A STUDY OF THE PLEISTOCENE MOLLUSCA COLLECTED IN 1927 FROM DEPOSITS IN FULTON COUNTY, ILLINOIS.*

FRANK COLLINS BAKER, CURATOR, MUSEUM OF NATURAL HISTORY, UNIVERSITY OF ILLINOIS, AND PLEISTOCENE INVERTEBRATE PALEONTOLOGIST, ILLINOIS STATE GEOLOGICAL SURVEY, URBANA.

During the Summer of 1927, the Illinois Geological Survey carried on extensive field operations in Fulton County, Illinois, during which time the Pleistocene formations were carefully examined and a large amount of material collected which contained a considerable fauna of this period. All of the interglacial intervals are represented, but two of these are of a very limited character. To summarize, there is one collection from the Aftonian, five from the Yarmouth, one from the Sangamon, eleven from the Peorian, eight from the Early Wisconsin and one of Late Wisconsin strata. The absence of large collections from the Sangamon is noteworthy, indicating that this interval is not well represented in this county. The Aftonian is also very unsatisfactorily represented. The Yarmouth, Peorian, and Early Wisconsin collections are among the best that have been studied by the writer, and their contents have made clear many points in the relationship of Pleistocene molluscan life.

In a previous paper in these transactions (Vol. XX, pp. 269-292) a resume is given of the knowledge of the Pleistocene molluscan life of the State of Illinois as it was known at the time of writing that communication. The material from Fulton County has changed opinions held concerning the status of some of the variations of species therein recorded, necessitating the diagnosis of six varieties and species as new to science, and the addition of at least one species new to the fauna of Illinois. (See The Nautilus, Vol. XLI, p. 133, for descriptions of these new forms). The general statements in the paper in volume XX stand practically as there published, with very slight variation. Several additional species show considerable variation in size and form and may eventually be distinguished as peculiar Pleistocene varieties of recent species. Not enough material is avail-

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able to settle this point in a satisfactory manner. These suggested changes are indicated under each species in the following pages.

A study of the tables at the end of this paper bring out several interesting facts. In the table of land species, it will be observed that as a whole, the fauna of the Illinois Pleistocene contains 31.5 per cent of extinct forms and of the 68.5 percent of living forms, 11.5 per cent are now found outside of the state boundaries, mostly far removed. Among the fresh water gastropods, 29.5 per cent are extinct and of the 70.5 per cent of living forms 8.5 per cent now live north of Illinois. Among the Sphaeriidae, the distribution is practically unknown, because of the absence of material from earlier formations. Dr. Sterki, however, finds little change from Pleistocene to recent, but this may be due to lack of material as well as, perhaps, a conviction that the differences found in the gastropods are not sufficiently important for recognition among the Sphaeriidae. While this is largely true as regards the recent fauna, it is only by the study of these small and apparently trivial variations from interval to interval that we can learn of the effect of the Ice Age on molluscan life.

When material of ample proportions from all of the intervals has been critically examined it will be possible to trace the ancestry of many of our common recent species. This has been possible in a limited manner from the material already at hand, which has shown that a Pleistocene variation grades into the recent form, usually in the Early Wisconsin stage. In at least one extinct species there has been observed a change from Aftonian to Peorian intervals. In several varieties, the two forms, recent and extinct, are seen to overlap in their distribution in a single interval. This is indicated on the tables by solid lines.

In some of the exposures examined, the material represents flood plain deposits gathered during flood periods, the fauna being of a mixed character, fluviatile and terrestrial. Such are very perplexing unless the manner of their formation at the present time is kept in mind. While they represent the fauna of the interval, they do not represent actual living conditions as does a deposit formed in situ at the bottom of a river or lake or in a true land deposit, as the loess. Care must also be used in interpreting the presence of fluviatile species among true land species, as in loess formations where a valve or two of Pisidium may be present. Many extraneous agencies may carry such ma-

terial from flood plain or shore to uplands of pure land habitats. The presence of such genera as Pomatiopsis and Fossaria in true loess formations is to be accounted for by the fact that these groups contain species which live on wet mud, often away from true water bodies, in tracts of land subject to overflow or water accumulation during spring and early summer but dry during the remainder of the year. Such deposits are usually formed on partly abandoned flood plains or in hollows. Loess accumulates during the dry seasons, which accounts for the mixture of faunas. Typical upland loess does not usually contain these amphibious species.

It may be of value to describe typical outcrops of each interval and indicate the association of life in each (data by Dr. Wanless.)

Aftonian Interval

Locality: Second ravine north of road in NW ¼ SE ¼ sec. 32, T. 4 N., R 3 E., Isabel Twp., about ¾ mile west and ¼ mile north of Enion.

Material: Dark gray or brownish gray soil and fossiliferous silt or loess including wood and some logs several feet long incorporated in lower portion of Kansan till in bed and banks of deep, steep-walled ravine. About one hundred feet downstream the contact between calcareous Kansan till and weathered Nebraskan till is exposed.

Molluscan Life:

Vertigo loessensis, rare.
Hendersonia occulta, rare.
Goniodiscus macclintocki angulata, rare.

Yarmouth Interval

Locality: Along northwest bank of ravine near center of NE. ¼ sec. 5, T. 3 N., R. 3 E., Kerton Twp. One-half mile west and one quarter mile south of Enion.

Material: Hard, dark brownish gray loess-like silt with abundant fossils. At east end of this outcrop may be seen Kansan till and rolled fragments of Nebraskan till.

Molluscan Life:

Succinea ovalis pleistocenica, common.
Succinea grosvenori gelida, rare.
Succinea retusa fultonensis, rare.
Polygyra monodon peoriensis, rare.
Polygyra multilineata wanlessi, rare.
Gonyodiscus macclintocki angulata, common.
Zonitoides arborea, rare.
Glyphyalinia indentata, rare.
Pisidium abditum, 4 valves.
Circinaria concava, rare.
Strobilops virgo, rare.
Hendersonia occulta, common.
Vertigo loessensis, rare.
Vertigo modesta, rare.
Gastrocopta pentodon, rare.
Pomatiopsis scalaris, rare.
Fossaria parva tazewelliana, rare.
Pisidium concinnulum, 2 valves.

The life is a typical loess fauna of almost pure land mollusks. Pomatiopsis and Fossaria live in places that might become loess-covered. The presence of the two species of Pisidium, a typical fresh water genus of small mussels, can be accounted for only by accidental intrusion. Of the above gastropods 10 or 62.5 per cent are extinct, at least to varieties.

PEORIAN INTERVAL

Locality: Cut on private road in upper part of Illinois River bluff, in Se. ¼ SE. ¼ sec. 31, T. 5 N., R. 4 E., Liverpool Twp.

Material: Characteristic Peorian loess.

Molluscan Life:

Succinea ovalis pleistocenica, common.
Succinea grosvenori gelida, common.
Polygyra multilineata wanlessi, common.
Polygyra hirsuta yarmouthensis, common.
Polita hammonis electrina, common.
Carychium exile canadense, rare.
Fossaria parva tazewelliana, common.
Vertigo loessensis, common.
Gonyodiscus anthonyi, common.
Gonyodiscus macclintocki, common.
Circinaria concava, rare.
Polygyra monodon, common.
Vallonia gracilicosta, rare.
Hendersonia occulta, common.
Euconulus fulvus, rare.
Columella hasta, rare.
Columella alticola, common.

Locality: Cut in private road in upper part of bluff of Illinois River in SW. ¼ SW. ¼ sec. 14, T. 5 N., R. 4 E., Liverpool twp.

Stratigraphic Horizon: Peorian loess. Fossils occurred in beds in upper and lower part of loess, separated by about ten feet; upper loess grayer than lower loess.

Molluscan Life:

Upper Part.	Lower Part.
Succinea ovalis pleistocenica, rare	*Succinea ovalis pleistocenica*, common.
Succinea grosvenori gelida, common.	*Succinea grosvenori gelida*, common.
Gonyodiscus anthonyi, common.	*Gonyodiscus anthonyi*, rare.
Vallonia gracilicosta, rare.	.....
Polygyra monodon, common.	*Polygyra monodon*, rare.
Vertigo modesta, rare.	*Vertigo modesta*, rare.
Polygyra multilineata wanlessi, common.	*P. multilineata wanlessi*, rare.
Fossaria parva tazewelliana, rare.	*Fossaria parva tazewelliana*, common.
.....	*Polita hammonis electrina*, rare.
.....	*Hendersonia occulta*, common.
.....	*Columella alticola*, rare.
.....	*Vertigo loessensis*, rare.

Early Wisconsin Interval

Locality: High terrace cut bank on southeast side of East Creek about 200 yards east of center of north line of sec. 11, T. 4 N., R. 3 E., Waterford Twp., about three miles south and one mile east of Lewistown.

Material: Terrace cut shows upper gray silt, probably loess, middle laminated silts, and lower red clay. Fossils numerous in two upper layers but scarce or absent from lower red clay.

Molluscan Life:

Laminated Layer.	Upper Gray Loess.
Water Breathers.	
Valvata tricarinata, common.	.....
Valvata tricarinata perconfusa, common.	.....
Pisidium compressum, rare.	.....
Pisidium variabile brevius, rare.	.....
Amphibious.	
Pomatiopsis scalaris, common.	*Pomatiopsis scalaris*, common.
Fresh Water Pulmonates.	
Fossaria obrussa decampi, rare.	.....
Fossaria parva tazewelliana, common.	*F. parva tazewelliana*, common.
Stagincola caperata, common.	.....
Gyraulus altissimus, rare.	.....
Land Pulmonates.	
Polygyra multilineata wanlessi, rare.	.....
Polygyra hirsuta yarmouthensis, rare.	*P. hirsuta yarmouthensis*, rare.
Polita hammonis electrina, rare.	*P. hammonis electrina*, rare.
Succinea retusa fultonensis, rare.	*S. retusa fultonensis*, rare.
Succinea grosvenori gelida, rare.	*S. grosvenori gelida*, rare.
.....	*Circinaria concava*, rare.
.....	*Polygyra monodon*, rare.
.....	*Gonyodiscus cronkhitei anthonyi*, rare.

The lower deposit as well as the middle deposit evidently represent fluviatile conditions during the early part of Early Wisconsin time, the common species being of a strictly aquatic character, the admixture of land forms being so rarely represented that they are to be considered as material washed into the stream, which frequently happens in recent times. In the upper deposit, while land forms are relatively rare, the aquatic forms are those which live on mud flats where loess-like silt would accumulate. The two species represented are almost uniformly found in loess deposits in Fulton County. This cut is an excellent example of exposures and included life in this county.

Exposures of Late Wisconsin strata are rare, since the territory is far beyond the limits and the decissive influence of the last Wisconsin glaciation. One exposure is believed to be of this age, containing a characteristic recent fauna, differing in nature from that of the Early Wisconsin of other places in the county.

My thanks are due Dr. M. M. Leighton, Chief of the Illinois State Geological Survey for the opportunity of studying this very interesting collection. Acknowledgment is due Dr. Harold R. Wanless of the Department of Geology, University of Illinois and Associate Geologist of the Illinois Survey, for the careful field notes accompanying the material. Dr. Wanless was in charge of the Pleistocene work in this county. Associated with Dr. Wanless in the collection of the material were Mrs. Wanless, and Mr. A. W. Waldo and Mr. H. B. Willman, the last two graduate students at the University of Illinois. Dr. V. Sterki has very kindly looked over the Sphaeriidae and his findings are reported under each species. The material upon which this paper is based is preserved in the Paleontological collection of the Museum of Natural History of the University of Illinois.

Discussion of Species Represented.

Land Mollusca

Family HELICIDAE

Polygyra monodon (Rackett)

Occurred in five exposures of Peorian age and in six exposures of Early Wisconsin age. The monodon of the middle and later Pleistocene is similar to the recent form as found in several localities in Illinois. It differs from the typical aspect of the species in having a higher and more dome-shaped spire, a more convex base, and a smaller parietal lamella which is not as deeply notched at the columella region. The umbilicus is also smaller than in many recent specimens. As this type of shell also occurs living in widely separated localities it cannot be considered a peculiarly formed Pleistocene species, though the typical form with low spire and wide umbilicus is to be considered a descendent of the high-spired, narrow umbilicated form.

Polygyra monodon peoriensis F. C. Baker.

A single specimen, rather larger than the type, occurred in loess of Yarmouth age in one exposure. Peoriensis appears to abound in the Yarmouth interval and to live into the Peorian interval, where it disappears, its place being taken by the large form described above. The two forms evidently overlap in the Peorian interval. None have been seen from the Sangamon interval.

Polygyra hirsuta (Say)

Typical hirsuta apparently first appears in Early Wisconsin time. The large form with huge parietal lamina descending below the basal lip was found in one exposure in Early Wisconsin strata and in one exposure in Late Wisconsin strata.

Polygyra hirsuta yarmouthensis F. C. Baker

Throughout almost the entire period of Pleistocene time this small form of hirsuta persists. It occurred in one exposure of Yarmouth strata, four exposures of Peorian strata, and five exposures of Early Wisconsin strata. It is also known from Sangamon strata in other places in Illinois and it is thus represented in all intervals excepting the Aftonian and further researches will doubtless find it in this interval. Some specimens from Peorian strata are larger than typical yarmouthensis and approach the typical hirsuta, though having the small parietal lamina of the variety.

Polygyra multilineata wanlessi F. C. Baker. (See Nautilus, Vol. 41, p. 132.)

This new variety of multilineata occurred in one exposure of Yarmouth age, ten exposures of Peorian age, and three exposures of Early Wisconsin age. A single specimen was found in an exposure believed to be of late Wisconsin age. None have been seen from the Sangamon interval, but a very large variety, altonensis F. C. Baker, has been described from this interval. Wanlessi probably occurs in the Sangamon but no specimens have yet been seen. The nearest relative of wanlessi in the recent fauna is variety algonquinensis Nason, the type locality being Algonquin, McHenry County, Illinois. The fossil variety differs in having a deeply impressed umbilical region and in being frequently widely perforate, characteristics lacking in the recent variety. The fossil form ranges both larger and smaller than algonquinensis, but is on the whole somewhat larger and in many examples has a more depressed spire. Algonquinensis is without doubt the lineal descendant of wanlessi. The large recent form may have descended from variety altonensis.

Polygyra clausa (Say)

Observed in one exposure each of Early and Late Wisconsin

strata. Only a few specimens obtained and they are typical of the species as it is found recent.

Polygyra thyroides (Say)

Associated with clausa in Early and Late Wisconsin strata. The Early Wisconsin form has a parietal denticle but the Late Wisconsin form is without a denticle. Does not differ from the recent form. It is noteworthy that neither of these species have been seen in Early Wisconsin deposits in Illinois.

Family PUPILLIDAE

Columella hasta (Hanna)

One specimen from exposure of Peorian age. The specimen measures 4.5mm. in length and has eight whorls. This species was originally described from Pleistocene deposits at Long Island, Phillips County, Kansas (see Hanna, Proc. U. S. Nat. Mus., Vol. 41, p. 372, 1911) and the Illinois specimen indicates that it had a wider distribution during mid-Pleistocene time. The Illinois example is somewhat smaller than the type specimen from Kansas but much larger than any alticola recent or fossil. Additional material from Pleistocene deposits will be looked for with interest.

Columella alticola (Ingersoll)

Alticola was more or less abundant in five exposures of Peorian loess and in two exposures of Early Wisconsin loess. It was most abundant in several Peorian deposits. The Illinois species measures 2.8 mm. in length and 1.3 mm. in width and has from 6½ to 7 whorls. It is known as a fossil in Phillips Co., Kansas, associated with the large *Columella hasta*. Alticola is extinct as far as Illinois is concerned, but is known living from Canada, British Columbia, Wyoming, Colorado, New Mexico, and Arizona. As a fossil it is known from the Peorian and Early Wisconsin intervals but has not been found in Yarmouth or Sangamon (see Pilsbry, Manual Conch., Series II, Vol. XXVII, p. 243, 1926.)

Gastrocopta armifera (Say)

Early and Late Wisconsin, one exposure each. Typical of the species as in the recent fauna. Armifera has not been seen from the Yarmouth interval, but is known from Sangamon and Peorian.

Gastrocopta contracta (Say)

Early and Late Wisconsin. Not yet observed in earlier deposits in Illinois.

Gastrocopta pentodon (Say)

This species is apparently rare in Pleistocene deposits, at least in Illinois. A single specimen, with parietal, columellar, and, two palatal teeth, was collected from Yarmouth deposit; and a single specimen with parietal, columellar, and five palatal denticles was collected in a Late Wisconsin deposit. Typical specimens have been seen from New Harmony, Indiana, in loess supposed to be of Peorian age.

Vertigo loessensis F. C. Baker (see Nautilus, Vol. 41, p. 135.)

A common loess fossil found in one Aftonian, seven Yarmouth, and three Early Wisconsin exposures. Its absence from the Sangamon probably indicates that it has been overlooked. Loessensis is related to gouldii and was at first listed as that species. Its wider shell and differently shaped aperture, separates it from the gouldii of the recent fauna. It has been referred to *Vertigo elatior* Sterki, but that species has a strong palatal callus which is absent in loessensis. Immature and broken specimens were previous referred to ventricosa in papers on Illinois Pleistocene mollusks, but all are doubtless variations of the present species. It appears to be the most abundant and widely distributed of the small pupoids in the Pleistocene.

Whether the species reported by Iowa geologists as gouldii is really that species or loessensis cannot at present be determined for lack of material from that state. It is apparently the same as the gouldii reported by Hanna from a Pleistocene deposit in Phillips County, Kansas (Kansas Science Bull. VII., p. 120, pl. xviii, fig. 4)

Vertigo modesta (Say)

Yarmouth interval, one exposure; Peorian interval, four exposures; Early Wisconsin interval, two exposures. Most abundant in the Peorian interval. Not yet observed from the Sangamon interval.

In two lots from the Peorian of Fulton County, this species shows considerable variation in the number and position of the denticles in the aperture. In one lot the basal denticle varies greatly in size. In the other lot, there was one specimen without parietal denticle, and two specimens with two denticles on outer lip. Modesta is known in the recent fauna from Maine to British Columbia. It is locally known in Connecticut and Vermont, but is absent from the Middle West. It apparently survived to Early Wisconsin time, but was rare. During the Pleistocene it was abundant in Illinois and Iowa and as far south as Phillips County, Kansas.

Strobilops labyrinthica (Say)

One specimen from Early Wisconsin strata. This species has not been seen from strata earlier than Early Wisconsin.

Strobilops virgo Pilsbry

Found in three exposures of Yarmouth, and one exposure each of Late and Early Wisconsin time. It is known from Peorian time in other parts of Illinois. Virgo appears to be the common Strobilops of Pleistocene time. The Fulton County material is perhaps somewhat lower in spire than in most recent specimens but is otherwise typical.

Family VALLONIIDAE

Vallonia gracilicosta (Reinh.)

Found at two exposures of Peorian strata. This fine-ribbed form appears to be the dominant Vallonia of the Pleistocene. In Illinois it is not yet known earlier than the Peorian interval.

Family CIRCINARIIDAE

Circinaria concava (Say)

In Fulton County this species occurred in one Yarmouth exposure, seven Peorian exposures, three exposures of Early Wisconsin age, and one of Late Wisconsin age. In no exposure was it abundant.

As has been noted before, the loess concava differ uniformly in size from the recent forms. The largest specimen seen measured, 12.5 mm. in diameter and 5.5 mm. in height. The whorls appear to be more tightly coiled with smaller nuclear whorls, and with 4½ to 5 whorls. This type of shell is not found later than Early Wisconsin time, the Late Wisconsin specimens being large and like the recent form. As there is a possibility that these may not be full grown the question of their distinction from recent concava must await the examination of additional material. The same form occurs in loess deposits at New Harmony, Indiana, possibly of Peorian age.

Family ZONITIDAE

Zonitoides arborea (Say)

Yarmouth interval, one exposure, Peorian interval, two exposures, Late Wisconsin interval, one exposure. It is also known from the Sangamon in Illinois. The Pleistocene arborea differs somewhat from the recent species. It is smaller, with usually four whorls, the spire depressed and the sculpture finer than in recent forms. Curiously enough, it is like the species as it occurs in Arizona, both in size and in the depressed spire. Measurements of the several forms are as follows:

Recent, Illinois: H:3.2; 3.2; 2.6 mm.; D: 5.8; 5.6; 5.1 mm.
Recent, Arizona: H:2.1; 2.1; 2.0 mm.; D: 5.0; 4.9; 4.1 mm.
Fossil, Illinois: H:2.0; 1.5; 1.5 mm.; D: 4.0; 3.6; 3.5 mm.

As in the case of other species, much more material is needed before safe conclusions may be drawn, but the evidence at presence indicates that the Pleistocene form is uniformly smaller and with a more depressed spire.

Striatura milium (Morse)

One specimen from Late Wisconsin strata. Apparently typical. This species has not been found in earlier deposits in Illinois.

Pseudovitrea minuscula (Binney)

Three specimens from a Peorian loess exposure appear to be typical minuscula, although the sculpture is finer than in recent specimens and approaches *P. laeviuscula* Sterki. The shape of the shell is that of minuscula, however. Also known from strata of Early Wisconsin age.

Retinella hammonis electrina (Gould)

Peorian interval, seven exposures, Early Wisconsin, two exposures. Not seen from Sangamon or Yarmouth deposits. The electrina of the loess differs from the species as it is found in Illinois today in being uniformly smaller and in having but 3½ whorls. The aperture, also, is ovate and not as round as in living specimens. In size and number of whorls it is like northern forms from Vermont, Maine, and Canada. Measurements of each form are shown below: Maine: H:1.6; D:3.4 mm. 3⅓ whorls. Vermont: H:1.1; D:3.7 mm. 3½ whorls. Illinois: H:2.0 and 2.4; D:4.1 and 4.8 mm. 4 whorls. Fossils: H:1.6; 1.5; 1.5; 1.7; 1.8; 1.9; mm. D:3.2; 3.3; 3.1; 3.5; 4.0; 4.0 mm. 3¼ to 3½ whorls. Here again the fossil form is slightly smaller than the species as found in the local recent fauna.

Glyphyalinia indentata (Say)

Collected from three Yarmouth intervals, two Early Wisconsin intervals, and one Late Wisconsin exposure. The Pleistocene specimens are on the whole a trifle smaller than recent specimens, but not enough material has been available for examination. Fossil specimens measure height 1.9, diameter 4.1 mm., and the largest recent specimens from Illinois 2.5 mm. in height and 5.8mm. in diameter. The fossil specimens have a slight indication of a perforation, resembling in this respect some examples of *G. umbilicata* (Ckll.) from Texas and Arizona.

Euconulus fulvus (Müller)

Two exposures each in Peorian and Early Wisconsin strata. None have been seen in earlier strata than Peorian. The specimens are like those living in Illinois today.

Family ENDODONTIDAE

Anguispira alternata (Say) Variety

Two exposures in Peorian interval; one exposure in Early Wisconsin. The Pleistocene alternata is uniformly smaller than the species as it occurs living in Illinois, and the whorls are not as high or the periphery as rounded. They are more like specimens from Michigan and farther north. The largest fossil specimen seen measured 12 mm. in height and 19 mm. in diameter. Recent shells measure 16 mm. in height and 23 mm. in diameter, both forms having the same number of whorls. The Pleistocene form is abundant from Sangamon time onward but has not yet been observed in Yarmouth strata.

Anguispira alternata (Say)

Late Wisconsin strata. The specimens from this late period appear to be referable to the typical form.

Anguispira solitaria (Say)

One exposure each in Early and Late Wisconsin strata. These do not differ in any way from the species as it is found in Illinois at the present time. It was more abundant in Late than in Early Wisconsin strata. This species has not been observed instrata earlier than Early Wisconsin time.

Gonyodiscus macclintocki F. C. Baker. (See Nautilus, Vol. 41, p. 133.)

This new species was found in six exposures of Peorian loess. It is very uniform in characteristics, varying only a trifle in height of spire. A single specimen in one deposit resembles the variety angulata. Macclintocki has been confused with shimekii

but is quite different in size, form, and sculpture, as noted in the diagnosis in the paper quoted. It is widely distributed, occurring in St. Clair, Bureau, Adams, and Warren counties, in loess.

Gonyodiscus macclintocki angulata F. C. Baker (Nautilus, Vol. 41, p. 134.)

Observed in four exposures of Yarmouth strata, and one of Aftonian strata, Angulata is the earliest form of this species, having a depressed spire and angulate periphery. In the Peorian interval the spire is high and the periphery flatly rounded. As no examples of perspectiva have been found in Illinois Pleistocene, it is presumed that macclintocki may be the ancestral form, since it does not occur in strata older than Peorian.

Gonyodiscus cronkhitei anthonyi (Pilsbry)

Occurred in three exposures of Early Wisconsin strata, in eight exposures of Peorian strata, and is known elsewhere from Late Wisconsin deposits.

Helicodiscus parallelus (Say)

Observed in three Peorian exposures, four exposures of Early Wisconsin age, and one of Late Wisconsin age. As has been previously stated, the Pleistocene parallelus differ somewhat from the species as it occurs in Illinois today. They are somewhat smaller, the spire is more depressed, causing the shell to be more orbicular, and the umbilicus is wider and has a 'reamed out' appearance, the umbilical region not being sunk below the coil of the last whorl. The aperture is smaller and more distinctly lunate. The largest fossil specimen seen had but 4½ whorls while recent forms have five full whorls. Sizes are as follows:

Recent, Illinois:

Height 1.5 and 1.5 mm.; diameter 4.1 and 4.5 mm.

Early Wisconsin:

Height 1.4 and 1.4 mm.; diameter 3.5 and 3.6 mm.

Yarmouth:

Height 1.3 and 1.2 mm.; diameter 3.8 and 3.4 mm.

Peorjan:

Height 1.2 and 1.2 mm.; diameter 3.4 and 3.5 mm.

Parallelus is known from the Yarmouth interval to the present. It is uniformly smaller with depressed spire up to Early Wisconsin time, when it becomes mixed with the higher spired recent form, and in Late Wisconsin the form is entirely like the recent form. Among recent specimens, the fossil form more nearly represents the aspect of the species as it occurs in the north, specimens from Minnesota being similar, though not quite like the fossils of Yarmouth and Peorian time.

Family SUCCINEIDAE

Succinea ovalis Say

The typical form of this species occurred in one deposit of Late Wisconsin age. In two exposures of Early Wisconsin age a form was found which varied toward pleistocenica.

Succinea ovalis pleistocenica F. C. Baker

This variety of ovalis occurred abundantly in five exposures of Yarmouth age, seven exposures of Peorian age, and one of Early Wisconsin age. In the latter there was evidence of variation toward typical ovalis. All were from typical loess deposits. Pleistocenica varies in form but retains the peculiar rounded form of aperture which is characteristic of the fossil form of this large Succinea. It occurs in the Yarmouth, Sangamon, Peorian, and Early Wisconsin intervals, but has not been seen from the Aftonian interval, though it doubtless also occurs here.

Succinea grosvenori gelida F. C. Baker

This small Succinea occurred in two exposures of Yarmouth age, ten exposures of Peorian age, and eight exposures of Early Wisconsin age. It varies greatly in the height of spire and in the size of the aperture. It disappears from Pleistocene deposits in Early Wisconsin time. It is one of the most abundant species of Pleistocene.

Succinea retusa fultonensis F. C. Baker (Nautilus, Vol. 41, p. 136.)

Collected from two exposures of Yarmouth age, one of Peorian age, and four of Early Wisconsin age. This race resembles the variety decampii Tryon, but is much smaller and has a longer spire and shorter aperture. Though no specimens have as yet been seen from Sangamon strata, the form no doubt has a continuous history from Yarmouth to Early Wisconsin time. None have been seen from deposits later than Early Wisconsin. In a previous paper (Trans. Ill. State Acad., XX. p. 269-292) this form was referred to both retusa and decampi, from both of which it is distinct.

Family HELICINIDAE

Hendersonia occulta (Say)

Occulta occurs abundantly in five exposures of Yarmouth age, eight exposures of Peorian age, and four exposures of Early Wisconsin age. A single broken specimen occurred in strata believed to be of Aftonian age. As it is also known from the Sangamon it has a continuous range geologically from Aftonian to Early Wisconsin time. There appears to be a size variation among most of the fossils examined. The present lot indicates that this is an individual variation and cannot be correlated with any interval. In many lots small and large specimens occur associated together. In others, the specimens will be all large or all small indicating colonies of local distribution. The largest specimen seen measured, height 5.6, diameter 7.4 mm., and the smallest specimen, height 4.0, diameter 6.0 mm. A specimen from Quincy measured but 5.1 mm. in diameter.

Hendersonia occulta rubella (Green)

Two specimens from a Late Wisconsin deposit have a slight carina and are of large size and appear to be referable to the living form. Typical occulta apparently died out in late Early Wisconsin time and was replaced by the carinated form called rubella.

Family AURICULIDAE

Carychium exiguum (Say)

Several specimens occurred in strata of Early and Late Wisconsin age. It is also known from strata of Yarmouth age.

Carychium exile canadense Clapp

Peorian loess, three exposures, Early Wisconsin, two exposures. It is also known from the Yarmouth interval. The fossil and recent specimens are similar. Carychium apparently had the same species, exiguum, exile, exile canadense, in the Pleistocene as in the recent fauna and the same amount of variation was present.

Fresh Water Pulmonates

Family LYMNAEIDAE

Stagnicola palustris elodes (Say)

Material apparently referable to this wide-spread species was collected from three exposures of Early Wisconsin time.

Stagnicola caperata (Say)

Observed in one exposure of Yarmouth age, one of Sangamon age, one of Peorian age, and four of Early Wisconsin age. Most of the Pleistocene caperata differ from the recent form as found in Illinois in being somewhat smaller, with a more obese body whorl, hence a wider shell, with an erect, wide, smooth inner lip which emargines the umbilical region leaving a conspicuous chink. Specimens from the Yarmouth interval measure as follows:

Height 10.5; diameter 6.0; aperture height 4.7; diameter 3.0 mm.
Height 11.1; diameter 7.0; aperture height 5.0; diameter 3.1 mm.
Height 9.0; diameter 5.0; aperture height 4.1; diameter 2.0 mm.

The Pleistocene form resembles more closely specimens from Colorado than those from the Mississippi Valley. It is thought

best at the present time to merely call attention to these differences. A few specimens from an Early Wisconsin deposit more nearly resembled the recent form indicating a change in this direction.

Fossaria parva (Lea)

Observed in three exposures of Early Wisconsin age. All of this material varies toward the variety listed below, indicating a transition toward the typical recent species.

Fossaria parva tazewelliana (Wolf)

Collected from one Yarmouth, one Sangamon, ten Peorian, seven Early Wisconsin exposures and one Late Wisconsin exposure. In many deposits it is very abundant and the dominant lymnaeid. Tazewelliana differs from the recent parva in having a longer spire, with usually one more whorl, rounder whorls, deeper sutures, a more obese body whorl, and a wider umbilicus. Specimens from Yarmouth to Peorian intervals are slightly smaller than those from Peorian and Early Wisconsin exposures. One lot from Late Wisconsin strata appeared to be referable to tazewelliana being very high of spire, and measuring 10 by 4.6 mm. Specimens from earlier strata measure as follows:

Yarmouth:	Height 5.8;	diameter 3.1 mm.
Sangamon:	Height 5.5;	diameter 2.9 mm.
Peorian:	Height 6.5;	diameter 3.3 mm.
Peorian:	Height 8.0;	diameter 3.5 mm.
Early Wisconsin:	Height 9.1;	diameter 4.2 mm.
Early Wisconsin:	Height 10.0;	diameter 4.6 mm.

From the material at hand there appears to be a progressive variation toward the large, short-spired recent form. An average recent form measures height 9.0; diameter 4.0 mm.

Fossaria modicella (Say)

A single rather characteristic specimen was found in material from an Early Wisconsin exposure. A similar specimen has been seen from silt of Peorian age. This species, very abundant in the recent fauna, appears very rare in Pleistocene deposits.

Fossaria obrussa decampi (Streng)

Observed in three exposures of Early Wisconsin strata. The Pleistocene decampi differ conspicuously from the form of the recent fauna in having a narrower shell, the body whorl more compressed and straighter, the spire whorls flat with a distinct and sharp shoulder, the sutures deep, and the base distinctly umbilicated. Late Wisconsin specimens are like the recent form.

Measurements are:

Height 11.0;	dia. 5.9;	Aper. height 6.0;	dia. 2.9 mm.	Fossil.
Height 9.0;	dia. 4.4;	Aper. height 4.5;	dia. 1.4 mm.	Fossil.
Height 9.2;	dia. 4.1;	Aper. height 4.5;	dia. 1.5 mm.	Fossil.
Height 11.6;	dia. 6.4;	Aper. height 6.6;	dia. 2.8 mm.	Recent.
Height 11.0;	dia. 5.9;	Aper. height 6.0;	dia. 2.5 mm.	Recent.

Family PLANORBIDAE

Planorbula crassilabris (Walker)

Two specimens in strata of Sangamon age The fossil specimens are smaller than some of those from the recent fauna but appear otherwise typical. The comparative measurements of the fossil and recent forms are as follows:

Sangamon:	Height 2.5; diameter 5.5 mm.
Sangamon:	Height 2.4; diameter 5.0 mm.
Recent:	Height 3.0; diameter 7.5 mm.

This is the first record of this species from Pleistocene deposits and its discovery in strata of other ages will be awaited with interest. As a living species it is known from Michigan, Iowa, and Indiana.

Gyraulus altissimus (F. C. Baker)

Collected from one exposure of Early Yarmouth age and eight exposures of Early Wisconsin age. There is considerable variation among the different specimens in the deflection of the aperture and in the depth of the sutures. On the whole it is very uniform, however. Its absence from the intervals between the Yarmouth and Early Wisconsin is noteworthy. It is known from the Late Wisconsin in many places in Wiconsin, Michigan, Illinois, and Indiana.

Gyraulus urbanensis (F. C. Baker)

A single specimen of this small species was found in material from one exposure of Early Wisconsin time. Urbanensis is of uncertain affinities, appearing related to Tryon's circumstriatus. Until more material is available it will be treated as a species.

Gyraulus crista (Linn.)

Two specimens of this small and characteristic species occurred in one exposure of Early Wisconsin silt. The fossils are somewhat larger than the recent specimens at hand for comparison and the lateral costae are not as heavily marked. Recent specimens are 1.3 and 1.4 mm. in diameter while the fossil specimens are 1.5 and 1.7 mm. in diameter. The number of specimens is too small for generalizations.

Family PHYSIDAE

Physella integra (Haldeman)

This species occurred in two exposures of Early Wisconsin strata and in one of Late Wisconsin strata. The largest specimen measured 12.8 mm. in length and 7.0 mm. in diameter. They are like recent specimens from Illinois. Physella appears to be rare in Early and middle Pleistocene time.

Fresh Water Pectinibranchiates

Family POMATIOPSIDAE

Pomatiopsis lapidaria (Say)

Typical forms of this species were found in three exposures of Early Wisconsin strata.

Pomatiopsis scalaris F. C. Baker

This long-spired, widely-umbilicated species occurred in one exposure of Yarmouth age, two of Peorian age, and six of Early Wisconsin age. The earlier forms are typical of scalaris, but

some of the Early Wisconsin forms show some variation toward the recent lapidaria. Scalaris is ancestral to lapidaria and might perhaps be considered simply a race of that species.

Family VALVATIDAE

Valvata tricarinata (Say)

This striking species was observed in one exposure of Yarmouth age, and in two exposures of Early Wisconsin age. They do not differ from the species as found in the recent fauna.

Valvata tricarinata perconfusa Walker

Observed in two exposures of Early Wisconsin strata.

Valvata tricarinata simplex (Gould)

One specimen observed in Early Wisconsin deposit.

Valvata lewisii precursor F. C. Baker (Nautilus, Vol. 41, p. 136.)

Young specimens were observed in strata of Early Yarmouth age. It is very abundant in exposures of Early Wisconsin age and must have been a dominant species of the streams of that time. It differs from the recent lewisii in its higher spire, showing four whorls in front profile while lewisii usually shows but three. The absence of this form in the intervals between Yarmouth and Early Wisconsin is noteworthy.

Class Pelecypoda

Small Fresh Water Mussels

Family SPHAERIIDAE

Sphaerium striatinum (Lam.)

Two valves of this species (immature) occurred in an exposure of Sangamon age, associated with *Planorbula crassilabris* and other fresh water species.

Sphaerium tenue (Prime)

Several odd valves of this species occurred in an exposure of Early Wisconsin age.

Pisidium compressum (Prime)

This characteristic species occurred in exposures of Yarmouth, Peorian, and Early Wisconsin age. As but a few odd valves are represented in many cases they may have been carried to the spot by outside agencies.

Pisidium pauperculum crystallense Sterki

A few specimens in strata of Early Wisconsin age. The original habitat of this variety is a lake.

Pisidium noveboracense (Prime)

A few valves from strata of Early Wisconsin age.

Pisidium abditum Hald

A single valve of this species was found in Yarmouth slit, evidently an accidental intrusion as the deposit is loess-like and contains a large fauna of land snails.

Pisidium concinnulum Sterki

Occurred in one exposure of Yarmouth age (one specimen evidently of accidental intrusion), two exposures of Early Wisconsin age, and one exposure of Late Wisconsin age. In none of these was it common, and most strata represent flood plain deposits.

Pisidium walkeri Sterki

One deposit of Early Wisconsin age, a few specimens.

Pisidium scutellatum Sterki

Found in three deposits of Early Wisconsin age, and common in but one exposure.

Pisidium tenuissimum Sterki

Occurred in two deposits of Early Wisconsin age.

Pisidium medianum Sterki

A single valve occurred in one exposure of Early Wisconsin age.

Pisidium rotundatum (Prime)

Three valves were found in one exposure of Early Wisconsin age.

Pisidium vesiculare Sterki

Three valves from Early Wisconsin strata are referred to this species by Dr. Sterki.

Pisidium variabilis cf brevius Sterki

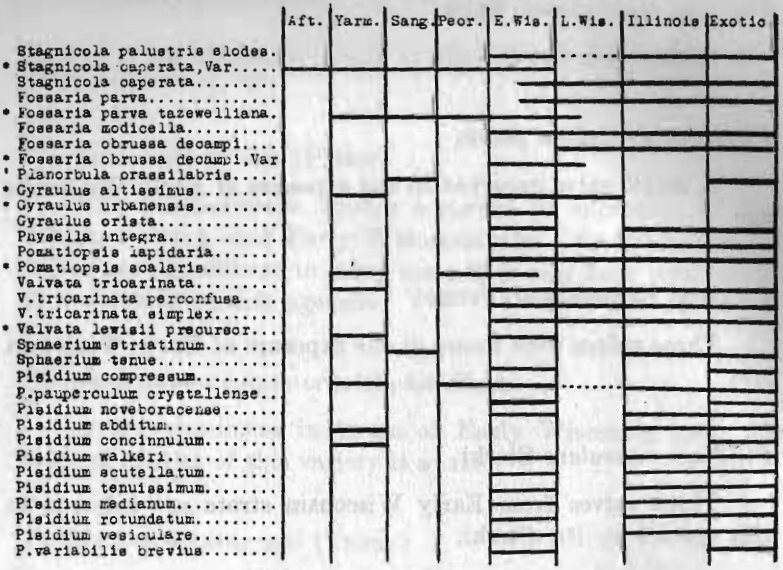
A single valve of a Pisidium is referred to this variety by Dr. Sterki. It was found in silt of Early Wisconsin age.

The Pisidia of the Pleistocene are insufficently known as regards species represented and variation due to glacial conditions. The few valves represented do not differ particularly from the species of the recent fauna. *Pisidium abditum* of the Yarmouth interval is somewhat smaller than specimens from the recent fauna.

Notes on Tables.

The starred names at the left indicate extinct varieties or species. The dagger indicates that the species is not now found in Illinois in the recent fauna. The geological intervals are in order, Aftonian, Yarmouth, Sangamon, Peorian, Early Wisconsin, Late Wisconsin. Illinois indicates that the species or variety is now living in the state. The exotic column indicates that the species is not living in Illinois at the present time but is living in some other part of the country. The solid lines indicate the extent of the range of each species or variety as it relates to the geological interval indicated.

DISTRIBUTION OF PLEISTOCENE FRESH WATER MOLLUSCA IN FULTON COUNTY



DISTRIBUTION OF PLEISTOCENE LAND MOLLUSCA IN FULTON COUNTY

Species	Aftonian	Yarmouth	Sangamon	Peorian	E.Wis.	L.Wis.
Polygyra monodon						
P.monodon peoriensis						
Polygyra hirsuta						
P.hirsuta yarmouthensis						
P.multilineata wanlessi						
Polygyra clausa						
Polygyra thyroides						
Columella hasta						
Columella alticola						
Gastrocopta armifera						
Gastrocopta contracta						
Gastrocopta pentodon						
Vertigo loessensis						
Vertigo modesta						
Strobilops labyrinthica						
Strobilops virgo						
Vallonia gracilicosta						
Circinaria concava						
Zonitoides arboreus						
Striatura milium						
Pseudovitrea minuscula						
Retinella hammonis						
Glyphyalinia indentata						
Euconulus fulvus						
Anguispira alternata.Var.						
Anguispira alternata,Typ.						
Gonyodiscus anthonyi						
Gonyodiscus macclintocki						
G.macclintocki angulata						
Helicodiscus paralellus						
Succinea ovalis						
S. ovalis pleistocenica						
S. grosvenori gelida						
S. retusa fultonensis						
Hendersonia occulta						
Carychium exiguum						
Caryohium exile canadense						