MOLLUSCAN LIFE OF THE LOESS DEPOSITS OF ILLINOIS.*

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Introduction.

Since the work of Dr. B. Shimek on the mollusks of the Iowa loess deposits, little attention has been paid to the life of these very interesting strata. During the interval between Dr. Shimek's studies and the present time, the classification of mollusks has become much more refined and the limits of species and varieties have been more closely drawn, more weight being given to small variations than formerly. This so-called splitting of the species has become more and more necessary in the study of geological horizons for the purpose of recognition of different faunas of subordinate strata, and it is not strange that the more recent life of the Pleistocene should receive similar treatment, the result of which has been to recognize a number of apparently stable variations characteristic of some of the loess faunae, and which are different from the related forms living today. It has been stated that the land snail fauna of the loess deposits, and, indeed, of the whole Pleistocene, is practically like that living in the same area today. This statement has been found to need qualification, however, as the fauna of the Pleistocene is considerably different from that of the present time, especially as regards the State of Illinois. The writer has believed that a careful comparison of the Pleistocene with the recent fauna would show many species which differ more or less from their relatives living today, and the studies of the past ten years have shown that this supposition is correct, not only as regards the land fauna, but also of the fauna of the streams and lakes. That this should be so is not strange, for the covering of so large an area with a huge sheet of ice must necessarily have changed both climate and environment, and the fact that not all species responded to these changes again indicates that not all species have the same

*Contribution from the Museum of Natural History, Univ. of Ill., No. 47.

degree of plasticity in responding to changes of such a drastic character.

During the past six years the Illinois State Geological Survey, under the direction of Dr. M. M. Leighton, Chief, has been conducting surveys in various parts of the state, during which the superficial deposits have been carefully examined and their stratigraphy accurately worked out. This accuracy in the examination of field relations is of the utmost importance, for the value of deductions from fossil faunae rest absolutely on the accuracy of the work of the field geologists. The Survey has been fortunate in having available for its field studies such men as Dr. Paul MacClintock, Dr. Geo. Ekblaw, Dr. Benj. Cox, and Dr. H. R. Wanless, to all of whom as well as to Dr. Leighton, the writer's thanks are due. The present essay is of a cooperative character, between the Illinois Geological Survey and the Museum of Natural History of the University. The material described in two previous papers, collected by the Illinois Survey, should be consulted in connection with this paper and certain changes made in the species listed. This data is incorporated in the present paper (see Journ. Geol., XXX, pp. 43-62, 1922; The Nautilus, XXXIV, pp. 61-68, 1920). See also Baker, Life of the Pleistocene, Bull. Univ. Ill., XVII, No. 41, 1920. The material studied is in the research collection of the museum of natural history. For descriptions of new varieties see Nautilus, XL, p. 114, 1927.

Ecological and Climatic Considerations.

Of the 49 species and varieties listed in the table, 43 are strictly land mollusks, three live under moist conditions, bordering streams *(Carychium)* and three are amphibious, living in small, shallow streams, or, more frequently, on wet mud flats above water mark *(Galba, Pomatiopsis)*. As these genera now live in association with true land mollusks, which have migrated to the wet surface, it is not strange that they should be incorporated together in some loess deposits. In many cases the loess was probably deposited after the shallow wet area had become dry and the land mollusks wandered into this area seeking moisture. Only in a few cases are these aquatic forms associated with loess mollusks, the majority of land species living in open

woodlands or shrub-covered areas far above streams. This has been called upland loess, and the strata containing acquatic forms lowland loess, by the Iowa geologists and the distinction is well taken.

The land snail fauna found in loess deposits of the interglacial intervals indicates strongly that the animals were under climatic and environmental conditions which were different from those obtaining in Illinois at the present time. Of the 49 species and varieties listed in this paper 32 now live in Illinois, 10 are extinct, and 7 are now living in areas far removed from the state. Only 65 per cent now live in the same areas. Taking the fauna as a whole, it contains many species which now live in a drier and relatively more severe climate—Wisconsin, Michigan, Colorado, Nebraska, Utah, Arizona, etc. In the table the present location of the fossil species is indicated and it will be seen that they are, in some cases, far removed from Illinois. The near relatives of the extinct species also live far from the state area.

It has been affirmed that the fauna of the loess does not differ materially from that of today in the same area and that the climate must have been similar. But this could not have been so, judging by the nature of the fossils, as well as of the deposits, aeolian or wind-blown, fine dust. The present habitat of *Oreohelix cooperi* (relative of *Oreohelix iowensis*), *Gonyodiscus cockerelli* (relative of *Gonyodiscus shimekii*), *Sphyradium alticolum, Vertigo modesta,* and *Vallonia gracilicosta* conculsively prove that the conditions in Illinois when these species lived must have been similar to those under which these species live today—drier and relatively cooler. The associated species, for the most part, now live with these species, in the western areas and their association together in Illinois loess deposits is not strange.

Several varieties of common local species, now abundant in Illinois, differ more or less markedly in size or form from the typical form as known today, as *Polygyra profunda pleistocenica, P. multilineata altonensis, P. hirsuta yarmouthensis, P. monodon peoriensis, Succinea ovalis pleistocenica, S. grosvenori gelida,* and *Pomatiopsis scalaris,* thus stamping the fauna as under more rigorous con-

ditions than at the present time, these variations being, for the most part, smaller than the typical form living today. This local variation will become more apparent, even in other species, when more material from more widely-spread localities is critically examined.

Of the four typical loesses represented, the Peorian at present contains the greatest number of species, 34 or 76 per cent, followed by the Early Wisconsin with 25, or 51 per cent. The Yarmouth and Sangamon will show a larger percentage of species when more deposits are discovered in Illinois. In Iowa the number recorded is greater than in Illinois. It is of more than passing interest to note that most of the Peorian loesses are regarded as Early Peorian, and some of them were probably laid down very soon after the retreat of the ice, indicating dry conditions at a very early stage of the interval. In the case of the loess overlying the Bloomington moraine in Bureau County near Weyenet, there is an absence of weathering between the till and the overlying loess, indicating that the loess was deposited soon after the recession of the ice. The climate thus would be somewhat colder than that of today and, apparently, was somewhat drier, perhaps like that of portions of Nebraska and the Dakotas at the present time, or even Idaho and Montana, where wind-blown sand in the form of dunes is now being deposited.

The present paper is to be regarded as a report of progress on a restudy of loess fossils from a modern viewpoint of taxonomy, as well as a more careful discrimination of stratigraphy than has been made previously. Greater quantities of many species are needed for comparison than have been available so that range of variation may be more clearly known. In the present contribution no attention has been paid to previous records of loess mollusks, only that material coming directly under the writer's attention being considered available. Some of these older records need confirmation.

Stratigraphic Data for Deposits in Which Terrestrial Life Occurs.

These deposits include silts, old soils, loess, and sands. The material has been collected by members of the Geologi-

cal Survey during the past four or five years. The species included in each deposit are listed and an interpretation is made of the geologic horizon of the stratum in which the life occurs.

Locality: Clark Co., three miles southwest of Marshall, NW, NE. sec. 16, T. 10 N., R. 12 W. Section as below noted:

1. Silts (like loess) but containing abundant glacial stones scattered through the mass, with fossils throughout the whole section, calcareous throughout..... 40 ft.
2. Leached and weathered pre-Illinoian drift..... 10 ft.
3. Pre-Illinoian till and gravel, calcareous..... 10 ft.

Stratigraphic Horizon: Probably Yarmouth, but might be Aftonian.

Dr. MacClintock believes that the best explanation of this deposit (1) is that it is an overridden pre-Illinoian deposit picked up by the ice and transported some distance. While this hypothesis appears doubtful from some standpoints, it seems the best at present available. The mixing of land, fresh water, and amphibious life suggests such a condition.

Molluscan Life: From number 1 silts.

Polygyra monodon peoriensis
Polygyra hirsuta yarmouthensis
Helicodiscus paralellus
Strobilops virgo
Succinea ovalis pleistocenica
Carychium exiguum
Galba parva
Pomatiopsis scalaris
Hendersonia occulta
Pisidium species

Locality: Clark Co., Big Creek exposure, near locality above.

Material: Taken from the top of the pre-Illinoian interglacial soil and from the lower few feet of the overlying Illinoian till, evidently picked up from the interglacial material and incorporated in the basal portion of the till, which is also very silty (MacClintock).

Stratigraphic Horizon: The pre-Illinoian till appears from its distribution to have had a Labradorian source and so may well be of Nebraskan age. The interglacial deposit, therefore, may be either of Yarmouth or Aftonian age, or possibly both, if the Kansan drift is absent (MacClintock). The mixing of land and fresh water species may indicate transportation from original locality.

Mulluscan Life:

Polygyra monodon peoriensis
Helicodiscus paralellus
Vertigo ventricosa
Cochlicopa lubrica
Succinea ovalis pleistocenica
Hendersonia occulta
Carychium exile
Carychium exile canadense
Galba parva
Gyraulus altissimus

Locality: Bureau Co., sec. 35, SW ¼ NE ¼, T. 16 N., R. 10 E., near Depue (Dr. Leighton).

Material: A section from a spur near Depue Zinc Co., shows:

1. Wash from slopes above..... 5 ft.
2. Stratified sand, few pebbles and few shells, layers perceptibly inclined to the east..... 10 ft.
3. Coarse gravel..... 1–2 ft.
4. Glacial till, probably Illinoian..... 10+ ft.
5. Fossiliferous silt with color bands gray and rusty; few scattered pebbles, changes above to glacial till. To the east, the slope becomes gray, stratified, and softer..... 5+ ft.
6. Sand with few scattered pebbles and fossils, pinkish yellow, some thin layers of pink silt, gives pink coating when washed down over sand. Few thin cemented fragments of sand about 1 in. thick in gully..... 20 ft.

Stratigraphic Horizon: The fossiliferous silts are believed to be of Yarmouth age, the stratified sand of Sangamon age.

Molluscan Life:

Polygyra hirsuta yarmouthensis
Polygyra monodon peoriensis
Helicodiscus paralellus
Succinea ovalis pleistocenica
Succinea grosvenori gelida
Hendersonia occulta
Galba parva

Locality: Jackson Co., Campbell Hill Quandrangle; Sec. 36, T. 7 S., R. 6 W., SW. ¼ NE. ¼. (Dr. MacClintock).

Material: Exposure along road cut up side of hill. Valley here shows terraces at 460 ft. AT and loess and till show in terrace deposits.

1. Leached loess..... 20–25 ft.
2. Leached pebbly drift, many striated stones..... 3–4 ft.
4. Leached loess..... 2 ft.
5. Loess, calcareous, irregular "kindchen," iran mottling and aspect of old loess, very dense, fossiliferous..... 10 ft.

Stratigraphic Horizon: No. 5 is believed to be pre-Illinoian loess, probably Yarmouth. Fossils rare.

Molluscan Life:

Hendersonia occulta
Strobilops virgo.

Locality: Mercer Co., Sec. 9, T. 14 N., R. 3 W., Mercer Township. From hard road cut (Dr. H. R. Wanless).

Material: Loess.

Stratigraphic Horizon: Early Peorian.

Molluscan Life:

Succinea grosvenori gelida
Succinea ovalis pleistocenica
Heicodiscus parelellus
Gonyodiscus shimekii
Sphyradium alticolum
Vertigo modesta
Hendersonia occulta
Galba parva

Locality: Mercer Co., Sec. 4, T. 14 N., R. 1 W. (Dr. Wanless).

Material: Loess.

Stratigraphic Horizon: Early Peorian.

Molluscan Life:

Polygyra thyroides
Succinea ovalis pleistocenica
Succinea grosvenori gelida
Gonyodiscus shimekii
Vitrea hammonis
Vertigo ventricosa
Vertigo modesta
Hendersonia occulta
Cochlicopa lubrica, var.

Locality: Warren Co., Sec. 12, T. 12 N., R. 3 W. From gully (Dr. Wanless).

Material: Loess.

Stratigraphic Horizon: Probably Peorian.

Molluscan Life:

Succinea ovalis pleistocenica
Succinea grosvenori gelida
Gonyodiscus shimekii
Sphyradium alticolum
Vertigo modesta
Hendersonia occulta

Locality: Rock Island Co., Sec. 22, SE ¼ of NW ¼, T. 18 N., R. 1 E. (Dr. Leighton).

Material: Loess over soil and gumbo till, 35 feet from top of hill.

Stratigraphic Horizon: Early Peorian Loess.

Molluscan Life:

Succinea ovalis pleistocenica
Succinea grosvenori gelida
Gastrocopta tappaniana
Sphyradium alticolum
Helicodiscus paralellus

Locality: As above.

Material: Loess over gumbo till, 15 feet from top of hill.

Stratigraphic Horizon: Early Peorian.

Molluscan Life:

Vertigo modesta *Succinea grosvenori gelida*

Locality: Whiteside Co., NE ¼ NE ¼ sec. 32, T. 22 N., R. 5 E.

Material: Yellow loess, road cut across and over spur 11 feet maximum depth, shows: 9½ feet yellow loess over 1½ feet gray loess, both fossiliferous and calcareous; yellow loess effervesces more violently than gray loess; no sharp line demarcates the two, for they are gradational within 1-12 inches. (Dr. M. M. Leighton).

Stratigraphic Horizon: Early Peorian.

Molluscan Life:

Vertigo modesta *Succinea grosvenori gelida*

Locality: Whiteside Co., sec. 23, T. 20 N., R. 3 E, near center (Dr. Leighton).

Material: Loess.

Stratigraphic Horizon: Early Peorian.

Molluscan Life:

Succinea grosvenori gelida *Pisidium species*
Galba parva

This deposit appears to be laid down near water, because the Galba is common while the *Succinea* is represented only by several immature individuals. The Pisidium also indicates nearness to water.

Locality: Bureau Co., NW ¼ sec. 1, T. 15 N., R. 6 E. New highway cutoff through three ridges going upgrade (Dr. Leighton).

Material: In lowest ridge is exposed 15-18 feet of pebbly sand, yellow; in next ridge, red sand beneath gumbotill gray and sandy, leached, passing through fossiliferous loess; in highest ridge fossiliferous loess. Between gumbotill and overlying fossiliferous loess is about 10 feet of chocolate brown, loess-like silt with band of gray color, calcareous mostly in spots. Fossils from fossiliferous yellow loess.

Stratigraphic Horizon: Peorian.

Molluscan Life:

Succinea ovalis pleistocenica *Gonyodiscus shimekii*
Succinea grosvenori gelida

Locality: Lawrence Co., 2 ¾ miles N-NW of St. Francisville, SE ¼ SE ¼ sec. 6, T. 4 N., R. 11 E. (Dr. MacClintock).

Material: Road cut in NW corner of group of hills rising above Wabash River flats and entirely surrounded by flood plain deposits. Top of cut is 8-10 feet below the highest elevation of the rather flat-topped hills. Road cut shows; from top to bottom:

1. Loess, leached, reddish buff ..... 3–4 ft.
2. Loess, calcareous, light yellowish buff ..... 4 ft.
3. Sand, calcareous ..... 1 ft.
4. Loess, calcareous, fossiliferous, containing abundant 'kindchen', gray drab, iron-mottled and concentrically stained ..... 4 ft.
5. Loess, leached, reddish buff more compact than that above .... 4 ft.
6. Till, weathered, leached and oxidized ..... 3½ ft.
7. Bed rock.

Stratigraphic Horizon: Dr. MacClintock suggests that No. 6 is Illinoian till, No. 5 Peorian loess, and No. 4 early Wisconsin loess. He also states that No. 5 might be Sangamon loess and No. 4 Peorian loess. The fossils do not include certain species which should be in Peorian loess and from this viewpoint the first interpretation would seem best.

Molluscan Life:

Polygyra hirsuta yarmouthensis
Strobilops virgo
Euconulus fulvus
Zonitoides minusculus
Hendersonia occulta

Locality: Madison Co., Collinsville bluffs (Dr. Leighton).

Material: Loess.

Stratigraphic Horizon: Early Peorian.

Molluscan Life:

Hendersonia occulta
Pyramidula alternata
Gonyodiscus shimekii
Pupoides marginatus
Gastrocopta armifera
Polygyra appressa
Succinea retusa peoriensis
Succinea grosvenori gelida

Locality: Adams Co., Quincy, Vine and Second St. (Leighton and Cox coll.).

Material: Fossiliferous loess overlying till.

Stratigraphic Horizon: Early Peorian.

Molluscan Life:

Gonyodiscus shimekii
Vertigo modesta
Hendersonia occulta

Locality: Adams Co., Municipal Quarry, NW ¼ NW ¼ sec. 26, T. 1 S., R. 9 W. (Leighton & Cox).

Material: Loess.

Stratigraphic Horizon: Early Peorian.

Molluscan Life:

Hendersonia occulta
Polygyra monodon peoriensis
Polygyra appressa
Gonyodiscus shimekii
Sphyradium alticolum
Vertigo ventricosa
Vertigo modesta
Succinea ovalis pleistocenica
Succinea grosvenori gelida
Vallonia gracilicosta

Locality: Adams Co., Quincy, quarry near (south of) Curtis Creek, near bluff road on east side SE ¼ SW sec. 11, T. 2 S., R. 9 W. (Leighton & Cox).

Material: Loess from 15 feet above bed rock.

Stratigraphic Horizon: Early Peorian.

Molluscan Life:

Hendersonia occulta
Polygyra monodon peoriensis
Polygyra fraterna
Helicodiscus paralellus
Gonyodiscus shimekii
Vertigo modesta
Succinea ovalis pleistocenica

Locality: Union Co., Alto Pass south of Textile Hollow (Dr. Ekblaw).

Material: Loess.

Stratigraphic Horizon: Probably Early Peorian.

Molluscan Life:

Polygyra profunda
Polygyra profunda near *pleistocenica*
Polygyra appressa
Polygyra tridentata
Polygyra fraterna
Succinea ovalis pleistocenica
Circinaria concava
Pyramidula solitaria
Pyramidula alternata
Gastrocopta armifera
Hendersonia occulta

The absence of such typical Peorian species as *Gonyodiscus shimekii, Sphyradium alticolum, Vallonia gracilicosta,* and *Succinea grosvenori gelida* suggests that this deposit may be younger than Peorian. These smaller fossils may have been overlooked, however, and the age may be true Peorian. The presence of a form of *Polygyra profunda,* described from Alton, gives a Peorian aspect to the deposit. All other species are present in the recent fauna.

Locality: Bureau Co., Buda Country Club, east bank Coal Creek. (Dr. MacClintock).

Material: Section of bank shows following strata:

1.	Soil and subsoil	2 ft.
2.	Pink till	7 ft.
3.	Laminated pink clays, calcareous	2 ft.
4.	Light buff-gray loess, fossiliferous	5 ft.
5.	Laminated (slightly fatty) gray clays	3⅔ ft.
6.	Dark gray loess, slightly calcareous, fossiliferous	4½ ft.
7.	Silt, dark gray, with small pebbles, slightly calcareous	1 ft.
8.	Clay, fatty, greenish to yellowish, leached and weathered	3½ ft.
9.	Silt, leached, with peat bands	2 ft.
10.	Alluvial coal (from underlying coal bed)	1 ft.
11.	Clay, no pebbles, leached	1½ ft.
12.	Till, calcareous, yellow to golden buff	2 ft.

Stratigraphic Horizon:

Dr. MacClintock interprets the section as 1, 2, Bloomington; 3, early Bloomington lake; 4-7, Peorian; 8-12 Iowan and Peorian. An alternative interpretation is that the lower may be Illinoian with Sangamon over it, and calcareous Peorian loess on the weathered Sangamon. Whichever one is correct makes the fossils Peorian in age.

Molluscan Life: The same species occur in both upper (4) and lower (6) loess.

Gonyodiscus shimekii
Polygyra monodon peoriensis
Succinea grosvenori gelida
Hendersonia occulta

Locality: Gallatin Co., Shawneetown hill, SW SW ¼ sec. 17, T. 9 S., R. 10 E. (Dr. MacClintock).

Material: Road cut on south side of hills exposes 20 feet of loess quite typical. Upper 3-5 feet leached, lower 15 feet calcareous and fossiliferous. This same loess covers the whole hill and no drift or rock was seen.

Stratigraphic Horizon: Dr. MacClintock does not venture an opinion concerning the age of the lower calcareous loess, but the life suggests Early Wisconsin, as it does not include typical Peorian fossils.

Molluscan Life:

Polygyra hirsuta yarmouthensis
Polygyra fraterna
Polygyra appressa
Pyramidula alternata
Gonyodiscus cronkhitei catskillensis
Hendersonia occulta
Vitrea hammonis
Helicodiscus paralellus
Strobilops labyrinthica
Vertigo gouldii
Gastrocopta armifera similis
Succinea grosvenori gelida

Locality: Gallatin Co., NE NW sec. 9, T. 9 S., R. 3 W., six miles west of Shawneetown (Dr. MacClintock).

Material: Loess.

Stratigraphic Horizon: Probably Early Wisconsin.

Molluscan Life:

Polygyra profunda
Polygyra appressa
Polygyra hirsuta yarmouthensis
Pyramidula alternata
Pyramidula solitaria
Hendersonia occulta
Galba parva

Locality: Bureau Co., Buda Quadrangle. (Dr. Mac Clintock)

Material: Railway cut exposing 15-20 feet of loess leached to depth of 6 feet. Gastropod fossils in a two-foot horizon about 9 feet from top of cut. Loess buff-drab in color and fairly dense in texture.

Stratigraphic Horizon: Post-Bloomington or Early Wisconsin.

Molluscan Life:

Vertigo modesta
Succinea grosvenori gelida
Vallonia gracilicosta

Locality: Bureau Co., Buda Quadrangle (Dr. Mac Clintock).

Material: Cut through gravelly phase of the Bloomington terminal moraine. Ten foot bank of Post-Bloomington loess, fossiliferous (MacClintock).

Stratigraphic Horizon: Early Wisconsin.

Molluscan Life:

Pupilla cf hebes
Vertigo modesta
Sphyradium alticolum
Succinea grosvenori gelida

Locality: Bureau Co., road cut east of Wyanet, east bank of West Bureau Creek, NE NW ¼ sec. 22, T. 16 N., R. 8 E. (Dr. MacClintock).

Material: Cut through Bloomington moraine shows:

1. Dark gray soil ..... ½–1 ft.
2. Bleached loess, yellow buff, with some gray mottling, limonite streak 1–2 in. thick near base ..... 7–8 ft.
3. Calcareous loess, yellow clay, with some ochre coloring in upper 2½ ft., mostly gray below with ferruginous pipes and stains up to 1 in. in diameter. Upper part of clay highly fossiliferous, lower part more compact ..... 6–7 ft.
4. Below loess calcareous till, pinkish yellow when dry, strong pink when wet, pebbly clay till with small sand lenses at top, limestone pebbles to top, some gray to dark shale.
   Till is dark gray at depth of 6–8 ft. below base of loess. On opposite side of valley the loess is underlain by 3–5 ft. sand and gravel.

Stratigraphic Horizon: Immediately post early Wisconsin.

Molluscan Life:

Polygyra pennsylvanica
Succinea grosvenori gelida
Vertiga modesta
Pupilla cf hebes
Sphyradium alticolum
Vallonia gracilicosta
Cochlicopa lubrica
Hendersonia occulta

Locality: Tazewell Co., SW NE ¼ sec. 27, T. 26 N., R. 4 W. (Dr. Leighton).

Material: Loess over Wisconsin till. Road cut near top of slope shows:

1. Gray soil ..... ½–1 ft.
2. Maximum leached buff loess ..... 3½ ft.
3. Maximum calcareous yellow fossiliferous loess ..... 4½ ft.
4. Gravel with limestone pebbles, maximum ..... 1 ft.
5. Banded silts for horrizontal distances of 20 ft., pinkish wavy ..... 1 ft.
6. Pink calcareous till ..... 6–7 ft.
7. Gray calcareous till, jointed, pinkish cast on surface ..... 6+ ft.

Stratigraphic Horizon: Immediately post Early Wisconsin.

Molluscan Life:

Succinea grosvenori gelida
Gonyodiscus cronkheitii anthonyi
Vertigo modesta
Sphyradium alticolum

Locality: Henry Co., NW NE ¼ sec. 16, T. 17 N., R. 2 E. (Dr. Leighton).

Material: Gully exposure south side road shows:

Three feet fine sand with thin wavy bedding, yellow, overlain by ¾ ft. of very fine sand or silt mottled with limonite stains, overlain by ½ to ⅔ ft. of greenish gray fossiliferous silt, overlain by thin bedded pink gritless clay alternating with gray silt, overlain by ¾ ft. of grayish yellow fine sand, all calcareous.

Stratigraphic Horizon: Probably late Wisconsin.

Molluscan Life:

Gonyodiscus cronkhitei anthonyi
Succinea avara vermeta

Locality: Bureau Co., 3 ¼ miles south of Wyanet (Dr. MacClintock).

Material: Post Bloomington loess, a section showing:

Leached loess ..... 3 ft.
Calcareous fossiliferous loess ..... 8–9 ft.
Medium gravel ..... ½ ft.
Pink calcareous till (Bloomington) ..... 5–10 ft.

Stratigraphic Horizon: Contacts are all distinct with no weathering showing that loess was deposited soon after recession of the ice, i. e., Early post-Bloomington or very Early Wisconsin. At southeast side of cut the gravel is missing and the loess lies on the till. (MacClintock).

Molluscan Life:

Succinea grosvenori gelida
Vertigo modesta
Pupilla cf hebes

Systematic Discussion of Species.

Family HELICIDAE

Polygyra tridentata (Say)

Alto Pass, Union Co. Early Peorian. This is the small form of Indiana and Illinois, but rather more depressed than recent specimens.

Polygyra profunda (Say)

Alto Pass, Union Co. (Early Peorian); near Shawneetown (Early Wisconsin). The large, flattened form typical of the recent fauna. Among the Shawneetown lot there are several specimens resembling *pleistocenica*.

Polygyra profunda pleistocenica F. C. Baker

Near Alton (see Baker, 1920, p. 63). Occurs in loess of Sangamon age and in a concretionary basal horizon believed to be of Yarmouth age. This small form appears quite constant in the Pleistocene deposits examined.

Polygyra multilineata altonensis F. C. Baker

Near Alton, in loess of Sangamon age. This large variety of *multilineata* is at present known only from this locality and horizon.

Polygyra appressa (Say)

Near Alton (Sangamon); Alto Pass, Union Co., Adams Co., Quincy, and Collinsville bluffs, Madison Co. (Early Peorian); near Shawneetown, Gallatin Co. (Early Wisconsn). Specimens show some variation; the Alto Pass material is like that living today; Gallatin Co. specimens are rather larger (23 mm.) than recent forms from Illinois, and one specimen is without a parietal denticle and with a strong basal callus on lower lip; another specimen has a heavy parietal denticle almost like *palliata*. Specimens from Shawneetown Hill loess and from Collinsville have a distinct denticle on the upper part of the outer lip.

Polygyra pennsylvanica (Green)

Bureau Co., immediately Early Wisconsin loess. A single specimen is small and has a very low spire. Somewhat similar specimens occur living in Washington Co., Ill. Height 10; diameter 14 mm.

Polygyra thyroides (Say)

Mercer Co., Early Peorian loess. A single broken specimen apparently typical.

Polygyra hirsuta yarmouthensis F. C. Baker

Clark and Bureau counties (Yarmouth); near Alton Ill., and New Harmony, Ind. (Sangamon); Lawrence Co., St. Francisville (Peorian); Gallatin Co., Shawneetown (Early Wisconsin). The Pleistocene *hirsuta* are uniformly smaller and have a differently formed parietal tooth or lamina than the form now living in Illinois and Indiana.

Polygyra monodon peoriensis F. C. Baker

Clark and Bureau counties (Yarmouth); Adams and bureau counties (Peorian). The *monodon* vary greatly in the loess. The Adams County forms are uniformly smaller than the *monodon* of the recent fauna. All fossil forms differ sufficiently from recent forms for varietal distinction.

Polygyra fraterna (Say)

Union Co. and Adams Co. (Peorian); Shawneetown Hill loess (Early Wisconsin). The Pleistocene *fraterna* are about the same in size as the recent form of the species. A single specimen from Alto Pass has a very high spire as compared with recent forms. H. 6. 2; D. 9 mm. Not enough matarial is at hand to satisfactorily compare Pleistocene with recent forms of this species.

Oreohelix iowensis (Pilsbry)

This species is known from the loess of Iowa, in the Yarmouth, Sangamon, and Peorian intervals. It has been cited from Cass Co. (Sangamon), Whiteside Co. (Peorian), and Peoria (Peorian). It is apparently not abundant in Illinois (See Baker, 1922, p. 58).

Family CIRCINARIIDAE

Polita hammonis (Ström.)

Near Alton (Sangamon); Union Co., Alto Pass (Peorian). The fossil material is smaller, with a more depressed spire and a wider umbilicus than living specimens from Illinois. It is apparently not common as a fossil.

Family ZONITIDAE

Polita hammonis (Ström.)

Mercer Co. (Peorian); Shawneetown Hill (Early Wisconsin). It has also been reported from all intervals from

Aftonian to pre-recent (see Baker, Pleistocene, p. 389). The few specimens examined are similar to the recent forms. The record of *Vitrea wheatleyi* from Carroll Co. peat deposits (Baker, 1922, p. 58) is erroneous, the specimen being a form of *hammonis*.

Zonitoides arborea (Say)

Near Alton (Sangamon). Also reported from all intervals from Aftonian to recent (Baker, Pleistocene, p. 289). The Sangamon specimens are somewhat smaller than shells of the recent fauna. Not enough material is at hand for a satisfactory comparison of the fossil with the recent forms.

Euconulus fulvus (Müller)

Whiteside Co. (Peorian); St. Francisville, Lawrence Co. (Early Wisconsin). Reported from all intervals. The fossil specimens appear similar to the recent form.

Family ENDODONTIDAE

Anguispira alternata (Say)

Near Alton (Sangamon); Collinsville and Alto Pass (Peorian); Gallatin Co. (Early Wisconsin). The *alternata* from the Sangamon interval near Alton are uniformly smaller than shells from the recent fauna, as are also shells from the Peorian at Collinsville. The Alto Pass and Gallatin Co. specimens are larger and more like the recent form. Measurements of maximum diameter of the different forms are: Alton (Sangamon) 17 mm.; Collinsville (Peorian) 16 mm.; Alto Pass (Peorian) 20 mm.; Gallatin Co. (Early Wisconsin) 22 mm.; recent fauna from Illinois, 23-25 mm. It will be observed that the early forms from Sangamon and Peorian time are usually smaller than those from later time. More material is needed to establish this geological variation more definitely.

Anguispira solitaria (Say)

Alto Pass, Union Co. (Peorian); Gallatin Co. (Early Wisconsin). The specimens from Gallatin Co. average considerably larger than the usual size of the species as found in Illinois and Indiana, diameter 29 mm. Largest Illinois and Indiana specimen, 25 mm.

Gonyodiscus shimekii (Pilsbry)

Near Alton; Adams Co.; Collinsville bluffs; Whiteside, Mercer, Bureau, Warren counties, all Peorian interval.

This very striking species appears to be characteristic of the Peorian interval, scarcely a deposit of loess occurring that does not include this species. It has been reported from the Yarmouth interval in Iowa (see Baker, Pleistocene, pp. 254-256), but late studies by Alden and Leighton indicate that some of these may be referable to Peorian time (An. Rep., Iowa Geol. Surv., XXVI, 1917). In Illinois *shimekii* is not at present known in strata earlier than Peorian, nor is it found in later deposits. It appears to be a horizon marker for this interval. It is abundant in loess deposits of Iowa.

Gonyodiscus cronkitei anthonyi (Pilsbry)

Tazewell Co. (Early Wisconsin); Henry Co. (Late Wisconsin). The few specimens examined do not differ from the recent form. This species has been recorded from all of the interglacial intervals, but no material from Illinois earlier than Early Wisconsin has been seen (see Baker, Pleistocene, p. 389). Some of these records may have been based on the var. *catskillensis*.

Gonyodiscus cronkhitei catskillensis (Pilsbry)

Shawneetown Hill loess, probably Early Wisconsin. One specimen with high spire and angulated periphery appears referable to this form.

Helicodiscus paralellus (Say)

Clark and Bureau Co. (Yarmouth); near Alton (Sangamon); Adams, Rock Island, Mercer Co. (Peorian); Shawneetown Hill (Early Wisconsin). This almost monotypic species varies but little throughout the Pleistocene. The Yarmouth and Sangamon specimens are a trifle smaller and have a wider umbilicus than in the recent form, though the last feature varies much among the living representatives.

Sphyradium alticolum (Ingersoll)

Adams, Rock Island, Mercer, Warren Co. (Peorian); Bureau Co. (Early Wisconsin); Tazewell Co. (Late Wisconsin). In Iowa, this species has been recorded from Af-

tonian, Yarmouth, and Sangamon intervals. Most of the Pleistocene *Sphyradium* are probably referable to *alticolum*, which appears to be a species approaching extinction. It does not occur living in Illinois and is found only in the higher regions of the west (Utah, Colorado, Wyoming). *Sphyradium edentulum* is the species now living in Illinois. The *alticolum* from Post Wisconsin deposits is more like the living form in having the last whorl somewhat enlarged, causing a peculiar constriction behind this whorl. The shell is also somewhat narrower than the shell of the species as it occurs in the Peorian deposits (see Hanna, Proc. U. S. Nat. Mus., XLI, p. 373, 1911, for figures of all American species).

Family SUCCINEIDAE

Succinea ovalis pleistocenica (F. C. Baker)

Clark, Bureau Co. (Yarmouth); near Alton (Sangamon); near Alton, Madison Co., Mercer, Warren, Rock Island, Bureau, Adams, Peoria, Union Co. (Peorian). Also in Peorian loess at Freeport, Iowa. The Pleistocene form of this common recent species differs from the living form in having a longer spire and a rounder aperture. It appears most abundant in the Peorian interval and has not been seen from later deposits.

Succinea grosvenori gelida (F. C. Baker)

Bureau Co. (Yarmouth); Boone Co. (Sangamon); Mercer, Warren, Whiteside, Bureau, Boone, Rock Island, Adams, Carroll, Ogle, Stephenson, Madison Co. (Peorian); Bureau, Tazewell, Gallatin Co. (Early Wisconsin). This small *Succoinea* has been variously reported, many years ago as *verrilli*, and later as *grosvenori*, *vermeta*, and *avara*. It is apparently a variety of *grosvenori* peculiar to Pleistocene time. It is smaller and much more elongated than *grosvenori*. Baker's references (Journ. Geol., XXX, p. 43, et seq.) are all based upon this form. It extends throughout the series of intervals from Yarmouth to Early Wisconsin.

Succinea avara (Say)

Stephenson Co., in loess-like clay (Post-Wisconsin). A few specimens in this deposit are referred to *avara*, re-

sembling the small forms living in the Mackenzie River district of Canada. The largest specimen measures 5.5 mm. in length. Specimens from Henry Co. (Late Wisconsin) are probably referable to variety *vermeta* (Say)

Succinea retusa (Lea)

Whiteside Co. (Post-Wisconsin). A single, rather small specimen.

Succinea retusa decampi (Tryon?)

Bureau Co. (Yarmouth soil). The specimens referred to this variety are rather small, with strikingly flat-sided whorls and long spire. Two specimens measure, length 9.5 and 8 mm., diameter 5 and 4 mm.

Succinea retusa peoriensis (Wolf)

Madison Co., Collinsville bluffs (Peorian). Several specimens of a *Succinea* with wide shell is referred to this variety. Additional material is needed for a more satisfactory determination.

Family PUPILLIDAE

Strobilops virgo (Pilsbry)

Clark Co., Jackson Co. (Yarmouth). Lawrence Co. (Early Wisconsin). Typical but apparently rare. It has been reported from the Aftonian and Peorian intervals, but none has been personally examined (Baker, Pleistocene, p. 388).

Strobilops labyrinthica (Say)

Gallatin Co., Shawneetown Hill loess (Early Wisconsin). Typical form with one large, heavy parietal lamella emerging from aperture. This species has been reported from all intervals, but many of the records were probably founded on some one of the allied species. It probably occurs in other strata.

Pupoides marginatus (Say)

Madison Co., Collinsville (Peorian). The fossil form is slightly wider and has half a whorl less than the recent form of the species. Not enough material is at hand for confirming this variation as a stable geological form.

Gastrocopta armifera (Say)

Whiteside Co., Union Co., Madison Co. (Peorian). Typical for the most part, the Alto Pass (Union Co.) specimens being slightly narrower.

Gastrocopta armifera similis (Sterki)

Near Alton (Sangamon); Gallatin Co. (Early Wisconsin). The *armifera* from these deposits are noticeably narrower than the typical form, the columellar lamella is more pointed, there are but two palatal lamellae, and the parietal lamella is smaller than usual. This form is quite noticeably different from the wide typical form and appears to be the same as the recent *similis*.

Gastrocopta tapaniana (C. B. Adams)

Rock Island Co. (Peorian). One broken specimen is referred to this species.

Gastrocopta contracta (Say)

McHenry Co. (Late Wisconsin). Common and typical.

Pupilla cf hebes (Ancey)

Bureau Co. (Early Wisconsin); Whiteside Co. (Peorian). The *Pupilla* from the Illinois loess deposits is not *muscorum* but apparently *hebes*. They are of the same size (larger than *muscorum*), the aperture is completely edentate, and the lip lacks the heavy deposit of the recent species. There are seven whorls. A specimen from Whiteside Co., has the outer lip slightly thickened, but the Bureau Co. specimens are exactly like *hebes* from Arizona identified by Pilsbry. Measurements of two specimens are: L. 3.4 and 3.6 mm., diameter 1.7 and 1.9 mm. Arizona specimen L. 3. 6, D. 1. 8 mm. The aperture is shaped like *hebes*, *not* like *muscorum*. Additional material is needed to satisfactorily determine the range of variation of this pleistocene form. Dr. Pilsbry suggests that it may be local form of *muscorum*.

Vertigo ventricosa (Morse)

Clark Co. (Yarmouth); Adams Co., Mercer Co. (Peorian). The few specimens are apparently typical. Variety *elatior* sterki is reported from loess deposits at New Harmony, Indiana (probably Sangamon).

Vertigo gouldii (Binney)

Gallatin Co., Shawneetown Hill loess (Early Wisconsin). A specimen is referable to this species, but is rather more elongated than in living examples.

Vertigo modesta (Say)

Whiteside, Mercer, Warren, Rock Island, Adams Co. (Peorian); Bureau, Tazewell Co. (Early Wisconsin). This small land shell is very common in the loess of Iowa and Illinois and exhibits great variation in size and number of denticles in the aperture. In the Tazewell deposit the single specimen has only a small parietal tooth; specimens from Mercer Co. are the same. From Mercer and Whiteside counties specimens occur without a parietal tooth and these are similar to the form *parietalis* (Ancey) now living in the Rocky Mountain Region. The majority have four teeth as in the typical form. The size runs from 1.9 to 2.6 mm. in length. It has been recorded from the Yarmouth and Sangamon intervals, but specimens have been seen only from Peorian and later deposits. Some of the early records may have been based upon deposits now considered of later age. The record by Hershey (Amer. Journ. Sci., II, p. 324, 1896) appears to be referable to the Yarmouth interval, the clays underlying Illinoian till. It is recorded as *Pupilla blandi* (not of Morse), under which name *modesta* has been listed by Iowan geologists.

Family COCHLICOPIDAE

Cochlicopa lubrica (Müller)

Mercer Co. (Peorian); Bureau Co. (Early Wisconsin). The few specimens seen from these deposits are like the typical form now living.

Cochlicopa lubrica (Müller) Variety

Clark Co. (Yarmouth). A specimen from the Yarmouth soil differs from the living form in the size of the shell and in the small size of the aperture. It is also more slender. Length 5, diameter 2 mm.; aperture length 1.5, diameter 1.1 mm. The aperture is about 30 per cent of the length while in typical *lubrica* it is 35 to 40 per cent. Additional material is needed to determine the nature of the variation.

Family VALLONIIDAE

Vallonia gracilicosta (Reinhard)

Whiteside and Adams Co. (Peorian); Bureau Co. (Early Wisconsin). This is the common *Vallonia* of the loess. Fossil specimens are a trifle larger than specimens from Colorado, with less thickened reflected lip, and with very fine striae.

Family AURICULIDAE

Carychium exiguum (Say)

Clark Co., loessal silt (Yarmouth). Typical.

Carychium exile (H. C. Lea)

Clark Co., (Yarmouth soil). Typical.

Carychium exile canadense (Clapp)

Clark Co., (Yarmouth soil). Typical. The presence of the three forms of this genus, common at the present time in northern United States, is interesting, indicating that the deposit was formed in low, damp or wet ground. The specimens examined are typical of the forms living today. They have been recorded from all the intervals from Aftonian to Late Wisconsin.

Family LYMNAEIDAE

Galba parva (Lea)

Clark, Bureau Co. (Yarmouth soil and loessal silt); Carroll Co., blue silt (Peorian). Mercer Co., Whiteside Co. (Peorian loess). The fossil material shows some variation, especially in the length of the spire and the flatness of the inner lip. Some specimens resemble variety *sterkii* Baker. The recent form also varies greatly.

Family PLANORBIDAE

Gyraulus altissimus (F. C. Baker)

Clark Co. (Yarmouth soil). A single, immature specimen is referred to this species.

Family HELICINIDAE

Hendersonia occulta (Say)

Clark Co. (Yarmouth soil), Jackson Co., Bureau Co. (Yarmouth loess); Mercer, Warren, Adams, Madison,

Union, Bureau Co. (Peorian loess); Bureau, Gallatin, Lawrence Co. (Early Wisconsin); Near Alton (Sangamon loess). This small species is one of the most abundant mollusks in loess deposits and must have been widely and continuously distributed during the different interglacial intervals. Its modern descendant is widely distributed, but it is extremely local and the distribution markedly discontinuous. Specimens from several places in the Peorian and Early Wisconsin intervals are notably smaller than those from other places, indicating a size variation during Pleistocene time. It may be possible to establish a maximum and minimum size when more material has been examined. Yarmouth specimens are rather large, and measure 6 to 6.5 mm. in diameter; Sangamon specimens, 6-6.2 mm.; Peorian, 5.1 to 7 mm.; Early Wisconsin, 5.5 to 6.8 mm. The smallest specimens are from near Quincy, Adams Co., and these measure 5.1 to 5.6 mm. Another set from Gallatin Co., measure 5.5 to 6.1 mm. Not enough material is at hand to determine the variation among the recent examples of the species.

Family POMATIOPSIDAE

Pomatiopsis scalaris (F. C. Baker)

Clark Co. (Yarmouth, loessal silt). This newly described species has been found in Illinois only in this interval. In Indiana, the type locality, New Harmony, Posey Co., the loess is of considerable extent and thickness but its stratigraphic horizon has not been determined accurately. It has been considered Sangamon by Shimek (Baker, Peistocene, p. 306) but may equally well be Peorian. In Illinois, loess deposits in Lawrence Co. (St. Francisville) and Gallatin Co. (Shawneetown) are regarded as of Early Wisconsin age.

Pomatiopsis lapidaria (Say)

Stephenson Co., near Ridott (Late Wisconsin). These specimens are like the recent species. See Baker, Journ. Geol., XXX, p. 45.

True Freshwater Mollusca

Pisidium species

Clark Co. (loessal silt). A single valve of a large Pisidium occurred with land species. As *Galba, Pomatiopsis,*

and *Carychium,* species which habitually live in or near small streams or on mud flats, also occurred, it is highly probable that the single valve was washed onto a mud flat bordering a stream, as occurs frequently at the present time.

TABLE OF DISTRIBUTION OF LOESS LAND MOLLUSCA*

Species	Y	S	P	EW	LW	E	I	Ex	Present location.
Polygyra tridentata			x				x		
Polygyra profunda			x	x			x		
Polygyra p. pleistocenica	x	x	x			x			
Polygyra m. altonensis		x				x			
Polygyra appressa		x	x	x			x		
Polygyra pennsylvanica				x			x		
Polygyra thyroides			x				x		
Polygyra h. yarmouthensis	x	x	x	x		x			
Polygyra m. peoriensis	x	x	x			x			
Polygyra fraterna			x	x			x		
Oreohelix iowensis	x	x	x			x			
Circinaria concava		x	x				x		
Polita hammonis			x	x	x		x		
Euconulus fulvus			x	x			x		
Anguispira alternata			x	x	x		x		
Anguispira alternata, var.		x	x					?	Minn., Wis.
Anguispira solitaria			x	x			x		
Gonyodiscus shimekii		?	x			x			
Gonyodiscus c. anthonyi				x	x		x		
Gonyodiscus c. catskillensis				x				x	Mich., Wis., Minn.
Helicodiscus paralellus	x	x	x	x	x		x		
Sphyradium alticolum			x	x	x			x	Utah, Col., Wyo.
Succinea pleistocenica	x	x	x			x			
Succinea g. gelida	x	x	x	x		x			
Succinea avara					x		x		
Succinea retusa					x		x		
Succinea r. decampi	x							x	Mich.
Succinea r. peoriensis			x				x		
Strobilops labyrinthica				x			x		
Strobilops virgo	x			x			x		
Pupoides marginatus			x				x		
Gastrodonta armifera			x				x		
Gastrodonta a. similis		x		x			x		
Gastrodonta contracta					x		x		
Gastrodonta tappaniana			x				x		
Pupilla cf hebes			x	x				x	N. Mex., Ariz., Nev., Utah, Col.
Vertigo ventricosa	x		x				x		
Vertigo modesta	x	x	x	x				x	Locally in Me., Vt., Ct., Rocky Mts.
Vertigo gouldii				x			x		
Cochlicopa lubrica			x	x	x		x		
Cochlicopa lubrica, var.	x					x			
Vallonia gracilicosta		x	x	x				x	Mont., Col., Dakotas
Carychium exiguum	x	x	x	x	x		x		
Carychium exile	x	x	x	x	x		x		
Carychium e. canadense	x						x		
Galba parva	x		x		x		x		
Hendersonia occulta	x	x	x	x			x		
Pomatiopsis scalaris	x	x	x			x			
Pomatiopsis lapidaria					x		x		
Total distribution	18	19	34	25	13	10	32	7	

*Symbols in table: Y, Yarmouth; S, Sangamon; P, Peorian; Ew, Early Wisconsin; Lw, Late Wisconsin; E, extinct; I, living in Illinois today; Ex, exotic or living north or west of Illinois today.