the Indiana deposit. The following gentlemen have examined critical material and to them my thanks are due: Dr. H. A. Pilsbry, Academy of Natural Sciences, Philadelphia, Amnicolidae; Dr. V. Sterki, New Philadelphia, Ohio, Sphaeriidae; Dr. Bryant Walker, Detroit, Michigan, Amnicolidae and Physa; and Mr. Calvin Goodrich, Pleuroceridae.

THE OHIO DEPOSIT

The material from Ohio occurs in extensive marl beds at the south end of Rush Lake, Logan County. Dr. M. M. Leighton, who collected the material, thus describes the deposit:

> The exposure occurs in an artificial ditch which drains into the lake from the south. The beds begin close to the lake and run south for a hundred yards or more. The farm land immediately to the east shows great numbers of these shells mixed in with the soil. The exposure is about six feet deep, and the shells make up whole beds of lenticular shape, interbedded with clay strata, in some of which are a few scattered shells. Some of the shell beds are as much as ten inches thick. The interbedded clay shows no lamination and is dark in color. I do not believe there is any question about their being post-Wisconsin in age, but on the other hand they do not seem to be extremely recent.

[1] *Contribution from the Museum of Natural History*, University of Illinois, No. 9.

Logan County is within the late Wisconsin drift border and the fauna is without question of post-Wisconsin age.

The fauna of the Ohio deposit contains several species of unusual interest. A new variety of *Amnicola* is related to a recent species described from Maine—*Amnicola winkleyi leightoni*. The two forms are widely separated geographically, but the relationship seems unquestionable. It is probable that this variety, as well as the typical form, occur in other places between the two localities, but have not yet been recognized. All of the large Amnicolas have generally been identified as "*limosa*" and many of the more recently described species and races of this and other groups will be found in other Pleistocene deposits when these are critically examined. *Physa anatina* is the most easterly record for this species which is abundant, living, west of the Mississippi River, and also more or less common in Illinois and Michigan. This is the first record of this *Physa* in Pleistocene deposits of the glaciated regions. The recently described *Planorbis altissimus*, first noted in a marl deposit in Illinois, occurs in abundance in the Ohio deposit. This small *Planorbis* is believed to have a wide distribution in the eastern and central parts of the United States in Pleistocene formations. It may also occur living. The number of species and varieties of the genera *Valvata*, *Amnicola*, and *Planorbis* in this deposit is also noteworthy.

It will be observed that in the Ohio deposit there are no land shells and only one naiad species, an *Anodonta*, a genus characteristic of quiet bodies of water like lakes and ponds. The *Sphaerium* is a species commonly found in lakes. The other genera present, particularly *Valvata* and *Planorbis*, contain species that usually have a wide distribution in lakes. The Ohio deposit may, therefore, be considered as having lived in a larger Rush Lake, perhaps not long after the ice had disappeared from Ohio.

The Indiana deposit contains many land shells and six species of naiads, characteristic of rivers and streams. *Sphaerium* and *Pisidium* are largely represented, as is also the family Amnicolidae. The presence of *Goniobasis semicarinata* also stamps this deposit as fluviatile in character, as distinguished from the Ohio deposit,

which is lacustrine. Th
of species represented in t

COMPARISON OF FA

Unionidae	
Sphaeriidae	
Valvatidae	
Amnicolidae	
Pleuroceridae	
Viviparidae	
Ancylidae	
Physidae	
Planorbidae	
Lymnaeidae	
Total number of spe	

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COMPAR

Ohio	
Anodonta species	
Sphaerium sulcatum	
Musculium rosaceum	

which is lacustrine. The family relationship as regards number of species represented in the two deposits is shown in Table I.

TABLE I

COMPARISON OF FAMILIES IN OHIO AND INDIANA DEPOSITS

	Ohio Lake Deposit	Indiana River Deposit
Unionidae	1	6
Sphaeriidae	8	12
Valvatidae	4	1
Amnicolidae	3	7
Pleuroceridae	.....	1
Viviparidae	.....	1
Ancylidae	1	1
Physidae	1	1
Planorbidae	7	2
Lymnaeidae	2	1
Total number of species	27	33

The species of the two deposits are shown in Table II, in which the particular species in each family are listed. It will be noted that there are twenty-seven species and races in the Ohio deposit and thirty-three species and races in the Indiana deposit.

TABLE II

COMPARISON OF FOSSIL FAUNAS

Ohio	Indiana
.....	*Lampsilis ventricosa*
.....	*Amblema undulata*
.....	*Carunculina glans*
.....	*Elliptio crassidens*
.....	*Elliptio gibbosus*
.....	*Actinonaias ellipsiformis*
Anodonta species	.....
.....	*Sphaerium solidulum*
.....	*Sphaerium stamineum*
.....	*Sphaerium striatinum*
.....	*Sphaerium fabale*
Sphaerium sulcatum	.....
Musculium rosaceum	.....
.....	*Pisidium virginicum*

TABLE II—*Continued*

COMPARISON OF FOSSIL FAUNAS

Ohio	Indiana
Pisidium compressum, var.	*Pisidium compressum*
. . . . .	*Pisidium cruciatum*
. . . . .	*Pisidium kirklandi*
. . . . .	*Pisidium fallax*
Pisidium pauperculum	*Pisidium pauperculum*
Pisidium noveboracense	*Pisidium noveboracense*
. . . . .	*Pisidium abditum*
Pisidium variabile	. . . . .
Pisidium tenuissimum	. . . . .
Pisidium medianum	. . . . .
Valvata tricarinata	*Valvata tricarinata*
Valvata tricarinata perconfusa	. . . . .
Valvata tricarinata unicarinata	. . . . .
Valvata sincera	. . . . .
Amnicola walkeri	*Amnicola walkeri*
Amnicola lustrica, var.	. . . . .
. . . . .	*Amnicola lustrica*
. . . . .	*Amnicola limosa parva*
Amnicola winkleyi leightoni	. . . . .
. . . . .	*Pyrgulopsis sheldoni*
. . . . .	*Somatogyrus depressus*
. . . . .	*Pomatiopsis lapidaria*
. . . . .	*Pomatiopsis cincinnatiensis*
. . . . .	*Goniobasis semicarinata*
. . . . .	*Campeloma integrum obesum*
Ferrissia parallela	. . . . .
. . . . .	*Ferrissia rivularis*
Physa anatina	. . . . .
. . . . .	*Physa crandalli*
Planorbis campanulatus	. . . . .
Planorbis antrosus	*Planorbis antrosus*
Planorbis antrosus striatus	. . . . .
Planorbis altissimus	. . . . .
. . . . .	*Planorbis parvus*
Planorbis deflectus	. . . . .
Planorbis hirsutus	. . . . .
Planorbis exacuous	. . . . .
Galba palustris	. . . . .
Galba obrussa decampi	. . . . .
. . . . .	*Galba humilis modicella*

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THE INDIANA DEPOSIT

The material from Indiana is from Flat Rock River, German Township, Bartholomew County. The deposit was discovered and has been studied quite extensively by Rev. W. H. Fluck, of Hope, Indiana, to whom I am indebted for the opportunity of working up this very interesting lot of mollusks.

Mr. Fluck writes as follows of the deposit and the territory immediately surrounding this place:

> On the surface, everywhere, we have glacial deposits in the form of clay, sand, gravel, and loam. The Illinoian moraine and the Shelbyville moraine are both south of these shell deposits. To the north are other moraines. In fact, the Flat Rock River flows a part of its course between moraines, to the north and east of the "Bartholomew Deposits," as I call the shell place. The top stratum, a sandy loam, in which the shells are found, is from two to twelve or more feet deep. Below this there is good gravel and sand. The river banks are twelve to fifteen feet high. On the east side of the river there is an open gravel bed where I also took shells. The shells range from just beneath the soil to as far down as I could examine, that is, down to the river surface, and, I suspect, down to the Devonian rock, over which the glacial deposits now lie. To be clear, on the east and west side of the river, and all along for several miles, below the Wisconsin drift, the shells are found. I have not explored north of this. On the west side, the shells come from a steep bank in which the shells are imbedded at all depths. On the east side, at about twenty-five yards back from the bank, I took some from an open gravel bed, not out of the gravel, but from the sandy loam above the gravel. The sample of soil and shells I am sending you came from the west bank, at about twelve feet below the surface.

The shells in the deposit seem referable to the Sangamon interglacial interval. The deposits of sand, sandy loam, and gravel are in valleys that were used as lines of drainage from the early and late Wisconsin ice sheets (see Leverett, 1902, Pl. II). The Illinoian till is only four or five miles west of Flat Rock River and the material in the stream valleys appears to be outwash or drainage material from the later ice sheets. Of the Sangamon interval in Indiana, Leverett says:

> The Sangamon soil and weathered zone may be seen beneath the surface silt in thousands of exposures in southeastern Indiana and southwestern Ohio, for the general thickness of the soil is only four or five feet. Farther north

there are, in addition to the silt, the heavy deposits of Wisconsin drift, which have buried the soil and weathered zone to such a depth that it is rarely exposed. However, a few exposures have been found in the deeper valleys, and wells not infrequently penetrate both the silt and soil under the Wisconsin drift (1902, p. 292).

On another page the same author says:

> In fact, the great majority of buried soils reported in Ohio, Indiana, and Illinois appear to be at this horizon (p. 293).

The shells in the deposit under discussion are not from one of these old soil horizons. They represent, probably, material that was washed down from flood plains farther upstream, where they had been deposited during periods of flood previous to the advance of the Wisconsin ice cap. The fact that the shells are found from just beneath the surface to the lowest strata accessible, as described by Mr. Fluck, indicates that the burying of the shells occurred more or less continuously during the deposition of the valley deposit.

What relation the Peorian interval may bear to these shells is not at present known, the Iowan invasion apparently not notably affecting this territory so far east of the area of this drift. The mollusks might have lived during Peorian time and then been buried by the Wisconsin deposits. As the land fauna is so nearly like that of deposits farther south, which are referred to the Sangamon interval by Leverett, it seems best to refer the Flat Rock shells to the same horizon. At Lawrenceburg, near the Ohio-Indiana line, old soils (forest beds) containing shells are found. Some years ago Mr. A. C. Billups (1902, p. 50) listed many species of land mollusks from the deposits along the Ohio River near Lawrenceburg. These are listed in Table III for comparison with the Flat Rock shells, which are also shown in this table. It will be noted that the two faunas are substantially the same. The difference is only what we would find in comparing the recent faunas of two more or less widely separated areas. It would appear, therefore, that the reference of the Flat Rock River shells to the Sangamon interval is well supported by the geological as well as faunal evidences.

Many deposits in the valleys of streams that formed drainage channels from the Wisconsin ice sheets probably contain the remains

of faunas belonging to th
study of this material fr
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LAND SHEL

Lawrenceburg
Vallonia pulchella
Cochlicopa lubrica
Gastrocopta contracta
Gastrocopta armifera
Pupoides marginatus
Succinea species
.....
Helicodiscus parallelus
Pyramidula perspectiva
Pyramidula cronkhitei a
Pyramidula solitaria
Pyramidula alternata
Gastrodonta ligera
Vitrea hammonis
Vitrea indentata
Circinaria concava
Polygyra monodon
Polygyra stenotrema
Polygyra mitchelliana
.....
Polygyra thyroides
Polygyra pennsylvanica
Polygyra elevata
Polygyra appressa
Polygyra palliata
Polygyra multilineata
Polygyra zaleta
Polygyra albolabris
Polygyra profunda
Polygyra inflecta
Polygyra tridentata
.....

species of mollusks. A
fresh-water snail know
glacial deposit. This

of faunas belonging to the Sangamon or Peorian intervals, and the study of this material from a wide area would aid very largely in understanding the interglacial and postglacial migrations of many

TABLE III

LAND SHELLS OF TWO INDIANA DEPOSITS

Lawrenceburg	Flat Rock River
Vallonia pulchella	.....
Cochlicopa lubrica	.....
Gastrocopta contracta	*Gastrocopta contracta*
Gastrocopta armifera	.....
Pupoides marginatus	.....
Succinea species	.....
.....	*Succinea avara vermeta*
Helicodiscus parallelus	*Helicodiscus parallelus*
Pyramidula perspectiva	.....
Pyramidula cronkhitei anthonyi	.....
Pyramidula solitaria	*Pyramidula solitaria*
Pyramidula alternata	*Pyramidula alternata*
Gastrodonta ligera	*Gastrodonta ligera*
Vitrea hammonis	*Vitrea hammonis*
Vitrea indentata	*Vitrea indentata*
Circinaria concava	*Circinaria concava*
Polygyra monodon	*Polygyra monodon*
Polygyra stenotrema	*Polygyra stenotrema*
Polygyra mitchelliana	.....
.....	*Polygyra clausa*
Polygyra thyroides	*Polygyra thyroides*
Polygyra pennsylvanica	.....
Polygyra elevata	*Polygyra elevata*
Polygyra appressa	.....
Polygyra palliata	*Polygyra palliata*
Polygyra multilineata	.....
Polygyra zaleta	*Polygyra zaleta*
Polygyra albolabris	.....
Polygyra profunda	*Polygyra profunda*
Polygyra inflecta	*Polygyra inflecta*
Polygyra tridentata	*Polygyra tridentata*
.....	*Polygyra fraudulenta*

species of mollusks. A case in point is the presence of the minute fresh-water snail known as *Pyrgulopsis sheldoni* in this old interglacial deposit. This species was described from material dredged

in Lake Michigan, off Racine, Wisconsin, at a depth of thirty fathoms. Additional records from both recent and fossil faunal areas are needed to understand the distribution of this tiny species. Geologists or others who discover such deposits should carefully collect the material, noting rather minutely the stratigraphy, and send the material, unsorted, to some competent malacologist for study. Such deposits occur plentifully in Iowa, Wisconsin, Illinois, Michigan, Indiana, Ohio, and Maine, and also in parts of other states which were overridden by the great ice sheets.

The material described in this paper forms a part of the Pleistocene collection of the Museum of Natural History of the University of Illinois.

ANNOTATED LIST OF MOLLUSCA FROM THE POSTGLACIAL DEPOSITS NEAR RUSH LAKE, LOGAN COUNTY, OHIO

Unionidae

Anodonta species. Fragments of a naiad, apparently a thin-shelled *Anodonta*, occur with the material. Evidently rare, as but few fragments were found.

Sphaeriidae

Sphaerium sulcatum (Lamarck). This large *Sphaerium* is abundant in the material from the Ohio deposit and is the only member of the genus found. These shells vary in form more than do most individuals of the recent fauna.

Musculium rosaceum (Prime). A dozen odd valves of a *Musculium* are referred to this species by Dr. Sterki, who says: "*Musculium*, different forms, but apparently of *rosaceum*, deformed."

Pisidium compressum Prime. A common, almost abundant species in this marl bed, but none typical. Sterki says: "near variety *laevigatum*."

Pisidium variabile Prime. About as common as *P. compressum*. Sterki states that this species is difficult to separate from *compressum*, especially among fossil individuals. This fact would indicate a common origin for both species, and the study of the Pleistocene material is, therefore, very important from the standpoint of geological evolution.

Pisidium tenuissimum Sterki. The most abundant species of Sphaeriidae in the deposit and quite typical of the species. This *Pisidium* seems to be a common Pleistocene fossil, occurring in widely separated deposits in Maine, Michigan, Ohio, and Illinois. In the deposits at Urbana, Illinois, believed to be pre-Wisconsin, a variety of this species—*calcareum* Sterki—is the most abundant mollusk in the material examined (see Baker, 1918, p. 663). It is quite significant that *tenuissimum* has not yet been found in deposits older than post-early Wisconsin; none are recorded from Sangamon or Peorian deposits. It is absent from the Indiana deposits discussed in this paper and believed to be of Sangamon age.

Pisidium medianum Sterki. A score of Pisidia, with small, thin shells and very prominent beaks, are referred to this species by Dr. Sterki.

Pisidium noveboracense Prime. *Pisidium pauperculum* Sterki. Two valves each of the foregoing species were identified from the material by Dr. Sterki. They are both typical of the species.

Valvatidae

Valvata tricarinata (Say). This is one of the most abundant species in this marl deposit. The majority of the specimens have three strong raised keels and are in every way typical of the species. In a few forms, however, the central carina is faintly developed, showing a variation toward the next variety.

Valvata tricarinata perconfusa Walker. About 10 per cent of the carinate Valvatas belong to this variety. There is some variation in the smooth space between the carinae on the shoulder of the whorl and on the base of the shell, there being in some specimens a faint ridge indicating the position of the central carina in typical *tricarinata*.

Valvata tricarinata unicarinata DeKay. A single specimen of DeKay's variety was found among several hundred *tricarinata*. This variety appears to be rare among both fossil and recent members of the species.

Valvata sincera Say. Three specimens of this characteristic species were picked out of a quart or more of marl specimens

(about 20,000 specimens), indicating that this species is very rare in this marl deposit. Compared with the same species from the marl deposit in Urbana, Illinois, the Ohio shells are a trifle more depressed.

Amnicolidae

Amnicola walkeri Pilsbry. Most of the Amnicolas referred to this species are quite typical, agreeing with Walker's figure in the *Nautilus* (Vol. XIX, Pl. V, Fig. 12). A few individuals have a higher spire with strongly rounded whorls and a very deep suture, i.e., scalariform. The largest specimen measures about 2.5 mm. in length. This characteristic species is not common in this deposit, only about fifty specimens being found in picking over a quart of material.

Amnicola lustrica Pilsbry. Variety. "Larger, more solid, with the lip much thickened within" (Pilsbry). This *Amnicola* is, equally with the following species, the most abundant species in the deposit, nearly 40 per cent of the bulk of a quart being composed of these two species of *Amnicola*. There is some variation in the width of the shell and in the height of the spire, the whorls of which, in some individuals, are quite round, with very deep sutures. A single specimen is so decidedly scalariform as to render it quite unrecognizable without its presence in the other material. Several specimens of this variety measure 4.5 mm. in length. In most individuals the inner lip (peristome) touches the parietal wall, but in others it is separated by a deep suture and the edge of the aperture is entirely separated from the body whorl. The same form of *lustrica* occurs in post-Wisconsin deposits of the Chicago region.

Amnicola winkleyi leightoni Baker. This *Amnicola* (described in the *Nautilus*, Vol. XXXIII) is related to *winkleyi* Pilsbry, described from Saco, Maine. It is uniformly wider, with somewhat shouldered whorls. Together with *Amnicola lustrica* variety, it is the most abundant species in this deposit. That a form related to the Maine shell should be found so far removed from the original locality is surprising, particularly as it occurs in a deposit of late Pleistocene age. The specimens have been examined by Dr. Pilsbry, who indicated their relationship to his Maine species and who agreed with the author as to their distinctness as a race believed to be extinct.

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Planorbis deflectus Sa
Planorbis were found in
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been examined by Dr.
to his Maine species and
distinctness as a race

Planorbidae

Planorbis campanulatus Say. A dozen specimens of this species, mostly mature, occurred in the material examined. The adults are of normal size and typical form.

Planorbis antrosus Conrad. A fairly abundant species of large-sized individuals, mostly mature. There is considerable variation among the specimens, especially in the shape of the aperture, which has a tendency to become bell-shaped. A number of individuals approach variety *aroostookensis* Pilsbry, and one specimen would certainly be called variety *portagensis* Baker, if found in Maine. Several specimens have a number of rounded ridges on the body whorl near the aperture; these indicate the location of former apertures.

Planorbis antrosus striatus Baker. About 10 per cent of the *antrosus* may be referred to this variety with strong spiral striation. This is very strongly marked in the majority of the fossils of this deposit.

Planorbis altissimus Baker. This small *Planorbis*, first described from marl deposits at Urbana, Illinois, proves to be widely distributed and to be the common *Planorbis* of the *parvus* group in the marl deposits. It is very variable, only a small percentage being typical as figured in the original description (Baker, 1918, p. 94). The aperture varies from rounded to elliptical and may be deflected to a marked degree or placed in an almost continuous line with the body whorl. In all specimens examined, however, the upper part of the aperture forms a distinct shoulder and the whorls are more or less flat-sided, features not found in true *parvus*, which is normally a smaller shell. *Altissimusis*, after *Amnicola lustrica* and *A. winkleyi leightoni*, is the most abundant shell in this deposit.

Planorbis deflectus Say. Three adult individuals of this small *Planorbis* were found in the material examined. The peripheral keel is very marked in these specimens, and the aperture varies in the degree of deflection, in one specimen being almost basal. The largest individual measures 6.5 mm. in greatest diameter.

Planorbis hirsutus Gould. A single specimen seems referable to this species, having the less conspicuous keeled periphery and rounded whorls of *hirsutus* from Massachusetts. This species seems quite separable from *deflectus*.

Planorbis exacuous Say. This flat, lens-shaped *Planorbis* is fairly common in this deposit. The specimens are of large size, several individuals measuring 6 mm. in greatest diameter.

Lymnaeidae

Galba palustris (Müller). A single broken specimen of a lymnaeid is referable to this protean species. When perfect it must have measured nearly 40 mm. in length.

Galba obrussa decampi (Streng). This small lymnaeid is quite common in the deposit. It exhibits more or less variation, principally in the degree of elevation of the spire, in the convexity of the whorls, and in the shoulder of the whorls. This species is characteristic of the cold waters of the early Wisconsin ice recession, in which it lived in considerable abundance. It is apparently much less common living in the recent fauna than it was in postglacial or interglacial times.

Physidae

Physa anatina Lea. This large *Physa* is apparently a form of Lea's species, which occurs abundantly in the states west of the Mississippi River. It is recorded from Michigan and is said to range clear across the southern part of this state (see Walker). It is also recorded from Hardin, McHenry, and Adams counties, Illinois (see Baker, *Ill. Cat.*). There seems to be no reason why it should not be found as far east as Ohio.

The Ohio shells differ from typical *anatina* in being larger, with a wider body whorl and aperture and more flat-sided spire whorls. Adult individuals are not common in the deposit, but immature shells of four whorls are almost abundant. Variation is so great in this genus that it has not been thought best to bestow a name on this form, although it differs more or less widely from the average recent shells of *anatina*.

Ancylidae

Ferrissia parallela (Haldeman). A single specimen of this fresh-water limpet was found in the material examined. As about 20,000 shells were picked over it must be considered very rare. The specimen is typical.

ANNOTATED LIST OF MOLLUSCA FROM SANDY LOAM DEPOSITS AT FLAT ROCK RIVER, BARTHOLOMEW COUNTY, INDIANA. BELIEVED TO BE REFERABLE TO THE SANGAMON INTERGLACIAL INTERVAL

Unionidae

Amblema undulata (Barnes). Mr. Fluck reports this large naiad as occurring in the deposit.

Elliptio crassidens (Lamarck). A right valve 47 mm. in length is quite characteristic of this heavy-shelled naiad, which is common in the Ohio and Wabash rivers.

Elliptio gibbosus (Barnes). Reported in the deposit by Mr. Fluck.

Actinonaias ellipsiformis (Conrad). A broken right valve and two immature shells (right and left valves) somewhat broken are referred to this common Indiana species. They are thinner, on the average, than recent shells of this species.

Carunculina glans (Lea). A left valve of a female shell 31 mm. in length appears not to differ from recent shells in any important degree.

Lampsilis ventricosa (Barnes). This species is reported from the deposit by Mr. Fluck.

Species incerta cedis.

A portion of the umbonal and lateral tooth region of an unknown naiad also occurs in the material examined. It belongs to the heavy-shelled species, like *rubiginosus* and *undatus*, but is quite unidentifiable.

Sphaeriidae

Sphaerium solidulum (Prime). A number of valves of this common species occur in the material examined, but they are not very characteristic, many individuals varying considerably from the typical form. The young and immature shells are much more typical.

Sphaerium stamineum (Conrad). Three valves of a *Sphaerium* are referred to this species by Dr. Sterki, with doubt.

Sphaerium striatinum (Lamarck). This species is about as abundant in this deposit as *solidulum*. There are many different forms, and the majority of the specimens are young or immature.

Sphaerium fabale Prime. One valve of this characteristic species occurred with the other *Sphaeria*. It is evidently very rare.

Pisidium virginicum (Gmelin). This large *Pisidium* is quite common in this deposit and also quite typical.

Pisidium compressum Prime. This is the most abundant *Pisidium* in the Indiana deposit, as it often is in most recent and fossil collections. The Indiana specimens are more typical than those from the Ohio deposit.

Pisidium cruciatum Sterki. A half-dozen valves, mostly immature, occur in the material.

Pisidium kirklandi Sterki. Fairly common but very characteristic of the species as found living.

Pisidium fallax Sterki. A half-dozen valves, small and slight, are referred to this species by Dr. Sterki.

Pisidium pauperculum Sterki. Two valves of a *Pisidium* are identified with this species by Dr. Sterki.

Pisidium noveboracense Prime. A score of odd valves, small and largely immature, are referred to Prime's species by Dr. Sterki. They are not typical of the species as found living today.

Pisidium abditum Haldeman. Two valves are doubtfully referred to *abditum* by Dr. Sterki.

Valvatidae

Valvata tricarinata (Say). Six young and immature specimens of this carinate *Valvata* were found in the material. The spire is rather depressed and the specimens somewhat resemble *Valvata bicarinata normalis* Walker.

Amnicolidae

Amnicola limosa parva (Lea). A score or more specimens of this variety of *limosa* occurred in the collection. The shells vary from depressed to somewhat elongated. The whorls are all tumid and strongly shouldered at the suture. The spire varies in height and the aperture in rotundity. More than half of the shells are immature.

Amnicola walkeri Pilsbry. A single, large, typical specimen of this *Amnicola* was found in the collection. It is larger than the individuals of the same species from the Ohio deposit.

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Amnicola lustrica (Pilsbry). Apparently typical examples of this common *Amnicola* occur more or less abundantly in the Indiana deposit. These are different from the *Amnicola* which occurs so abundantly in the Ohio deposit, and also commonly in the deposits in and about the Chicago region, which has a larger shell with more elongated spire and thickened lip margin. Many of the Indiana shells are immature.

Pyrgulopsis sheldoni (Pilsbry). The presence of this tiny species in these deposits is surprising, the species having been originally described from material collected in Lake Michigan, off Racine, Wisconsin, and dredged from a depth of thirty fathoms (Pilsbry, 1890, Vol. IV, p. 53). Its occurrence in an interglacial deposit far removed from the original locality and in an entirely different ecological environment, a river, is very interesting. These fossils are possibly the ancestors of the species that later restocked the waters of Lake Michigan after the recession of the Wisconsin ice. It should be looked for in other Pleistocene deposits. *Sheldoni* is not uncommon in the Indiana deposit, but the shell is smaller on the average than that of recent specimens. The identification of this tiny species has been confirmed by Dr. Bryant Walker.

Somatogyrus depressus Tryon. The half-dozen specimens of this species are typical.

Pomatiopsis lapidaria (Say). The single specimen occurring in the material is normal in size and general shape, but the whorls are rounder and the sutures more deeply impressed than is usually the case among recent shells of this species.

Pomatiopsis cincinnatiensis (Lea). Four specimens of this smaller species of the genus occurred. They do not differ from recent shells.

Pleuroceridae

Goniobasis semicarinata (Say). A *Goniobasis* abundant in the deposit is referred to Say's *semicarinata* by Mr. Calvin Goodrich, to whom specimens were sent for examination. It is a long-spired, graceful shell which seems very characteristic. In the lot from Bartholomew County there is little variation except in the comparative width of the last whorl.

Viviparidae

Campeloma integrum obesum (Lewis) Tryon. All of the Campelomae in the collection (and these shells are quite abundant) appear referable to this race of *integrum*. A few individuals have a more elongated spire and more ovate shell and might be referred to *integrum*. The variation, however, is all toward the obese type of shell and it seems best to refer all to the race. The majority of the individuals are adult. The shells are quite solid and heavy.

Ancylidae

Ferrissia rivularis (Say). That such fragile shells as the Ancylidae should be preserved in a flood-plain river deposit is surprising. Five specimens of this river limpet occurred in about two quarts of material examined. The specimens are fairly well preserved.

Physidae

Physa crandalli Baker. A heavy-shelled *Physa* with thick, reflexed inner lip and deep-sutured whorls is referred to this species. Only one specimen out of a score or more is adult. The same species has been reported by Daniels from Indiana in the recent fauna of Knox County (Daniels, 1903, p. 603).

Planorbidae

Planorbis antrosus Conrad. The *antrosus* from the Indiana deposit are smaller than those from the Ohio deposit. The aperture does not show a tendency to become bell-shaped as in so many of the Ohio specimens. Only seven individuals, mostly immature, were found in the material from the Indiana deposit.

Planorbis parvus Say. This small *Planorbis* seems to be typical *parvus* and not *altissimus* which is so abundant in the Ohio deposit. It is the same size as specimens of *parvus* from Philadelphia and about half the size of *altissimus*.

Lymnaeidae

Galba humilis modicella (Say). The only lymnaeid in the Indiana deposit is referable to *modicella*, the individuals of which, mostly immature, are similar to the recent shells of this species from the state. *Obrussa decampi*, so common in the Ohio deposit, is apparently not found in these Indiana beds.

Pupillidae

Gastrocopta contracta (Say) = *Bifidaria contracta*. Apparently rare in the deposit as but two specimens were found. These shells are typical but smaller than the average of living *contracta*.

Succineidae

Succinea avara vermeta Say. A single specimen of this race of *avara*, about 5 mm. long, was found in the material. It is, therefore, to be considered as rare.

Endontidae

Helicodiscus parallelus (Say). This common and widely distributed land shell occurred infrequently. The shells are smaller than those of the recent fauna and the spiral striation is but faintly developed.

Pyramidula solitaria (Say). The most abundant mollusk in the deposit. There is considerable variation among the individuals in the height of the spire. The largest specimen measures 30 mm. in greatest diameter. The majority of shells are typically banded. In a few individuals the reddish bands are very wide, leaving a broad peripheral band of white.

Pyramidula solitaria albina (W. G. Binney). A few individuals of *solitaria* without bands occur with the typically banded specimens.

Pyramidula alternata (Say). Found infrequently as compared with *solitaria*. As in the recent shells of this species the fossil examples vary in the height of the spire and in the degree of carination of the periphery of the last whorl. The color varies from albino to the most marked flames of red.

Pyramidula alternata alba (Tryon). Three examples of the albino variety were found associated with the more typical forms. The variety is apparently rare.

Zonitidae

Gastrodonta ligera (Say). This zonitoid land shell occurs rarely in this deposit. The few specimens found are smaller than shells from the recent fauna.

Vitrea indentata (Say). Two immature but characteristic examples of this imperforate *Vitrea* were found in the sand taken from the larger shells.

Vitrea hammonis (Ström.). Two typical specimens of this species were found in the sand from the interior whorls of a specimen of *Pyramidula solitaria*. This small land mollusk, as well as the other species of this family, appears to be very rare.

Circinariidae

Circinaria concava (Say). Not uncommon and as large as the recent shells from Indiana. The aperture is rounder in the fossil shells than in the recent individuals, and the peculiar flattening of the upper part of the outer lip is rarer in the fossil specimens.

Helicidae

Polygyra tridentata (Say). *Polygyra fraudulenta* Pilsbry. These two common species are apparently not abundant in the deposit in question.

Polygyra inflecta (Say). As but two individuals of this species were found in the large quantity of material examined it must be rare among the fossil land shells of this part of Indiana. The shells are apparently normal in both size (12 mm.) and form.

Polygyra profunda alba Walker. Nearly all of the specimens referred to *profunda* belong to the variety *alba*. One individual occurred which has the usual narrow bands on the last whorl and in addition has several large rosy blotches of color on the last half of the body whorl.

Polygyra zaleta (Binney) = *exoleta* (Binney). *Zaleta* is apparently rather rare, only seven specimens being found among several hundred land shells in the material. One specimen has a well-marked parietal tooth; the others are toothless.

Polygyra elevata (Say). Next to *Pyramidula solitaria*, *elevata* is the most abundant land mollusk in the deposit. In size and form they do not differ from the recent individuals. The same variation in height of spire noted among recent shells is also present in the fossil form.

Polygyra thyroides (Say). Of the twelve specimens of this species examined, three have a well-marked tooth on the parietal wall; the others are toothless. There is some variation in size, the extremes being 22 and 28 mm. in greatest diameter.

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BAKER, FRANK COLLINS
1906. "A Catalogue of
Nat. Hist., Vol. VI
1918. "Post-glacial Mol
Jour. Geol., Vol. X
1919. "Description of a
Post-glacial Depos
BILLUPS, A. C.
1902. "Fossil Land She
Nautilus, Vol. XV
DANIELS, L. E., and BLATCH
1903. "On some Mollus
Report, Dept. of G
LEVERETT, FRANK
1902. "Glacial Formatic
Basins," *Mon. U.*
PILSBRY, HENRY A.
1890. "Preliminary Not
pp. 52–53.
QUINN, E. J.
1912. "Soil Survey of B
of Geol. and Natu

Polygyra clausa (Say). Characteristic shells of this small *Polygyra* are common in the deposit. These do not differ materially from the recent forms of this species.

Polygyra fraterna (Say). This small *Polygyra* is reported by Mr. Fluck, who has found it more or less common at times.

Polygyra stenotrema (Fer.). Typical forms of this species are not uncommon in the deposit.

LIST OF WORKS CONSULTED

BAKER, FRANK COLLINS

1906. "A Catalogue of the Mollusca of Illinois," *Bull. Ill. State Lab. Nat. Hist.*, Vol. VII, pp. 53–136.

1918. "Post-glacial Mollusca from the Marls of Central Illinois," *Jour. Geol.*, Vol. XXVI, pp. 659–71.

1919. "Description of a New Species and Variety of Planorbis from Post-glacial Deposits," *Nautilus*, Vol. XXXII, pp. 94–97.

BILLUPS, A. C.

1902. "Fossil Land Shells of the Old Forest Bed of the Ohio River," *Nautilus*, Vol. XVI, pp. 50–51.

DANIELS, L. E., and BLATCHLEY, W. S.

1903. "On some Mollusca Known to Occur in Indiana," *27th Annual Report, Dept. of Geol. and Nat. Res. Indiana*, pp. 579–680.

LEVERETT, FRANK

1902. "Glacial Formations and Drainage Features of the Erie and Ohio Basins," *Mon. U.S. Geol. Surv.*, No. XLI.

PILSBRY, HENRY A.

1890. "Preliminary Notices of New Amnicolidae," *Nautilus*, Vol. IV, pp. 52–53.

QUINN, E. J.

1912. "Soil Survey of Bartholomew County," *36th Annual Report, Dept. of Geol. and Natural Res. Indiana*, pp. 320–34.