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CONTENTS

ILLUSTRATIONS

WISCONSIN MOLLUSCAN FAUNAS FROM HENDERSON COUNTY, KENTUCKY

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ABSTRACT

Molluscs of Wisconsin age are described from nine localities bordering the Ohio River in western Kentucky. The area is covered by the Henderson, Smith Mills, and Wilson 7 ½-minute quadrangles. The faunas, with a single exception, are from the Peoria loess. Molluscs were recovered from the Farmdale loess at one locality. Thirty-two species representing 12 families are covered by the study. Twenty-eight of these species are land gastropods. Of the remaining four, three are semiaquatic and one true aquatic. The general paleoenvironment is considered to have been a moist situation inhabited by species living in marsh and flood plain regions close to bodies of water. The area was forested or forest bordered and the climate was cool.

INTRODUCTION

A pre-convention Pleistocene field trip was conducted in conjunction with the annual meeting of the Geological Society of America in Cincinnati, Ohio, in 1961. At this time, Dr. Aurele La Rocque, paleontologist on the staff of Ohio State University at Columbus, Ohio, suggested that interested individuals undertake the study of Pleistocene molluscs in the various states where they are to be found. A contribution would thus be made to the general knowledge and distribution of the faunas.

Some time later and after several reconnaissance trips, the senior author decided to undertake this study for Kentucky. Mrs. Pamela Bruder of Anchorage, Kentucky, joined the project as co-worker.

ACKNOWLEDGMENTS

The authors wish to express their great appreciation to Dr. William J. Wayne, glacial geologist with the Geological Survey, Indiana Department of Conservation, Bloomington, Indiana. Dr. Wayne visited the collecting sites and reviewed the preliminary draft of this manuscript. His help and guidance concerning specific problems were invaluable. Mrs. Virginia Schott, of Louisville, Kentucky, gave generously of her time in assisting with the collection of the material.

The photographs were made by Mr. Charles Stone of Lexington, Kentucky.

PROCESSING OF MATERIAL

The following procedure was adopted for the collecting and processing of the material: The site was cleared and shoveled to

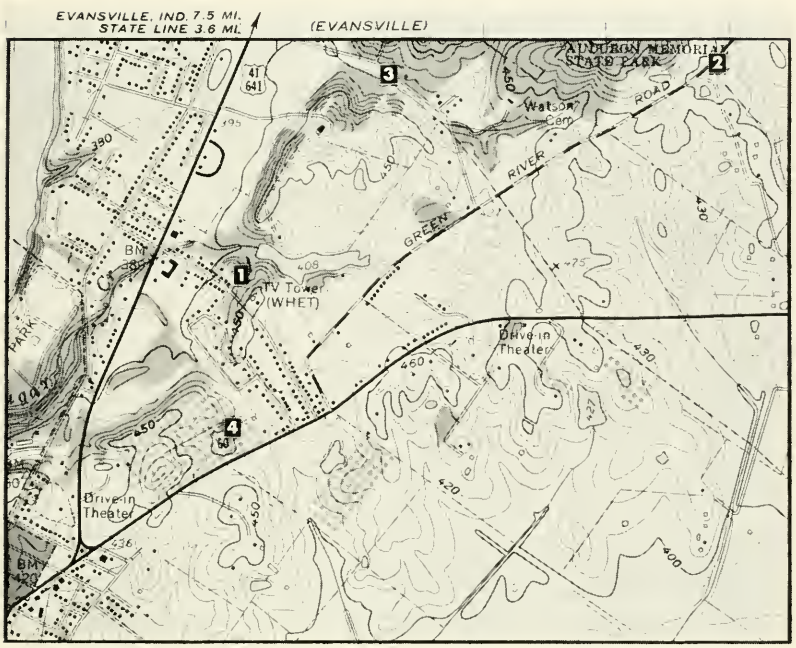
present a fresh exposure. Samples were then taken stratigraphically in one-foot collecting intervals with approximately five pounds of material taken from each interval.

To process the samples the silt was placed in jars covered with water to which baking soda had been added to help separate the specimens from the matrix. Jars were left standing a minimum of 12 hours and sample was agitated in the interim to help disintegrate it. The samples were then washed gently through a 25-mesh sieve and the residue was thoroughly dried. Specimens were then boiled a few minutes in a low-sudsing detergent to clean them. Identification was made with a Bausch and Lomb stereozoom microscope.

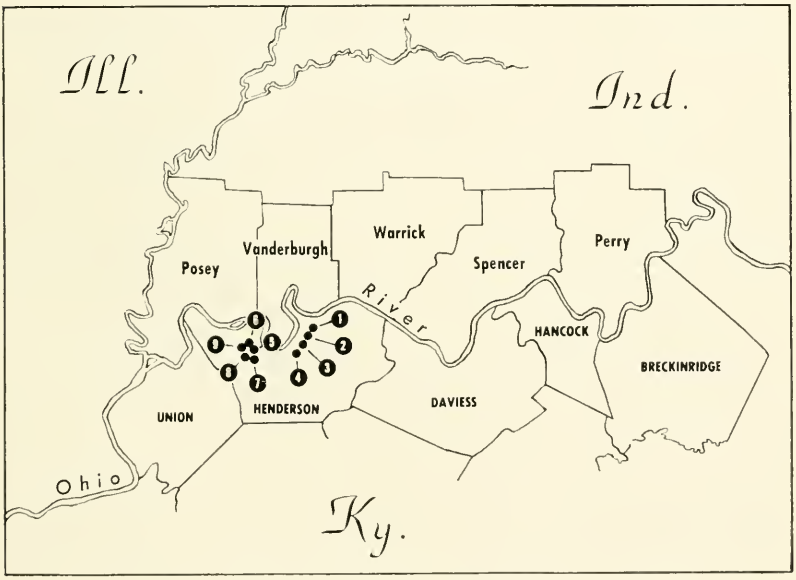
LOCATION OF SITES

All nine localities covered by this study are located on either the Henderson or the Smith Mills 7-1/2 minute topographic quadrangles published by the United States Department of the Interior, Geological Survey. Five of the sites are on the Henderson Quadrangle and four on the Smith Mills. Maps (Text-figs. 1, 2, 3) show localities.

Text-fig. 1. Parts of Smith Mills and Wilson 7.5′ quadrangles showing localities 5-9



Text-fig. 2. Part of Henderson 7.5′ quadrangle showing localities 1-4



Text-fig. 3. Collecting Localities

STRATIGRAPHIC DESCRIPTION OF SITES

GENERAL STATEMENT

The authors have adopted Wayne's (1963) terminology in applying formation names to the Pleistocene deposits described below.

Munsell[1] color notations are given; all color determinations were taken under laboratory conditions with moist samples unless otherwise specified.

SECTION 1

Atherton Formation:	Thickness ft	in
Peoria Loess Member:		
4. Silt: Medium yellow brown (10 yr 5/6), noncalcareous	2	
3. Silt: Medium yellow brown (10 yr 5/6), dunal, calcareous, powdery, nonfossiliferous	13	
2. Covered unit: probably silt	14	
1. Silt: Very pale brown (10 yr 7/4, field; 10 yr 5/5, lab), calcareous, compact, powdery, sparsely fossiliferous; contains irregularly shaped calcareous concretions	2	
Total Peoria	31	

SECTION 2(a)

Basement excavation for house, approximately 250 yards west from section 2b

Atherton Formation:	Thickness ft	in
Peoria Loess Member:		
4. Silt: Medium yellow brown (10 yr 5/6), mottled with dark brown (7.5 yr 4/4), weathered, clayey, noncalcareous	2	6
3. Silt: Very dark brown (10 yr 2/2), peaty, noncalcareous	1	

[1]Munsell Soil Color Chart distributed by Geological Society of America, Boulder, Colorado.

2. Silt: Pale yellow brown (10 yr 5/4), powdery, noncalcareous, nonfossiliferous, gradational with underlying clay silt; zone of banded iron oxide is present about 1-1/2 feet below overlying soil horizon 3
1. Silt: Yellowish gray (5 y 7/2), clayey, (aquatic?), mottled with medium yellow brown (10 yr 5/6), calcareous, fossiliferous, contains concretions of Mg and Fe ..... 2± 6
Total Peoria ..... 9±

SECTION 2(b)

Atherton Formation:	Thickness	
Peoria Loess Member:	ft	in
4. Silt: Medium yellow brown (10 yr 5/6), noncalcareous, contains humus in top 11-12 inches	3±	
3. Silt: Medium yellow brown (10 yr 5/6), dunal, calcareous, powdery, contains few fossils, mostly broken or fragments	10	6
*2. Silt: Yellowish gray (5 y 7/2) clayey, noncalcareous, nonfossiliferous		
*1. Silt: Yellowish gray (5 y 7/2), clayey, calcareous, mottled wtih iron staining medium yellow brown (10 yr 5/6), fossiliferous; contains concretions of Mg and Fe	2±	6
Total Peoria	20	

SECTION 3

Atherton Formation:	Thickness	
Peoria Loess Member:	ft	in
1. Silt: Dark yellowish brown (10 yr 4/4), noncalcareous, compact	5	
3. Silt: Dark yellowish brown (10 yr 4/4), noncalcareous, compact, transitional zone	1	

*Units 1 and 2 are considered to be the same, the former being aquatic. (See Text-fig. 4.)

2. Silt: Light yellowish brown (10 yr 5/5), calcareous, compact, powdery, fossiliferous; contains small calcareous platy concretions 13
1. Silt: Light brownish yellow (10 yr 6/6), mottled with yellowish gray (5 y 7/2), clayey, calcareous, compact, fossiliferous; contains large calcareous concretions measuring one foot in length and 5-6 inches in diameter, nodular to antler-like in shape .....
Total Peoria 29

Colluvium in gully is dark yellow brown (10 yr 4/4).

SECTION 4

Atherton Formation:	Thickness ft	in
Peoria Loess Member:		
7. Silt: Dark yellowish brown (10 yr 4/4), clayey, noncalcareous	2 (?)	
6. Silt: Light yellow brown (10 yr 5/5), calcareous, fossiliferous	14+ (est.)	
Farmdale (?) Loess Member:		
5. Silt: Medium olive gray (5 y 6/2), noncalcareous, powdery, nonfossiliferous	1	
4. Silt: Medium yellow brown (10 yr 5/6), last inch at top becoming gray, calcareous, fossiliferous; contains few Mg and Fe concretions	2	
3. Silt: Light yellow brown (10 yr 5/5), mottled with medium yellow brown (10 yr 5/6), calcareous, powdery, fossiliferous; contains Mg and Fe concretions	4	
2. Clay: Yellowish gray (5 y 6/2), mottled with pale yellowish brown (10 yr 5/4), calcareous, massive and compactly bedded; contains sparse wood fragments	6	
1. Clay: Gray (10 yr 5/1), mottled with dark grayish brown, calcareous, nonfossiliferous except for fragments of fossil wood which are common	3	6
Total Peoria and Farmdale (?)	27	

SECTION 5

UPPER PART

Atherton Formation:	Thickness
Peoria Loess Member:	ft in
3. Soil: Dark, contains humus	3
2. Silt: Transitional with overlying soil zone, light yellowish brown (10 yr 5/4), leached, nonfossiliferous	6
1. Silt: Light yellowish brown, (10 yr 5/4), unleached, powdery, compact, sparsely fossiliferous	4
Total Peoria exposed	13

This part of section was augered to a depth of 8 feet below the exposed section (see illustration). The silt seemed finer at depth. The relationship of this upper part of section 5 to the lower part is undermined. There are no diagnostic horizons and a very sparse fauna.

LOWER PART

Atherton Formation:	Thickness
Peoria Loess Member:	ft in
3. Silt: Light yellowish brown, (10 yr 5/4), powdery, compact, sparsely fossiliferous	5
2. Silt: Light yellowish brown (10 yr 5/4), unleached, compact, fossiliferous, lower half mottled with grayish clay areas, contains calcareous concretions in top 5 to 6 feet of unit	10
Total Peoria exposed	15

This part of section was augered to a depth of four feet below exposed silt (see illustration). The augered material is a brownish yellow (10 yr 6/6) water laid silt, fossiliferous and containing some concretions.

Estimated loess unexposed is 7 feet.

Road gravel and concretions prevented augering to a depth that might have encountered definative horizons at this section. Since the loess blanket at section 7 is known to be 32 to 33 feet deep, the estimated thickness for this section is postulated on this

basis. The top of the concretionary band appears to correspond with that in section 7 as does the faunal change showing a decline in numbers of woodland species.

SECTION 6

Atherton Formation:	Thickness
Peoria Loess Member:	ft in
3. Soil	1
2. Silt: Light yellowish brown (10 yr 5/4), unleached, powdery, fossils less numerous than in unit 1, contains a few platy and spinose calcareous concretions	8
1. Silt: Light yellowish brown (10 yr 5/4) unleached, clayey, compact, fossiliferous, contains botryoidal, platy and spinose calcareous concretions in top 6 feet of unit	14
Total Peoria exposed	23 (?)
Estimated loess unexposed	10±

The estimated thickness of loess at this section is arrived at on the same basis as at section 5. Although the concretionary zone extends to the top of the section, the same faunal change as is noted in sections 5 and 7 is present at the approximate horizon (collecting interval 16) and the loess changes from a clayey silt.

Augering of this site was not possible and no visible contacts were present to determine the slope of the loess blanket. Thus, the exposed thickness is inaccurate to the extent the blanket varies from the horizontal.

SECTION 7

Atherton Formation:	Thickness
Peoria Loess Member:	ft in
5. Soil:	±1
4. Silt: Medium yellow brown (10 yr 5/4) lab, pale yellow brown (10 y 7/5), field, unleached, strongly effervesces with HCl, (dunal silt), less compact than unit 3, fossils less numerous than unit 3	10

3. Silt: Light yellowish brown (10 yr 5/4) lab, unleached, powdery compact, fossiliferous, contains calcareous concretions in top 4 feet of unit and iron concretions in basal part 19

Total Peoria 30

Farmdale (?) Loess Member:

2. Silt: Brown (10 yr 5/3), leached, nonfossiliferous 3

Total Farmdale (?) 3

Sangamon soil:

1. Silt: Strong brown (7.5 yr 5/6), leached, unfossiliferous, weathered surface on Loveland Loess

SECTION 8

Atherton Formation:	Thickness ft	in
Peoria Loess Member:		
2. Silt: Medium yellow brown (10 yr 5/6), clayey, noncalcareous	3±	
1. Silt: Light yellowish brown (10 yr 5/5), calcareous, powdery, fossiliferous; large calcareous concretions (measuring 5 inches in diameter) present in 3-4-foot interval	10±	
Total Peoria	13±	

SECTION 9

Atherton Formation:	Thickness ft	in
Peoria Loess Member:		
4. Silt: Moderate yellow brown (10 yr 5/7), noncalcareous, nonfossiliferous	1±	
3. Silt: Moderate yellow brown (10 yr 5/7), dunal, calcareous, powdery, nonfossiliferous	8	
2. Silt: Light yellow brown (10 yr 5/5), mottled with moderate yellow brown iron stain (10 yr 5/7), calcareous, compact, powdery; contains botryoidal calcareous concretions and small concretions of Fe	5	
1. Silt: Mixed with soil, slumped and partially covered — upper slope		

Silt: Pale yellow brown (10 yr 5/4), mottled with moderate yellow brown iron stain (10 yr 5/7) clayey, calcareous, fossiliferous — lower slope	12
Total Peoria exposed	26

DISCUSSION OF ECOLOGY

Of 32 species covered by this study, 12 comprise five percent or more of the nine study sites. These 12 species are *Discus cronkhitei*, *Punctum minutissimum*, *Strobilops labyrinthica*, *Helicodiscus parallelus*, *Vertigo gouldi*, *Vertigo hubrichti*, *Vertigo modesta*, *Vallonia albula*, *Carychium exile canadense*, *Gastrocopta armifera*, *Succinea grosvenori*, and *Succinea gelida* (both of the latter two being "form" species).

The remaining species, which occur in lesser amounts than five percent, are *Hendersonia occulta*, *Hawaiia minuscula*, *Zonitoides arboreus*, *Stenotrema leai*, *Stenotrema barbatum*, *Discus cronkhitei catskillensis*, *Euconulus fulvus*, *Nesovitrea binneyana*, *Retinella indentata*, *Columella alticola*, *Gastrocopta tappaniana*, *Gastrocopta contracta*, *Anguispira alternata*, *Mesodon elevatus*, *Triodopsis multilineata*, *Haplotrema concavum*, *Deroceras laeve*, *Pomatiopsis lapidaria*, *Fossaria dalli*, and *Fossaria obrussa decampi*.

All of the species in the fauna are extant with the exception of *Vertigo hubrichti*. Of the extant species all may be found living in the Canadian life zone. Five of the six species not living in Kentucky are now restricted to regions of cooler climate. The species are *Nesovitrea binneyana*, *Vallonia albula*, *Columella alticola*, *Carychium exile canadense*, and *Succinea gelida* (see Wayne 1959, p. 93; 1963, p. 137).

The dominant species of the fauna inhabit flood plain, marsh or woodland environment. The presence of large woodland forms such as *Anguispira*, *Triodopsis*, *Mesodon*, and *Haplotrema* would indicate that woodlands must have been more extensive than woodland borders. The single locality where none of the larger snails was found is one where only three species were recovered. (Text-fig. 5.)

Four aquatic species were recovered from the fauna. Of these only one, *Fossaria obrussa decampi*, might be considered wholly aquatic.

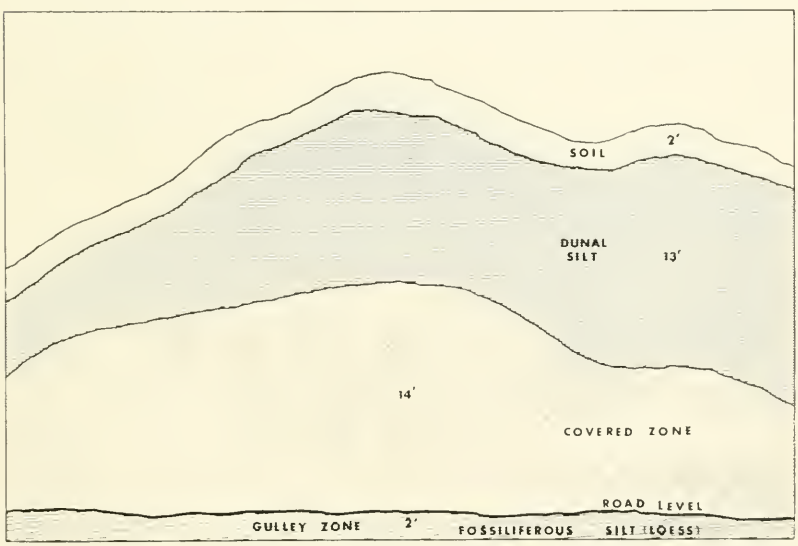
In summary, the general paleoenvironment was a moist situation inhabited by species living in marsh and flood plain regions close to bodies of water. The area was forested and the climate was cool, probably not unlike that of southern Canada today where the species, with the single exception above noted are living.

LOCALITY 1

Only three species were recovered from this site and two of these in small numbers. Hence, the fauna may not be representative. *Discus cronkhitei* is present, a species which thrives in rather wet areas, close to running water. *Succinea gelida,* the only species occurring in large numbers, indicates a moist habitat with cool climate. The country was probably fairly open.

SPECIES	FOOT INTERVAL 1	FOOT INTERVAL 2	NO OF INDIV	% OF TOTAL INDIV.	GRAPHIC REPRESENTATION OF PERCENTAGE OF SPECIES IN FAUNA (20 40 60 80)
Discus sp (broken)	1	0	1	1.01	
% of indiv.	100				
Succinea gelida (Boker)	6	90	96	96.96	
% of indiv	6	94			
Vallonia albula Sterki	1	1	2	2.02	
% of indiv	50	50			
TOTAL			99		

LOCALITY 1

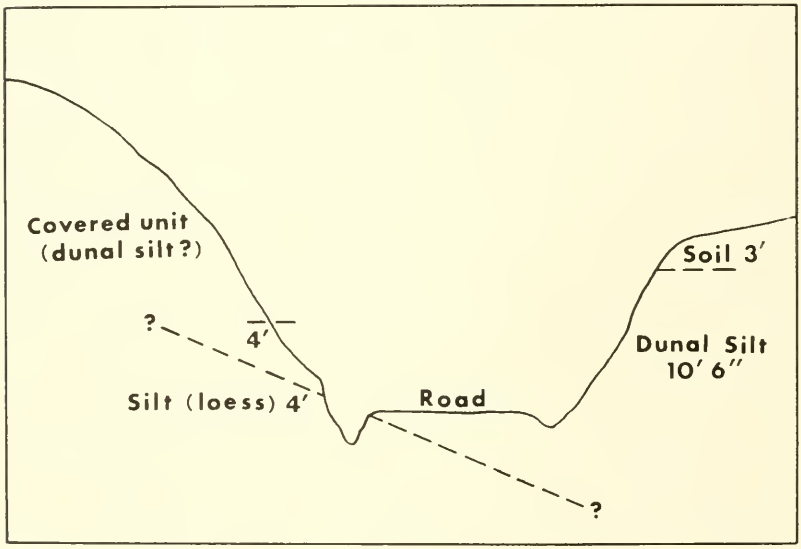


NE Locality 1 SW

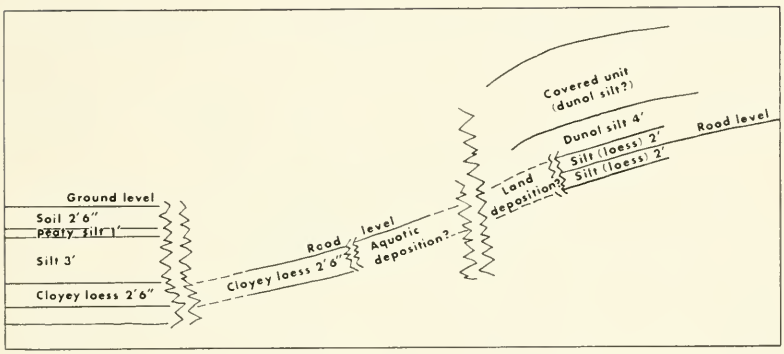
LOCALITY 2

A yellowish gray "clay-like" fossiliferous loess occurs, at the base of a hill, in a two-foot ditch which parallels Green River Road. The species recovered here inhabit a moist, open woodland environment. The presence of *Carychium exile canadense* and *Euconulus fulvus* which live in the Canadian life zone (Leonard and Frye, 1960, p. 20) indicates a cooler climate than exists in the area today.

The dunal silt, which is present at the top of the hill, contained only a few broken molluscs. This is typical of dunal silts which accumulate rapidly. *Hendersonia occulta, Discus cronkhitei,* and *Succinea* sp. were recovered, all from the same level. These are all species which occur in moist woodlands or woodland borders. Besides the molluscs, two calcified pupae were found in the dunal silt.



NW Locality 2 — Green River Road SE
Cross section at top of hill



SW a b c NE
basement excavation base of hill top of hill
Locality 2

LOCALITY 3

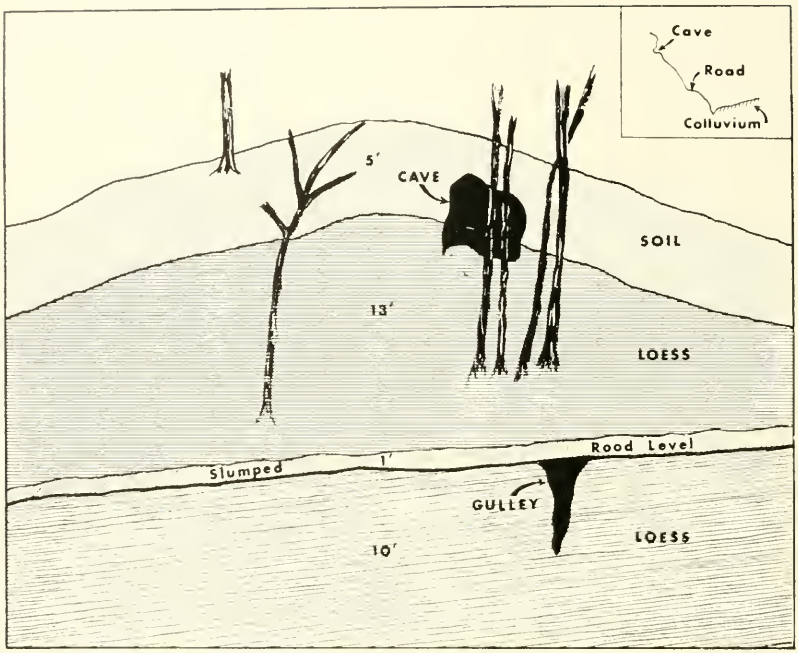
The gully section or basal part (intervals one to five feet) at this locality differs from the upper part (13 to 22 feet) of the section.

In the basal part of the section the dominance of the listed woodland species and the presence of *Anguispira alternata* and *Discus cronkhitei* implies a humid, forested or forest-bordered situation. The decrease of *Succinea* upward and the presence of *Deroceras laeve* only in the first foot interval suggests a decrease in moisture. The presence of *Euconulus fulvus* and *Vertigo modesta* indicates a cooler climate than exists in the area today.

In the upper part of the section, the small percentage of woodland species and the absence of *Anguispira alternata* implies more open country than existed in the basal part of the section. The area was still cool since *Vertigo modesta* still persisted. It was, however, drier than the gully section. *Succinea grosvenori* and *Deroceras laeve* had disappeared.

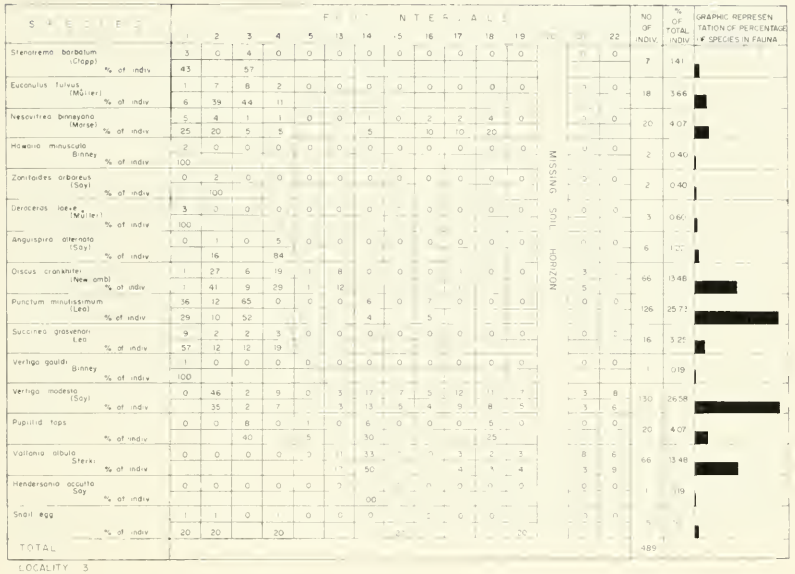
LOCALITY 4

Sampling before Locality 4 (Henderson Bypass) was destroyed by construction of the bypass showed the following species to be present in the powdery calcareous loess overlying the basal clay at the base of the section — *Hendersonia occulta, Vertigo gouldi, Fossaria dalli, Carychium exile canadense,* and *Deroceras laeve.* These species are all indicative of a moist habitat. The basal clay contained no molluscs but an abundance of fossil wood was retrieved.



W Locality 3 E

The uppermost loess stratigraphically is a light yellow brown calcareous, fossiliferous silt. Slump prevented accurate measurement of its thickness, but it was estimated to be about 14 feet. This silt is shown in Text-figure 6 as the light material above the vertical part of the section, the darker portion of the picture. The line of demarcation is clearly visible. Many specimens of *Anguispira alternata* were recovered from the base of this silt. Other species, found in abundance in the silt, were *Punctum minutissimum, Vertigo modesta, Vertigo hubrichti, Discus cronkhitei,* and *Succinea gelida.* The ecological requirements of these species implies forest bordered woodlands. The presence of the larger snails (*Anguispira, Mesodon,* and *Haplotrema*) at the base of this unit is indicative of true woodlands. The climate was cool; (*Vertigo modesta* and



SPECIES	FOOT INTERVAL 1	2	3	4	5	13	14	15	16	17	18	19	22	NO OF INDIV.	% OF TOTAL INDIV.	GRAPHIC REPRESENTATION OF PERCENTAGE OF SPECIES IN FAUNA
Stenotrema barbatum (Clapp)	3	0	4	0	0	0	0	0	0	0	0	0	0	7	1.41	
% of indiv.	43		57													
Euconulus fulvus (Müller)	1	7	8	2	0	0	0	0	0	0	0	0	0	18	3.66	
% of indiv.	6	39	44	11												
Nesovitrea binneyana (Morse)	5	4	1	1	0	0	1	0	2	2	4	0	0	20	4.07	
% of indiv.	25	20	5	5			5		10	10	20					
Hawaiia minuscula Binney	2	0	0	0	0	0	0	0	0	0	0	0	0	2	0.40	
% of indiv.	100															
Zonitoides arboreus (Say)	0	2	0	0	0	0	0	0	0	0	0	0	0	2	0.40	
% of indiv.		100														
Deroceras laeve (Müller)	3	0	0	0	0	0	0	0	0	0	0	0	0	3	0.60	
% of indiv.	100															
Anguispira alternata (Say)	0	1	0	5	0	0	0	0	0	0	0	0	0	6	1.22	
% of indiv.		16		84												
Discus cronkhitei (New comb)	1	27	6	19	1	8	0	0	0	1	0	0	3	66	13.48	
% of indiv.	1	41	9	29	1	12				1			5			
Punctum minutissimum (Lea)	36	12	65	0	0	0	6	0	7	0	0	0	0	126	25.73	
% of indiv.	29	10	52				4		5							
Succinea grosvenori Lea	9	2	2	3	0	0	0	0	0	0	0	0	0	16	3.25	
% of indiv.	57	12	12	19												
Vertigo gouldi Binney	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0.19	
% of indiv.	100															
Vertigo modesta (Say)	0	46	2	9	0	3	17	7	5	12	11	7	3	130	26.58	
% of indiv.		35	2	7		3	13	5	4	9	8	5	3			
Pupillid tops	0	0	8	0	1	0	6	0	0	0	5	0	0	20	4.07	
% of indiv.			40		5		30				25					
Vallonia albula Sterki	0	0	0	0	0	11	33			3	2	3	8	66	13.48	
% of indiv.						17	50			4	3	4	9			
Hendersonia occulta Say	0	0	0	0	0	1				0	0	0	0	1	.19	
% of indiv.							00									
Snail egg	1	1	0	1	0	0	0			0	0		0	3		
% of indiv.	20	20		20												
TOTAL														489		

MISSING SOIL HORIZON

LOCALITY 3

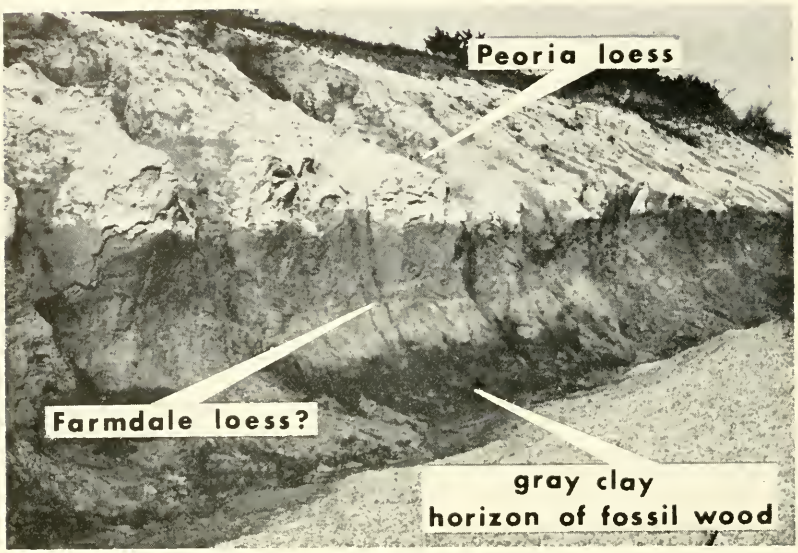
Vallonia albula present.) Although all the above listed require a moist habitat it is likely that this period was drier than that represented by the basal part of the section. *Fossaria dalli, Deroceras laeve,* and *Vertigo gouldi* had disappeared.

LOCALITY 5

The ecology of the visible section seems identical to that of sections 6 and 7. Except for a single specimen of *Strobilops labyrinthica* and *Hawaiia minuscula* in section 7, the faunas of all three are the same.

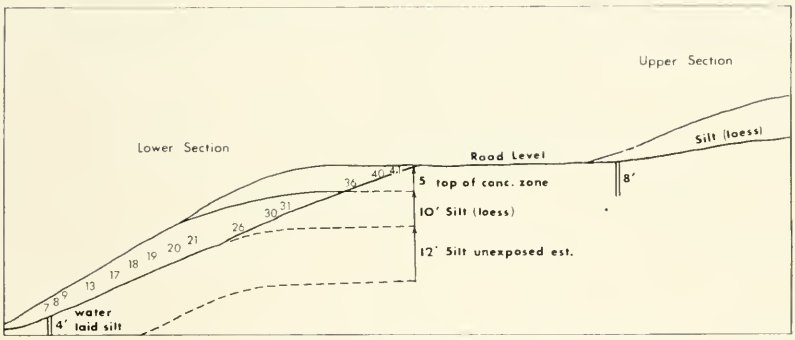
The climate was moist and cool with woodlands prevailing during the deposition of the lower part of the loess. A less favorable environment for survival seems indicated by the upper part of the section. Beyond the 36 collecting interval, fossils are fewer and the woodland forms, *Euconulus fulvus* and *Punctum minutissimum* drop off sharply in numbers.

From the four feet of water-laid silt augered at base of section only three molluscs of two species were recovered, *Hendersonia occulta* and *Nesovitrea binneyana.* Both thrive in a damp environment.



E Locality 4 W

LOCALITY 5



SE Locality 5 NW

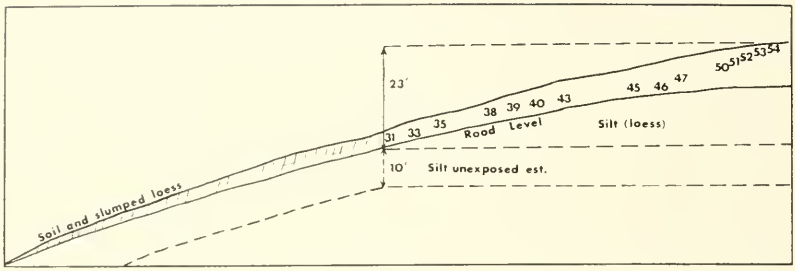
LOCALITY 6

The climate throughout the period of deposition of loess in this section was moist and cool. *Discus cronkhitei catskillensis* and *Hendersonia occulta,* species which thrive in damp environments, are present. *Vertigo modesta, Vallonia albula,* and *Euconulus fulvus* are all indicative of a cool climate. The latter species and *Punctum minutissimum,* present in large numbers in the lower two-thirds of the section, imply a hardwood cover. *Anguispira alternata,* the large woodland snail, is restricted in number collected, but the recovered specimens, with one exception, are all from the lower part of the section. The upper part of the section, beyond the 46 collecting interval, shows a marked decline in the woodland species as the area became more open.

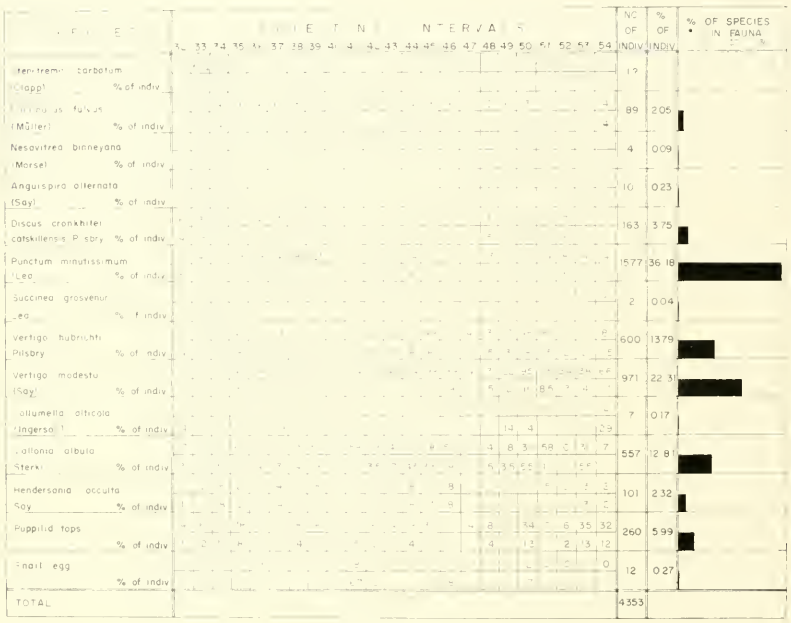
LOCALITY 7

The visible section shows two types of silt, such as are found at some of the other localities. The lower silt, 22 feet thick, is compact and quite fossiliferous. The upper, a dunal silt, is less compact, less fossiliferous and somewhat deeper in color (Text-fig. 7).

The fauna from the lower silt is dominated by species which inhabit a woodland environment. Woodlands were probably represented by hardwood forests or forest borders because *Anguispira alternata* is present. The environment was moist and probably close to water. The general absence from the section of the semiaquatics



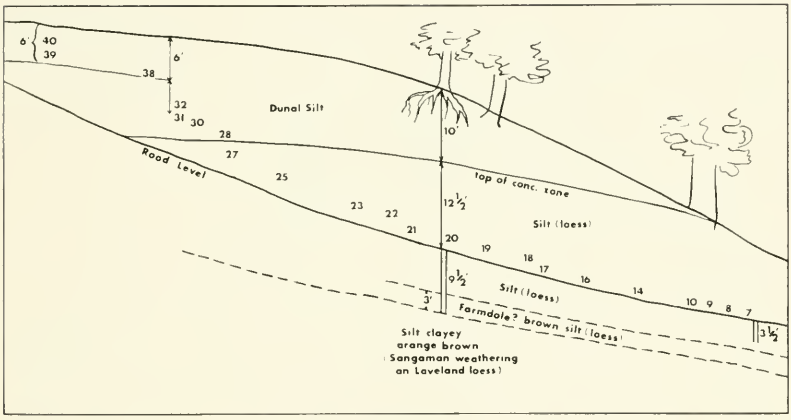
W Locality 6 E



LOCALITY 6

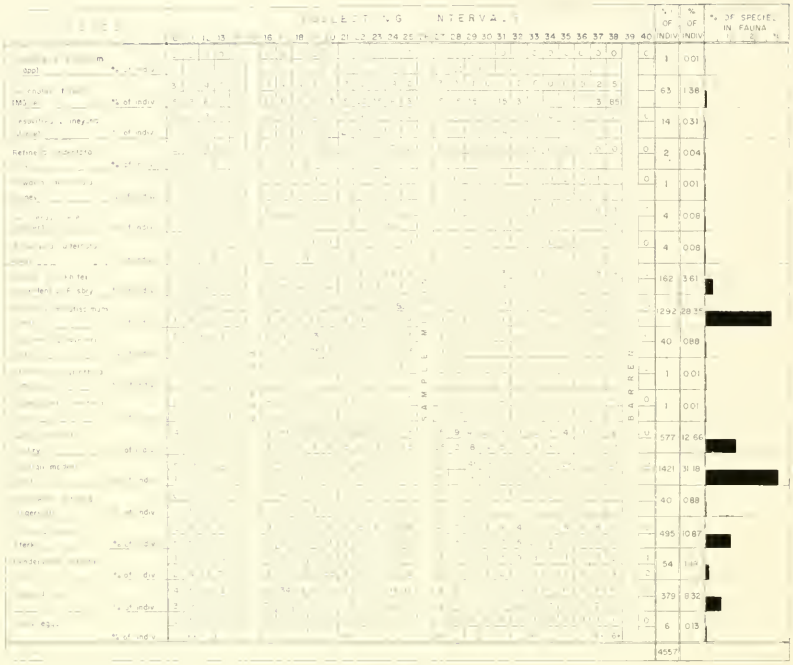
or species which thrive in a marsh situation leads to the belief that this locality, like localities 5 and 6, was somewhat drier than others covered by this study.

Optimum ecological conditions did not prevail during the deposition of the 13 through 15 collecting intervals because few specimens were recovered from this part of the section.



SW Locality 7 NE

SW Locality 7 NE

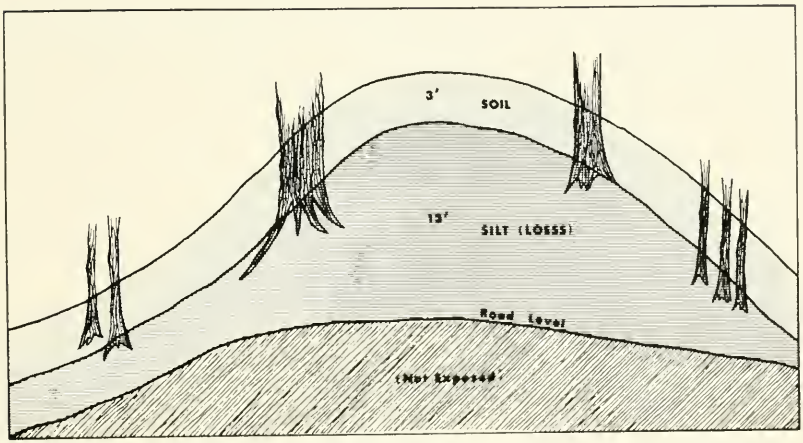


Considerably fewer numbers of specimens were found in the upper part of the section. The habitat was, apparently, less favorable for survival. Perhaps this silt accumulated at a greater rate than the underlying silt which is finer and more compact.

The area was probably more open but still moist and cool when the dunal silt was deposited. *Anguispira alternata* had disappeared from the section as had *Nesovitrea binneyana*. *Columella alticola*, a species restricted to areas of cool temperature and humid climate, is also absent from the silt in the upper part of the section.

LOCALITY 8

The dominance, in the fauna of species indigenous to woodlands, shows that the area was wooded. The woods were, no doubt, hardwoods since *Punctum minutissimum* has a preference for beech and *Helicodiscus parallelus* is frequently found in stands of oak



SW Locality 8 NE

and hickory. Intervals six through ten feet have the largest number of species. The habitat was moist throughout the entire time with *Deroceras laeve* and *Vertigo gouldi* generally present. *Fossaria obrussa decampi,* a species which inhabits shallow-standing bodies of water, was recovered only from the four- and five-foot intervals. This indicates the basal part of the section was probably the wettest. *Pomatiopsis lapidaria,* an amphibious species with a habitat preference close to water, was found only in the nine-foot interval.

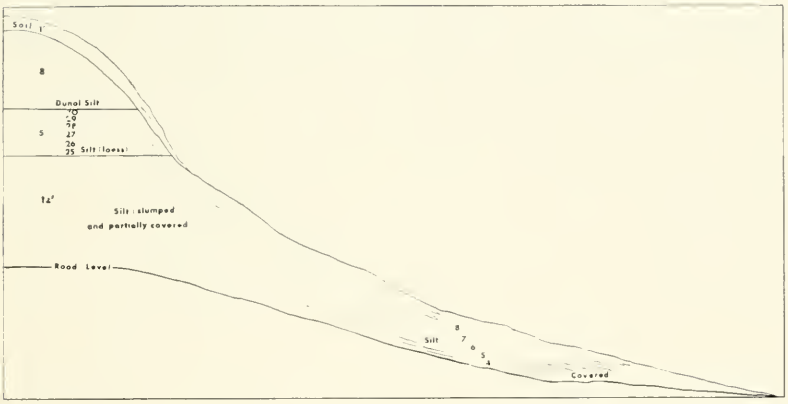
LOCALITY 9

Triodopsis multilineata is present throughout this entire section. This is a species which lives today in humid forests or forest borders. In Illinois, Baker (1939, p. 51) recorded it from a variety of hardwood forests — oak, hickory, box, elder, tamarack, maple, and cottonwood. The remainder of the fauna is, typically, one which inhabits woodland or marsh environments.

Carychium exile canadense, Deroceras laeve, and *Vertigo gouldi* all require a damp habitat. The fact that all these species increase upward in the section suggests that the environment became, increasingly, more moist and wet. In the upper part of the section (intervals 25 to 30 feet), the presence of *Fossaria obrussa decampi* indicates the existence of a shallow-standing water.

SPECIES	FOOT INTERVAL 1	2	3	4	5	6	7	8	9	NO OF INDIV	% OF TOTAL INDIV	GRAPHIC REPRESENTATION OF PERCENTAGE OF SPECIES IN FAUNA
Stenotrema barbatum (Clapp)	0	0	0	1	0	1	0	1	1	4	0.35	
% of indiv				25		25		25	25			
Stenotrema leai (Binney)	5	0	0	0	2	0	0	0	0	7	0.60	
% of indiv	71				29							
Haplotrema concavo (Say)	1	0	0	0	0	0	2	1	1	5	0.43	
% of indiv	20						40	20	20			
Euconulus fulvus (Müller)	14	6	6	7	10	4	5	1	5	58	5.01	
% of indiv	24	10	10	12	17	7	9	2	9			
Nesovitrea binneyana (Morse)	9	8	1	1	15	1	4	1	2	42	3.63	
% of indiv	22	19	2	2	36	2	10	2	5			
Hawaiia minuscula Binney	0	0	0	0	0	11	5	1	3	20	1.73	
% of indiv						55	25	5	15			
Zonitoides arboreus (Say)	0	0	1	0	0	0	0	0	0	1	0.09	
% of indiv			100									
Deroceras laeve (Müller)	0	2	0	5	7	3	3	3	4	27	2.33	
% of indiv		7		19	26	11	11	11	15			
Helicodiscus parallelus (Say)	0	0	0	0	1	0	44	15	1	61	5.27	
% of indiv					2		72	24	2			
Punctum minutissimum (Lea)	2	1	69	31	5	50	18	16	5	197	17.03	
% of indiv	1	5	35	16	3	25	9	8	3			
Succinea gelida (Baker)	22	20	17	38	52	34	11	60	16	270	23.34	
% of indiv	8	7	6	14	19	13	4	23	6			
Strobilops labyrinthica (Say)	30	0	7	35	58	8	26	14	1	179	15.48	
% of indiv	16		4	20	32	4	15	8	1			
Gastrocopta armifera (Say)	1	6	0	33	1	1	44	67	18	171	14.77	
% of indiv	1	4		19	1	1	25	39	10			
Vertigo gouldi Binney	0	5	1	7	6	13	7	3	0	42	3.63	
% of indiv		12	2	17	14	31	17	7				
Pomatiopsis lapidaria (Say)	0	0	0	0	0	5	0	0	0	5	0.43	
% of indiv						100						
Fossaria obrussa decompi Streng	1	66	0	0	0	0	0	0	0	67	5.79	
% of indiv	1	99										
Snail egg	1	0	0	0	0	0	0	0	0	1	0.09	
% of indiv	100											
TOTAL										1157		

LOCALITY 8



SE Locality 9 NW

Columella alticola, a species which is intolerant of high temperatures, was recovered only from the upper part of the section (intervals 25 to 30 feet). Thus, the climate probably became cooler. This seems to be borne out by the increase in numbers of *Euconulus fulvus*, another species which thrives in the cooler areas of the north.

SYSTEMATIC PALEONTOLOGY

GENERAL STATEMENT

In the description of species which follows data records for both the ecology (habitat) and distribution of the individual species are a compilation of information assembled from articles by various authors.

Data for distribution records were compiled from the following articles: Archer 1948, Baker 1928, Branson, Taylor, and Taylor 1962, Cheatum and Allen 1965, Conkin and Conkin 1962, Getz and Hibbard 1965, Hibbard and Taylor 1960, Hubricht 1961, 1962, 1964, 1965, La Rocque 1963, Leonard 1950, 1952, Leonard and Frye 1960, 1962, Pilsbry 1940, 1946, 1948, Roscoe 1961, 1963, Roy 1962, 1963, 1964, Taylor 1960 and Tuthill, Laird, and Frye 1964.

Pilsbry 1940, 1946, and 1948 was the principal source for recent distribution records on the terrestrial molluscs and Baker (1928) for recent distribution records on the aquatic molluscs.

SPECIES	COLLECTING INTERVAL 4	5	6	7	8	25	26	27	28	29	30	NO. OF INDIV	% OF TOTAL INDIV	GRAPHIC REPRESENTATION OF PERCENTAGE OF SPECIES IN FAUNA (5 10 15 20)
Stenotrema barbatum (Clapp)	2	5	1	3	1	3	0	3	3	2	0	23	2.00	
% of indiv	9	22	4	13	4	13		13	13	9				
Triodopsis multilineata (Say)	0	0	0	1	0	0	1	0	0	1	0	3	0.26	
% of indiv				33			33			33				
Haplotrema concavo (Say)	0	1	0	1	0	1	1	0	1	0	0	5	0.44	
% of indiv		20		20		20	20		20					
Euconulus fulvus (Müller)	0	0	0	2	1	2	7	17	9	5	5	48	4.20	
% of indiv				4	2	4	15	36	19	10	10			
Nesovitrea binneyana (Morse)	8	3	2	3	3	3	1	5	9	3	4	44	3.82	
% of indiv	18	7	5	7	7	7	2	11	20	7	9			
Retinella indentata (Say)	1	0	0	0	0	0	0	0	0	0	1	2	0.17	
% of indiv	50										50			
Hawaiia minuscula Binney	0	1	1	1	2	0	0	0	0	0	0	5	0.44	
% of indiv		20	20	20	40									
Deroceras laeve (Müller)	10	1	0	0	1	6	2	4	5	9	1	39	3.40	
% of indiv	26	3			3	15	5	10	13	22	3			
Discus cronkhitei (Newcomb)	0	0	0	1	0	0	1	0	0	0	0	2	0.17	
% of indiv				50			50							
Helicodiscus parallelus (Say)	8	6	2	0	0	0	0	0	0	0	0	16	1.40	
% of indiv	50	37	13											
Punctum minutissimum (Lea)	1	8	4	0	3	5	19	60	21	31	33	185	16.19	
% of indiv	1+	4	2		1+	3	10	32	11	17	18			
Succinea grosvenori Lea	0	0	0	0	0	1	0	0	2	0	10	13	1.13	
% of indiv						8			15		77			
Succinea gelida (Baker)	15	0	1	3	0	8	8	6	12	21	0	74	6.47	
% of indiv	20		1	4		11	11	8	16	29				
Strobilops labyrinthica (Say)	26	12	5	2	1	0	0	0	3	4	1	54	4.72	
% of indiv	48	22	9	4	2				6	7	2			
Gastrocopta contracta Say	0	3	0	0	0	0	0	0	0	0	0	3	0.26	
% of indiv		100												
Vertigo gouldi Binney	30	9	4	5	2	17	22	29	46	37	47	248	21.61	
% of indiv	12	4	1+	2	1	7	9	11	18	15	19			
Columella alticola (Ingersoll)	0	0	0	0	0	1	0	0	0	0	1	2	0.17	
% of indiv						50					50			
Corychium exile conadense Clapp	21	12	1	1	0	13	22	73	45	37	40	265	23.11	
% of indiv	7	4	1	1		5	8	28	17	14	15			
Hendersonia occulta Say	0	1	4	8	0	1	1	2	0	0	0	17	1.48	
% of indiv		6	23	47		6	6	12						
Fossaria obrussa decampi Streng	0	0	0	0	0	5	1	0	3	24	5	38	3.32	
% of indiv						13	3		8	63	13			
Pupillid tops	0	0	0	0	0	0	0	12	0	14	34	60	5.24	
% of indiv								20		23	57			
TOTAL													1145	

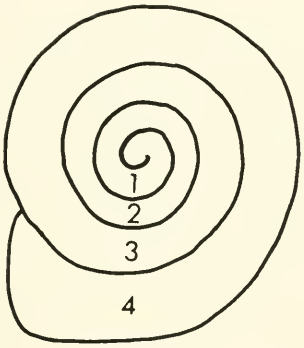
LOCALITY 9

Data for the ecology came from the following sources: Archer, 1948, Baker, 1928, 1935, Call, 1900, Clark, 1961, Franzen and Leonard, 1947, Leonard, 1950, Oughton, 1948, and Pilsbry, 1940, 1946, 1948.

The synonomy is selected. Original reference is given. Pilsbry's (1940, 1946, 1948) citations are listed for the terrestrial forms and Baker (1928) is the source for the few aquatic forms. Those papers which record species' change are also listed.

Descriptions of species is based on ten or more specimens, except in the few instances noted where lesser numbers of specimens were available.

Because all authors have not counted the number of whorls in a uniform manner, the illustration given below indicates the manner in which the authors counted the whorls.



The type specimens are deposited in the Paleontological Research Institution at Ithaca, New York, Nos. 27576 - 27607.

PHYLUM MOLLUSCA
CLASS GASTROPODA
SUBCLASS PULMONATA
ORDER STYLOMMATOPHORA

Family **POLYGYRIDAE**

Genus **STENOTREMA** Rafinesque, 1819

Stenotrema barbatum Clapp Pl. 16, figs. 7-9

Stenotrema hirsutum (Say), Binney, 1878, Terr. Moll., 5, p. 296 (in part).

Polygyra (Stenotrema) barbatum Clapp, 1904, Nautilus, vol. 18, p. 85.
Stenotrema hirsutum barbatum Clapp, Pilsbry, 1940, Acad. Nat. Sci. Philadelphia, Monogr., No. 3, vol. 1, pt. 2, p. 665, figs. 412 b, c, e, 413.
Stenotrema barbatum Clapp, Archer, 1948, Geol. Sur. Alabama, Museum Pap. 28, p. 30, pl. 2, figs. 7, 8; pl. 6, fig. 6.

Description. — Shell depressed, spire low; color light tan, occasionally white; whorls 4½ - 5, increasing regularly in size, nuclear whorls smooth with radial striae; parietal tooth low, sinuous, directed slightly toward interdenticular sinus; tooth on peristome present but not prominent; basal peristome narrow and closely appressed on outer margin, inner margin with submedian notch bordered with raised edge; upper half of outer lip concave, reflected; interdenticular sinus shallow; buttress present.

Geologic range. — Yarmouth (?) to Recent.

Recent distribution. — Ranges from central Alabama northward through the Appalachian regions of Tennessee and Kentucky and throughout the central United States and southern Ontario, and as far as Iowa and eastern Kansas. In the Blue Ridge Province and mountainous regions it is lacking as far up as West Virginia, but from there it occurs northeast to Massachusetts and again southeast to coastal North Carolina.

Fossil distribution. —

Pleistocene — Wisconsin faunas — Kentucky: Fulton, Crittenden, Henderson and Jefferson Cos.[2]

Pleistocene — age unknown — Missouri: St. Charles, St. Louis, and Jefferson Cos. Illinois: Madison, St. Clair, Monroe, and Union Cos. Mississippi: Hinds, Warren, Jefferson, Adams, Wilkinson, De Soto, Tate, Tallahatchie, Grenada, Carroll, Yazoo, and Claiborne Cos. Louisiana: West Feliciana Parish. Indiana: Posey Co.

Pilsbry (1940, p. 665) mentioned Clark Co., Illinois, and Posey Co., Indiana, as places where the form described by Baker as *P. hirsuta yarmouthensis* has been found.

Because many forms identified as *S. hirsutum* (Say) are probably this species the fossil distribution record for *S. hirsutum* is given as follows:

Pleistocene — Illinoian faunas — Indiana: Monroe Co. Yarmouth faunas — Illinois: Clark Co. Wisconsin faunas — Ohio:

[2]Reported here by the authors.

Erie Co. Illinois: Fulton, Mason, Cass, Brown, Scott, Green, Jersey, Madison and Alexander Cos. Kentucky: Union Co.

Pleistocene — age unknown — Missouri: Boone, Callaway, and St. Louis Cos. Indiana: Posey Co.

Pilsbry (1940, p. 663) stated that *S. hirsutum* is found in the "loess of Indiana, Illinois, Iowa, Missouri and Mississippi."

Habitat. — Thrives in a variety of habitats from wet lowland woods to hills and bluffs bordering rivers and swampy areas. Lives in leaf debris under rocks and logs in hardwood cover. May also be found in open pastures under plant cover.

Remarks. — This is the small *Stenotrema,* common in the loess, which Baker (1927, p. 115) considered a "loess form" and described as *P. hirsuta yarmouthensis.* Unfortunately, this species was long considered either synonymous or, at least, a lowland form of *Stenotrema hirsutum* until Archer (1948, p. 30) pointed out the differences. Most probably, many forms recorded from the Pleistocene in Ohio, Indiana, and Iowa as *Stenotrema hirsutum* (Say) or *Polygyra hirsutum yarmouthensis* Baker are this species. Archer listed shell differences between *S. barbatum* and *S. hirsutum* as follows: *S. barbatum* possesses a buttress which is missing in *S. hirsutum.* The edge of the parietal callus of *S. barbatum* is sinuous instead of oblique as is that of *S. hirsutum.* The nuclear whorl of *S. barbatum* is smooth and striated, whereas it is granular in *S. hirsutum.* Differences in anatomy in Recent forms, as well as shell differences, separate the two species.

Occurrence. — Localities 2, 3, 4, 5, 6, 7, 8, 9.

Measurements of Stenotrema barbatum in m m.

Locality	Height	Width	H/W	Whorls
2	3.75	6.70	.56	4 1/2
2	4.10	6.70	.61	5
2	3.80	6.20	.61	4 3/4
4	4.50	8.10	.55	5
4	4.55	7.28	.63	5
4	4.12	6.55	.63	4 7/8
8	4.36	6.92	.63	4 3/4
9	4.40	7.40	.59	5 1/3
9	4.30	6.85	.62	4 7/8
9	3.80	6.10	.62	4 1/2

Stenotrema leai (Binney) Pl. 16, figs. 1-3

Helix leaii "Ward, Ms." A. Binney, 1840, Boston Jour. Nat. Hist., vol. 3, No. 3, p. 362.
Stenotrema monodon Pilsbry, 1940, Acad. Nat. Sci. Philadelphia, Monogr., No. 3, vol. 1, pt. 2, p. 676, figs. 421, a, b.
Stenotrema leai (Binney), Pilsbry, 1948, Acad. Nat. Sci. Philadelphia, Monogr., No. 3, vol. 2, pt. 2, p. 1099.

Description. — Shell subglobose with low spire; color light brown; whorls 5½-6, closely coiled, increasing regularly in size, first 1½ whorls smooth, remainder irregularly striate, final whorl with periphery above the middle, bluntly angular to rounded; sutures impressed; parietal tooth short, low, situated on a low callus, obliquely descending into aperture; inner part of outer peristome concave or dished; inner peristome reflected, partially covering a narrow deep umbilicus.

Geologic range. — Yarmouth to Recent.

Recent distribution. — Occurs mostly within the Central Lowland Province from southwestern Ontario and central Ohio, southward to the Arkansas and Cimarron Rivers, even as far as Colorado Springs, Colorado. The area where it intergrades with the subspecies *S. aliciae* extends from southern Illinois to Oklahoma.

Fossil distribution. —

Pleistocene — Kansan faunas — Texas: Knox and Baylor Cos. Illinoian (?) faunas — Oklahoma: Canadian and Caddo Cos. Yarmouth faunas — Kansas: Meade Co. Oklahoma: Beaver Co. Illinoian faunas — Kansas: Philips Co. Indiana: Monroe and Wayne Cos. Sangamon faunas — Kansas: Meade Co. Texas: Foard Co. Wisconsin faunas — Ohio: Erie, Butler and Warren (?), Madison and Cuyahoga Cos. Indiana: Johnson Co. Illinois: Carroll, Marshall, Fulton, Tazewell, Mason, Schuyler, Cass, Menard, Brown, Pike, Scott, Greene, Jersey, and Madison Cos. Oklahoma (Wisconsin or Illinoian?): Harper Co. Texas: Clay, Hardeman, and Delta Cos. Kentucky: Fulton, Henderson, Union, and Jefferson Cos.

C-14 dated records — Texas: Motley Co. 31,400± 5,600 years, Dallas County slightly more than 37,000 years B. P., Denton Co. 28,840 B. P.

Pleistocene — age unknown — Missouri: Boone, Callaway and St. Louis Cos. Illinois — Madison, St. Clair, Monroe, Bureau, Adams, and Clark Cos. Indiana: Posey Co.

Habitat. — Lives in marshes and wooded swamps, along the banks of streams, river flood plains and shores of lakes and in ravines adjacent to rivers. It is also present in tall grass prairies and open fields, all in lowland areas. *S. leai* is a gregarious species.

Remarks. — Kentucky is located where the southern limits of *S. leai* and the northern limits of the subspecies *S. leai aliciae* overlap. Both have been reported as fossils from the state by Browne and McDonald (1960, p. 175).

Leonard (1950, p. 36) stated, "*Stenotrema monodon* has been replaced in the Midcontinent region by *S. monodon aliciae* and *S. fraternum,* both of which live in a somewhat drier habitat. The former has been found in dense growths of grass in ravines in the High Plains region." Archer (1948, p. 56) gave a range in elevation from 100 feet to 750 feet for the species *S. leai aliciae,* noting that "it is most abundant in calcareous uplands." This is in contrast to *S. leai* which is a lowland species.

Occurrence. — Locality 8.

Measurement of Stenotrema leai in m m.

Locality	Height	Width	H/W	Whorls
8	3.90	6.80	.57	6
8	4.29	6.97	.62	5 5/8

Genus **MESODON** Rafinesque, 1821

Mesodon elevatus (Say) Pl. 16, figs. 10-12

Helix elevata Say, 1821, Acad. Nat. Sci. Philadelphia, Jour. 3, vol. 2, p. 154.
Mesodon elevatus (Say), Pilsbry, 1940, Acad. Nat. Sci. Philadelphia, Monogr., No. 3, vol. 1, pt. 2, p. 727, figs. 440a, 441.

Description. — Shell circular in outline, beehive-shaped with elevated spire; color yellowish white; whorls 6¾ (one specimen), increasing uniformly in size; nuclear whorls smooth, becoming rib striate after 1¾ revolutions; spiral striae visible on final whorl which descends to aperture; sutures impressed; aperture lunate-ovate; peristome white, broadly reflected with small swelling on basal part; strong, short, obliquely entering tooth on parietal wall; umbilicus closed.

Geologic range. — Wisconsin to Recent.

Recent distribution. — Eastern United States from New York south to Mississippi and Alabama and west to Missouri and Arkansas.

Fossil distribution. —

Pleistocene — Wisconsin faunas — Ohio: Hamilton, Warren (?), Butler (?), and Defiance Cos. Kentucky: Henderson Co.

Pleistocene — age unknown — Missouri: Moniteau, Boone, Callaway, St. Louis, and St. Charles Cos. Mississippi: Claiborne, Hinds, Jefferson, Adams, and Wilkinson Cos. Louisiana: West Feliciana Parish. Illinois: Madison and St. Clair Cos. Tennessee: Clay, Jackson, and Smith Co. Michigan: Berrien and Kent Cos. Alabama: Clark Co.

Habitat. — Forest snail. Found also in urban gardens and waste places.

Remarks. — A single specimen of this forest snail was recovered from the fauna. The shell conforms to living forms. This is the first record for this species, as a fossil, in Kentucky. However, the reported fossil occurrences seem, in general, to cover the same area where the species lives today. It has not been reported west of Arkansas and Missouri.

Occurrence. — Locality 4.

Measurement of Mesodon elevatus in m m.

Locality	Shell			Aperture			Whorls
	Height	Width	H/W	Height	Width	H/W	
4	17.20	21.20	.81	7.20	9.70	.74	6 3/4

Subfamily **TRIODOPSINAE**

Genus **TRIODOPSIS** Rafinesque, 1819

Subgenus **NEOHELIX** Von Ihering, 1892

Triodopsis multilineata (Say) Pl. 16, figs. 19-21

Helix multilineata Say, 1821, Acad. Nat. Sci. Philadelphia, Jour., vol. 2, p. 150.
Polygyra multilineata algonquinensis Nason, 1906, Nautilus, vol. 19, p. 141.
Polygyra multilineata wanlessi F. C. Baker, 1928, Nautilus, vol. 41, No. 4, p. 132.
Triodopsis multilineata algonquinensis (Nason), Pilsbry, 1940, Acad. Nat. Sci. Philadelphia, Monogr., No. 3, vol. 1, pt. 2, pp. 847, 849.

Description. — Shell globose, moderately elevated, thin, shiny, fragile, imperforate; base flattened and indented about the um-

bilical region; color pale buff with encircling bands of cinnamon brown; whorls 5⅝ (one specimen); nuclear whorls smooth, remainder obliquely rib striate; final whorl descends slightly to aperture; aperture ovate-lunate; peristome narrowly reflected.

Geologic range. — Wisconsin (Tazewell) to Recent.

Recent distribution. — Eastern North America from southern Ontario to Minnesota, south to Arkansas and Mississippi. Western limits are reached in eastern Nebraska and Kansas and eastern limit in Ohio. Shimek, 1904, reported living *T. algonquinensis* chiefly through the Prairie region.

Fossil distribution. —

Pleistocene — Wisconsin faunas — Ohio: Hamilton, Sandusky or Erie (?), and Defiance Cos. Illinois: Cass, Jersey, Monroe, Madison, and Dearborn Cos. Kentucky: Jefferson Co.

Pleistocene — age unknown — Missouri: Atchinson, Holt, Platte, Howard, St. Charles, and St. Louis Cos. Illinois: Madison, St. Clair, and Monroe Cos. Indiana: Posey Co.

Pilsbry (1940, p. 848) stated concerning *T. multilineata* "in the loess, generally distributed from Indiana to Topeka, Kansas."

Because the authors consider *T. multilineata* and *T. m. algonquinensis* to be the same species, the distribution record for the latter species is given as follows:

Pleistocene — Wisconsin faunas — Illinois: Carroll, Henry, Bureau, Henderson, Fulton, Tazewell, Menard, Brown, Pike, Jersey, Madison, and Cass Cos. Kentucky: Henderson and Jefferson Cos.

Pleistocene — age unknown — Iowa: Johnson, Gordo, and Pottawattamie Cos. Indiana: Posey Co.

Habitat. — Characteristic habitat for *T. multilineata* is marshy woodland and meadows. Recorded in Illinois (Baker, 1939, p. 51) from damp woods of oak, hickory, box elder, tamarack, maple, and cottonwood.

Remarks. — The distinction between *Triodopsis multilineata* and *Triodopsis multilineata algonquinensis* has been made principally on the basis of size. Forms 20 mm and over have been designated *T. multilineata* and the smaller forms, under 20 mm, *T. m. algonquinensis*. *T. m. algonquinensis* is considered also to have a somewhat more depressed shell.

Identification of the two species is contradictory in the litera-

ture. Leonard (1952, p. 24) gave the diameter of *T. multilineata* as "about 22 mm. On plate 2 of the same publication, he figured a specimen as *T. multilineata* with a diameter of 12.5 mm. Leonard (1959, pp. 99, 100) stated, "*T. multilineata* is readily distinguished from *T. m. algonquinensis* by larger size (major diameter of shell 20 or more millimeters instead of less than 20)." Leonard's illustrations (1952) on plate 5 are in accord with the descriptions. Leonard and Frye (1960, pl. 1, figs. P, Q, R.) showed a form identified as *T. algonquinensis* with a diameter of 25 mm). Pilsbry (1940, p. 850), in describing *T. multilineata* form *algonquinensis,* stated, "I am wholly disposed to believe this snail an ecologic form as Shimek held and not properly a subspecies." He quoted Shimek on distribution of living *algonquinensis* ". . . . . bordering the Mississippi and Missouri Rivers; however, this form grades into the larger type."

Many fragments were recovered from this fauna, but the single complete specimen recovered has the dimensions of the larger form with the more depressed shell and somewhat flattened base supposedly characteristic of *T. m. algonquinensis.*

The authors agree with Pilsbry that *T. m. algonquinensis* is not properly a subspecies. Burch (1962, p. 159) gave the range of *T. multilineata* as 14.5 mm to 32 mm which encompasses the extremes of both species. He, apparently, did not recognize *T. m. algonquinensis* as a subspecies.

Occurrence. — Localities 4, 9.

Measurement of Triodopsis multilineata in m m.

Locality	Shell			Aperture			Whorls
	Height	Width	H/W	Height	Width	H/W	
4	11.20	23.00	.49	7.60	9.10	.84	5 5/8

Family **HAPLOTREMATIDAE**

Genus **HAPLOTREMA** Ancey, 1881

Haplotrema concavum (Say) Pl. 15, figs. 24-26

Helix concava Say, 1821, Acad. Nat. Sci. Philadelphia, Jour., vol. 2, p. 159.
Haplotrema concavum (Say) Pilsbry, 1946, Acad. Nat. Sci. Philadelphia, Monogr., No. 3, vol. 2, pt. 1, p. 208, fig. 100.

Description. — Shell moderately thick and shiny; spire depressed

with coiling nearly in same plane; color white; whorls five, convex, increasing unevenly in size, irregularly rib striate with ribs becoming more pronounced around the umbilicus; umbilicus open, showing all the whorls to the apex; aperture slightly ovate-lunate to roundly lunate; peristome thickened, reflected basally and over columellar margin; upper lip straightened or more typically with slight indentation.

Geologic range. — Wisconsin (Tazewell) to Recent.

Recent distribution. — Humid division of eastern North America, north to shortly beyond the 45th parallel in Maine, Canada, and Michigan, west to Iowa, western Missouri, and Arkansas, south to nonpeninsular Florida, and Mobile Bay, Alabama. Its westward and southwestward limits are not known.

Fossil distribution. —

Pleistocene — Wisconsin faunas — Ohio: Defiance, Hamilton, and Butler (?), or Warren (?) Cos. Indiana: Dearborn (?) Co. Illinois: Fulton, Tazewell, Schuyler, Cass, Menard, Brown, Pike, Scott, Jersey, Madison, and Alexander Cos. Kentucky: Fulton, Henderson, Union, Crittenden, and Jefferson Cos.

Pleistocene — age unknown — Missouri: Moniteau, Boone, St. Louis, Calloway, St. Charles, Franklin, and Jefferson Cos. Mississippi: De Soto, Carroll, Tate, Hinds, Warren, Claiborne, Jefferson, Adams, and Wilkinson Cos. Louisiana: West Feliciana Parish. Illinois: Madison, St. Clair, Monroe, and Union Cos. Kentucky: Franklin Co. Tennessee: Jackson and Smith Cos. Indiana: Posey Co.

Habitat. — *H. concavum* is a forest species. Rarely occurs in large numbers in one locality. Prefers moist situations around marshes or on flood plains and in stream drifts. May also be found on loam deposits of forests, under logs, on stumps in marl beds and burrowing in clay. Sometimes feeds on other snails.

Remarks. — Ancey (1882, p. 111) named forms of this species of 11 mm diameter var. *minor* and a form of 21 mm var. *major*. Pilsbry (1946, p. 210) found that size intergrades so completely that subspecies based on shell dimensions have no validity "but there is no objection to the use of the terms 'form' *minor* or *major* to express extremes of a continuous variation series or cline."

Forms of this fauna incline toward the "form" *minor* in dimensions. The largest individual recovered has a diameter of 13.50 mm.

H. concavum is a snail known to be, at least partially, carnivorous, and it is not colonial in habit. The specimens recovered all have the final whorl descending in front. This feature apparently varies because descriptions state the final whorl may or may not descend in front.

Occurrence. — Localities 2, 4, 8, 9.

Measurements of Haplotrema concava in m m.

Locality	Shell Height	Width	H/W	Aperture Height	Width	H/W	Umbilicus	Whorls
4	4.70	10.25	.46	3.90	3.55	1.08	2.90	4 1/2
4	6.60	13.50	.49	5.33	5.25	1.01	5.33	4 7/8
4	5.66	12.60	.45	3.90	4.00	.98	4.00	5
8	5.75	13.06	.44	4.60	4.70	.98	4.60	5

Family **ZONITIDAE**

Subfamily **EUCONULINAE**

Genus **EUCONULUS** Reinhardt, 1883

Euconulus fulvus (Müller) Pl. 16, figs. 4-6

Helix fulva Müller, 1774, in part, Verm. terr. fluv . . . 2, p. 56.
Euconulus fulvus (Müller), Pilsbry, 1946, Acad. Nat. Sci. Philadelphia, Monogr., No. 3, vol. 2, pt. 1, p. 235, fig. 117.

Description. — Shell thin and glossy, globular, obtusely conic with convex base, imperforate to slightly perforate; color may be white but normally is yellowish white with paler apex; whorls 5 - 5¾, finely rib striate, average five in number and increase regularly in size; spiral striae faintly visible; final whorl normally slightly angulated with angulation disappearing towards the aperture; aperture broadly lunate; peristome thin and sharp.

Geologic range. — Middle Pliocene to Recent. In North America ranges from middle Pleistocene (Kansas) to Recent.

Recent distribution. — "Almost throughout the Holarctic realm, but wanting in Gulf and South Atlantic States from Texas to North Carolina." (Pilsbry, 1946, p. 236).

Fossil distribution. —

Pleistocene — Kansas faunas — Indiana: Putnam Co. Texas: Knox and Baylor Cos. Yarmouth faunas — North Dakota: Grant Co.

Iowa: Harrison and Monona Cos. Kansas: Jewel, Gove, Russell, Lincoln, Dickinson, and Meade Cos. Oklahoma: Woodward and Beaver Cos. Illinoian faunas — Indiana: Monroe Co. Oklahoma: Caddo and Canadian Cos., (Illinoian?). Sangamon faunas — Kansas: Meade Co. Ohio: Cuyahoga Co. Texas: Foard Co. Wisconsin faunas — Kansas: Doniphan, Republic, Jewel, Smith, Phillips, Norton, Decatur, and Rawlins Cos. Ohio: Erie, Shelby, Cuyahoga, and Butler Cos. Indiana: Johnson, Hendricks, Shelby, and Morgan Cos. Illinois: Cass, Carroll, Rock Island, Henry, Peoria, Woodford, Fulton, Tazewell, Menard, Brown, Morgan, Pike, Scott, Green, Madison, Jackson, and Alexander Cos. Wisconsin: Oconto Co. Texas: Delta, Clay, and Hardeman Cos. Oklahoma: Caddo and Harper Cos. (Wisconsin or Illinoian?). Kentucky: Fulton, Union, Crittenden, Henderson, Daviess, and Jefferson Cos.

C-14 dated records — Texas: Denton Co. 28,840 B. P., and Motley Co. 31,400 ± 5,600 years B. P.

Pleistocene — age unknown — Missouri: St. Charles and St. Louis Cos. Mississippi: Warren and Adams Cos. Indiana: Posey Co. Illinois: Madison, St. Clair, and Monroe Cos.

Habitat. — Lives among damp leaves in well-shaded places and may usually be obtained by leaf sifting. Common in the drift debris of creeks and rivers. Must have good cover of organic debris. Sometimes in open pastures — not generally in large numbers.

Remarks. — *Euconulus fulvus* is one of the dominant species of this fauna, occurring at all but one of the study sites. Leonard (1950, p. 44) listed *Euconulus* as one of the seven genera which "are normally woodland animals but are known to thrive in narrow bands of timber along streams in terrain that is otherwise treeless."

This species has a long geologic range, but its distribution pattern apparently changed with time. Although it is not now known from the Gulf States and south Atlantic States, it has been recorded as a fossil from this area. Perhaps there was a more equitable distribution of rainfall in the region or seasonal temperatures were less marked at the time *E. fulvus* lived.

Occurrence. — Localities 2, 3, 4, 5, 6, 7, 8, 9.

Measurements of Euconulus fulvus in m m.

Locality	Shell Height	Shell Width	Shell H/W	Aperture Height	Aperture Width	Aperture H/W	Whorls
2	2.01	2.56	.79	1.00	1.24	.81	4 3/4
4	2.84	3.28	.87	1.08	1.54	.70	5 3/4
4	2.15	2.84	.76	.94	1.28	.73	5
5	2.59	3.01	.86	1.08	1.48	.72	5 1/2
5	2.59	3.12	.83	1.08	1.48	.72	5 1/2+
6	2.62	3.12	.84	1.00	1.48	.68	5 1/4
6	2.22	2.77	.80	1.00	1.41	.71	5
6	2.28	2.91	.78	1.00	1.41	.71	5 1/8
8	2.28	2.84	.80	1.00	1.34	.75	5 5/8
9	2.15	2.62	.82	.94	1.24	.76	5

Subfamily **ZONITINAE**

Genus **NESOVITREA** Cooke, 1921

Nesovitrea (Perpolita) binneyana (Morse) Pl. 16, figs. 25-27

Hyalina binneyana Morse, 1864, Portland Soc. Nat. Hist., Jour., vol. 1, pp. 13, 61, figs. 25, 26.

Retinella binneyana (Morse), Pilsbry, 1946, Acad. Nat. Sci. Philadelphia, Monogr., No. 3, vol. 2, pt. 1, p. 259.

Nesovitrea binneyana (Morse), Forcart, 1957, Archiv für Molluskenkunde, vol. 86, p. 110.

Description. — Shell thin, shiny, depressed with comparatively low spire; umbilicus deep, showing all the whorls to the spire, measures approximately one-sixth the diameter of shell; radial grooves, wanting on the embryonic whorl and the base of shell, impress the remaining surface; whorls 3 - 3½, slowly increasing in size; peristome thin, sharp; aperture ovate-lunate.

Geologic range. — Yarmouth (?) to Recent.

Recent distribution. — Quebec west to western Ontario, south to Wisconsin, Ohio, Pennsylvania, New York, and Maine.

Fossil distribution. —

Pleistocene — Yarmouth faunas — North Dakota: Grant Co. Wisconsin faunas — Ohio: Erie and in Hamilton Co. *N.* cf. *binneyana,* Wisconsin: Marinette Co. Utah: San Pete Co. Kentucky: Fulton, Henderson, and Daviess Cos. PostHypsithermal faunas — North Dakota; Richland Co.

C-14 dated records. North Dakota: Richland Co. 2,540 ± 300 years B. P.

Pleistocene — age unknown — Indiana: Posey Co.

Habitat. — Inhabits damp woodlands, especially those of deciduous trees; occasionally found in sphagnum bogs.

Remarks. — Reported fossil occurrences for this species are

Wisconsin or younger in age. The species to which it is most allied, *N. electrina* (Gould), is recorded from the late Pliocene, Rexroad local fauna, Meade Co., Kansas (Leonard and Frye, 1952, p. 151). These two species, in their fossil form, are differentiated solely by size — *N. binneyana* being nearly one-third smaller than *N. electrina*. Because this is so, the possibility arises that misidentification has been made where the number of specimens is limited.

This report is the most southerly given for the species, whereas *N. electrina* is recorded as far south as Texas (Cheatum and Allen, 1965, pp. 8, 10).

N. binneyana was recovered from all sites but one in the study area.

Occurrence. — Localities 2, 3, 4, 6, 7, 8, 9.

Measurements of Nesovitrea binneyana in m m.

Locality	Shell Height	Shell Width	Shell H/W	Aperture Height	Aperture Width	Aperture H/W	Umbilicus	Whorls
3	2.01	4.00	.50	1.54	1.68	.92	.87	3 1/2
3	1.61	3.27	.49	1.41	1.58	.89	.54	3 1/4
4	1.61	3.55	.46	1.28	1.41	.91	.67	3 1/4
4	1.68	3.22	.52	1.28	1.41	.91	.60	3 1/2
8	1.54	3.12	.49	1.14	1.34	.85	.47	3
9	1.34	2.98	.45	1.28	1.34	.96	.60	2 4/5
9	1.54	3.40	.45	1.28	1.41	.91	.47	2 3/4
9	1.54	3.76	.41	1.51	1.61	.94	.70	3 1/8
9	1.68	3.33	.50	1.41	1.54	.92	.47	2 4/5
9	1.24	2.48	.50	1.00	1.21	.83	.47	2 4/5

Genus **RETINELLA** Fischer, 1877

Subgenus **GLYPHYALINA** Von Martens, 1892

Retinella indentata (Say) Pl. 15, figs. 11-13

Helix indentata Say, 1823, Acad. Nat. Sci., Philadelphia, Jour., vol. 2, p. 372 (Harrigate and New Jersey).

Retinella (Glyphyalina) indentata (Say), Baker, 1930, Acad. Nat. Sci. Philadelphia, Proc., vol. 82, p. 209.

Retinella indentata (Say), Pilsbry, 1946, Acad. Nat. Sci. Philadelphia, Monogr., No. 3, vol. 2, pt. 1, p. 288, fig. 146a.

Description. — Shell thin, depressed, heliciform, highly polished, and somewhat translucent; color pale yellow to white; whorls 3½-4, convex, increasing rapidly in size, marked by nearly equidistant, widely spaced impressed radial grooves which extend to center of umbilicus; aperture lunate; peristome sharp and thin, inner margin reflected over umbilicus; umbilical region indented, minutely perforate.

Geologic range. — Wisconsin (?) to Recent.

Branson, Taylor, and Taylor (1962) recorded *R. indentata* from Oklahoma in deposits considered of *probable* Illinoian age. They ruled out Wisconsin age because of the occurrence of several specimens of *Physa skinneri*.

Recent distribution. — Canada from southern Ontario north to Ottawa. United States from Maine to Alabama and west to Utah and Arizona.

Fossil distribution. —

Pleistocene — Illinoian (?) faunas — Oklahoma: Canadian and Caddo Cos. Wisconsin faunas — Ohio: Erie, Defiance, Butler, Summit, and Portage Cos. Texas: Bee Co. (Wisconsin?) and Delta Cos. Kentucky: Fulton and Henderson Cos.

C-14 dated records — Texas: Denton Co. 28,840 years B. P. and Dallas Co. 37,000 years B.P.

Pleistocene — age unkown — Illinois: Madison and St. Clair Cos. Mississippi: Tate, Tallahatchie, Hinds, Warren, Carroll, Adams, and Wilkinson Cos. Louisiana: West Feliciana Parish. Missouri: Boone, Callaway, St. Charles, Franklin, St. Louis, Platte, and Jefferson Cos. Indiana: Posey Co.

Remarks. — The minute umbilicus distinguishes *R. indentata*. This feature and the smaller size separate it from *R. paucilirata*, a more southerly ranging form. *Zonitoides arboreus* and *Nesovitrea binneyana*, both woodland species also, are associated with *R. indentata* in the fauna. *N. binneyana* was found in greater numbers and over a wider area. While *N. binneyana* was recovered from seven sites in the study area, *R. indentata* was found at only two sites.

Occurrence. — Localities 7, 9.

Measurements of Retinella indentata in m m.

Locality	Shell			Aperture			Whorls
	Height	Width	H/W	Height	Width	H/W	
7	1.48	2.70	.55	1.31	1.41	.93	3
7	2.01	3.82	.53	1.28	1.84	.69	3 1/2
9	2.01	4.36	.46	1.68	1.95	.86	4 1/8

Genus **HAWAIIA** Gude, 1911

Hawaiia minuscula (Binney) Pl. 16, figs. 16-18

Helix minuscula Binney, 1840, Boston Jour. Nat. Hist., vol. 3, No. 3, p. 435.

Hawaiia minuscula (Binney) Pilsbry, 1946, Acad. Nat. Sci. Philadelphia, Monogr., No. 3, vol. 2, pt. 1, p. 420, figs. 228a, b ; 229 Nos. 1-3.

Description. — Shell thin and silky; spire depressed and base flattened; color white; whorls average 3½ - 4 in number, gradually increasing in size; umbilicus broad and open showing all the whorls to apex, measures about ⅓ the diameter of the shell; sutures impressed; aperture round; peristome thin and sharp.

Geologic range. — Late Miocene to Recent.

Recent distribution. — North America from Alaska and Maine to Costa Rica.

Fossil distribution. —

Miocene — California: San Bernardino Co.

Pliocene — Wyoming: Teton Co. Texas: Oldham Co. Kansas: Meade and Seward Cos. Idaho: Owyhee Co.

Pleistocene — Nebraskan or Aftonian faunas — Nebraska: Brown Co. Kansas: Kingman Co. Texas: Crane Co. (Kansan?). Aftonian faunas — Kansas: Meade Co. Kansan faunas — Kansas: Norton and Phillips Co. Texas: Knox and Baylor Cos. Indiana: Putnam Co. Yarmouth faunas — Iowa: Harrison and Monona Cos. Nebraska: Knox and Harlan Cos. Kansas: Gove, Russell, Lincoln, Dickinson, Clark, Meade, and Seward Cos. Oklahoma: Beaver, Woodward, and Washita Cos. Texas: Roberts and Hartley Cos. Illinoian faunas — Texas: Brisco Co. Sangamon faunas — Kansas: Meade Co. Texas: Foard Co. Wisconsin faunas — Kansas: Doniphan, Republic, Phillips, Decatur, and Rawlins Cos. Ohio: Erie, Madison, Shelby, and Cuyahoga Cos. Indiana: Vigo Co. Illinois: Cass, Menard, Brown, Pike, Jersey, Madison, and Alexander Cos. Kentucky: Fulton, Henderson, and Union Cos. Texas: Reeves, Delta, Hardeman, and Clay Cos. Oklahoma: Harper Co. (Wisconsin or Illinoian?)

C-14 dated records — Texas: Denton Co. 31,400 ± 5,600 years B. P. and Dallas Co. slightly more than 37,000 years B. P.

Pleistocene — age unknown — Missouri: St. Charles and Callaway Cos. Mississippi: Tate, Tallahatchie, De Soto, and Warren Cos. Texas: Ward, Crockett, Pecos, Terrell, Comal, Kendall, Kerr, and Brooks Cos. Illinois: Madison Co.

Habitat. — This species has a wide distribution because of its adaptability to various habitats. Found on rocky ledges or among dead leaves and under fallen logs. Thrives in piles of moist drift

where it has been cast by flood waters. It withstands arid conditions but is most numerous in wooded and moist places.

Remarks. — This tiny, common, and ecologically adaptable form was recovered from an apparent woodland habitat, judging by the associated species at the four sites.

The specimens are close to Binney's type, being intermediate in size and with somewhat larger umbilicus than Canadian zone and some Carolinian forms described by Pilsbry (1946, p. 423).

Occurrence. — Localities 3, 7, 8, 9.

Measurements of Hawaiia minuscula in m m.

Locality	Shell Height	Shell Width Max. Min.	Shell H/W	Aperture Height	Aperture Width	Aperture H/W	Umbilicus	Whorls
3	.98	2.22 2.01	.44 .49	.67	.80	.83	.67	3 3/8
3	.80	1.88 1.74	.42 .46	.67	.74	.90	.67	3 1/2
3	.80	1.81 1.61	.44 .50	.60	.64	.94	.67	3 5/8
7	1.00	2.48 2.28	.40 .44	.67	.70	.95	.87	4 3/8
7	.87	1.95 1.88	.44 .46	.60	.64	.94	.60	3 1/2
9	.54	1.21 1.08	.44 .50	.40	.44	.92	.40	3
9	.80	1.68 1.48	.47 .54	.54	.54	1.00	.54	3 1/2
9	.70	1.48 1.38	.47 .51	.47	.50	.93	.34	3 1/8
9	.94	1.48 1.34	.63 .70	.50	.50	1.00	.50	3 1/2

Subfamily **GASTRODONTINAE**

Genus **ZONITOIDES** Lehmann, 1862

Subgenus **ZONITOIDES** s. s.

Zonitoides arboreus (Say) Pl. 15, figs. 21-23

Helix arboreus Say, 1816, (Nicholson's) Amer. Edit. British Encycl., vol. 2, art. Conchology, species No. 2, pl. 1, fig. 4.

Zonitoides arboreus (Say), Pilsbry, 1946, Acad. Nat. Sci. Philadelphia, Monogr., No. 3, vol. 2, pt. 1, p. 480, figs. 261, 262.

Description. — Shell depressed, shiny, porcellaneous; spire slightly elevated; base not prominently convex; color white; whorls 4 - 4½, convex, regularly increasing in size, first 1½ whorls smooth, remainder marked by weak irregular growth lines, barely perceptible on base; sutures impressed; umbilicus broad, deep, contained

about four-five times in the diameter; aperture broadly lunate; peristome thin, sharp, not reflected.

Geologic range. — Early Pliocene to Recent.

Recent distribution. — North America from northern Canada to Costa Rica.

Fossil distribution. —

Pliocene — Oklahoma: Beaver Co. Kansas: Meade Co.

Pleistocene — Nebraskan or Aftonian faunas — Kansas: Meade Co. Kansan faunas — Kansas: Osborne Co. Texas: Knox Co. Yarmouth faunas — North Dakota: Grant Co. Kansas: Meade Co. Oklahoma: Beaver Co. Illinoian (?) faunas — Oklahoma: Canadian and Caddo Cos. Sangamon faunas — Kansas: Meade Co. Wisconsin faunas — Kansas; Smith, Phillips, and Decatur Cos. Ohio: Defiance, Erie, Butler, and Summit (?), or Portage (?) Cos. Oklahoma: Harper Co. (Wisconsin or Illinoian?). Illinois: Madison and Alexander Cos. Texas: Delta and Hardeman Cos. Kentucky: Fulton, Henderson, Union, and Jefferson Cos. PostHypsithermal faunas — North Dakota: Richland Co.

C-14 dated records — Texas: Dallas Co. slightly more than 37,000 years B. P., Denton Co. 28,840 years B. P., Motley Co. 31,400 ± 5,600 years B. P. North Dakota: Richland Co. 2,540 ± 300 years B. P.

Pleistocene — age unknown — Mississippi: Hinds, Warren, Jefferson, Adams, Wilkinson, De Soto, Tate, Carroll, and Yazoo Cos. Missouri: Callaway, St. Louis, Boone, and St. Charles Cos. Illinois: Madison, St. Clair, and Monroe Cos. Louisiana: West Feliciana Parish. Indiana: Posey Co. Texas: Kerr and Bandera Cos. Utah: Lake Bonneville basin.

Habitat. — Requires reasonable degree of moisture and woodland situation, if only patches of timber. Lives under sticks, leaves, stones, and in decaying logs or vegetation. *Z. arboreus* is a gregarious species.

Remarks. — *Zonitoides arboreus* is one of the long ranging (early Pliocene to Recent) species covered in this study. The early Tertiary record is from the Laverne Formation of Beaver Co., Oklahoma (Leonard, and Franzen, 1944).

This form is widespread geographically and normally abundant.

Specimens, however, are not numerous in this fauna and tend to be somewhat smaller than the normal maximum size.

Occurrence. — Localities 3, 4, 8.

Measurements of Zonitoides arboreus in m m.

Locality	Shell Height	Shell Width	Shell H/W	Aperture Height	Aperture Width	Aperture H/W	Umbilicus	Whorls
4	1.68	4.10	.41	1.28	1.61	.79	1.14	4
4	2.01	4.56	.44	1.41	1.74	.81	1.14	4 1/4
4	1.88	4.17	.45	1.21	1.68	.72	.94	4 3/8
4	1.54	4.17	.39	1.28	1.48	.87	.94	4
4	1.74	4.36	.40	1.21	1.68	.72	.87	4
4	1.61	4.02	.40	1.28	1.61	.79	.80	4
4	1.34	3.22	.41	1.08	1.34	.81	.67	3 1/2
4	1.47	3.49	.42	1.14	1.21	.94	.67	4
3	1.88	5.05	.38	1.41	1.81	.78	1.21	4 1/2
3	1.61	4.23	.38	1.28	1.68	.76	.87	4

Family **LIMACIDAE**

Genus **DEROCERAS** Rafinesque, 1820

Subgenus **DEROCERAS** s. s.

Deroceras laeve (Müller) Pl. 17, figs. 17, 18

Limax laevis Müller, 1774, Verm. terr. fluv. . . ., Hist. 2, p. 2.
Derocerας laeve Pilsbry, 1948, Acad. Nat. Sci. Philadelphia, Monogr., No. 3, vol. 2, pt. 2, p. 539, figs. 289, 291.

Description. — Shell flat ovoid, elongate plate with concentric growth lines; left margin slightly more convex than the right; nucleus located off center on left side at posterior end of shell.

Geologic range. — Illinoian to Recent.

Recent distribution. — North America generally, from the Arctic to middle Florida and Central America, the southern limit not determined.

Fossil distribution. —

Pleistocene — Yarmouth faunas — North Dakota: Grant Co. Illinoian faunas — Indiana: Monroe Co. Oklahoma: Beaver Co. Illinoian (?) faunas — Oklahoma: Canadian and Caddo Cos. Sangamon faunas — Kansas: Meade Co. Wisconsin faunas — Kansas: Doniphan, Republic, and Norton Cos. Ohio: Erie Co. *(Deroceras* cf. *D. laeve),* Indiana: Morgan, Johnson, Shelby, and Noble Cos. Kentucky: Fulton and Henderson Cos.

Pleistocene — age unknown — Louisiana: West Feliciana Parish. Missouri: St. Louis Co. Illinois: St. Clair Co. Mississippi: Warren Co.

Habitat. — Inhabits moist to fairly wet places, often beside streams, ponds, springs, and marshes. Also in protected spots under leaves, stones, and logs. Not seen unless humidity is high. In dry times hides under logs and stones.

Remarks. — Recent distribution of *Deroceras laeve* covers much of the United States. Pleistocene studies record it from the central area of the country — west to Oklahoma and Kansas and east to Kentucky and Ohio.

Leonard (1950, p. 19), in describing forms from the Pleistocene of Kansas, gave the length of the shell as 4 mm. Specimens of this fauna are about half that size, ranging from 1.3 mm to 2.6 mm.

The only other known fossil *Deroceras, Deroceras* cf. *aenigma,* has a larger, thicker shell with a different stratigraphic and geographic distribution. It ranges from the Pliocene to the late Pleistocene. With the exception of two Ohio records (Sterki, 1920, p. 177) and La Rocque and Conley (1956, pp. 335, 326) it has been recorded only from the Plains States south to Texas and north to Nebraska and Iowa. Since both Ohio records for *D.* cf. *aenigma* include this species from stratigraphically younger sediments for *D.* cf. *aenigma* from the Mid-Continental region the Ohio occurrences, may, as La Rocque and Conley suggested "throw some light on the Pleistocene migration route of the species. La Rocque and Conley's specimens are thicker than shells of living *Deroceras* but not so large as those from the Mid-Continental area.

Occurrence. — Localities 2, 4, 8, 9.

Measurements of Deroceras laeve in m m.

Locality	Length	Width	Height
9	1.34	1.00	.20
8	1.48	.87	.30
8	1.61	.94	.40
9	1.81	1.21	.50
9	1.95	1.21	.50
9	2.18	1.48	.60
9	2.28	1.34	.70
9	2.45	1.54	.70
8	2.48	1.44	.30
9	2.62	1.48	.70

Family ENDODONTIDAE
Subfamily ENDODONTINAE
Genus ANGUISPIRA Morse, 1864

Anguispira alternata (Say) Pl. 15, figs. 18-20

Helix radiata Müller, 1774, in part, Verm. terr. fluv. . . ., 2, p. 23.
Helix alternata Say, 1816, [Nicholson's] British Encyclo., Sp. No. 1, pl. 1, fig. 2.
Anguispira alternata (Say). Jones, 1935, Jour. Morph., vol. 57, p. 547.
Anguispira alternata (Say). Pilsbry, 1948, Acad. Nat. Sci. Philadelphia, Monogr., No. 3, vol. 2, pt. 2, p. 568, fig. 305.

Description. — Shell thin, globose to moderately depressed; umbilicus deep and widely open, measures ¼ the diameter of shell; color ivory white to tan with upper surface marked by rufous spots arranged almost vertically, base of shell marked by similar spots below the periphery and occasional rufous streaks directed toward the umbilicus; embryonic whorl smooth, white and often glossy, remaining whorls marked by distinct rib striae which become less pronounced basally; fine spiral striae detectable on some specimens; peristome thin and sharp; aperture rotund-lunate.

Geologic range. — Wisconsin (Tazewell) to Recent.

Recent distribution. — Nova Scotia to Lake of the Woods; South Dakota, Nebraska, and Kansas west to about the 97th meridian; south to middle Louisiana and Mississippi, and in the east at least to Tennessee, northern Alabama, and North Carolina.

Fossil distribution. —

Pleistocene — Illinoian (?) faunas — Oklahoma: Caddo Co. Wisconsin faunas — Ohio: Erie, Defiance, Warren (?), and Butler Cos. Indiana: Morgan Co. Illinois: Fulton, Mason, Schuyler, Menard, Morgan, Scott, Greens, Jersey, Madison, Jackson, Randolph, and Alexander Cos. Kentucky: Union and Jefferson Cos.

C-14 dated records — Texas: Denton Co. 28,840 years B. P.

Pleistocene — age unknown — Missouri: La Fayette, Howard, Boone, Callaway, St. Louis, St. Charles, and Franklin Cos. Mississippi: De Soto, Tate, Panola, Grenada, Carroll, Yazoo, Hinds, Warren, Claiborne, Jefferson, Adams, and Wilkinson Cos. Illinois: Madison, St. Clair, Monroe, and Union Cos. Kentucky: Franklin Co. Tennessee: Jackson and Smith Cos. Indiana: Posey Co.

Habitat. — *A. alternata* is a widely distributed and common species. Habitat varies from wooded flood plains to upland situ-

ations. Lives under dead wood, loose bark, and on limestone ledges. The species has been found on trees at a distance as much as 15 feet above ground.

Remarks. — Leonard and Frye (1960, p. 11) made a study of Wisconsin molluscan faunas in Illinois. They observed, "It would appear that the heavy forests of Altonian time persisted through the Farmdalian Substage until the beginning of, or perhaps slightly into earliest Woodfordian time, at least in southern Illinois."

It appears from this study that the beginning of Tazewell time was marked in Kentucky by a woodland fauna. *Anguispira alternata,* the most widespread of the larger species, is found at this horizon. Associated with it in the fauna are the other large woodland species, *Triodopsis multilineata, Haplotrema concavum,* and *Mesodon elevatus.* Each of these species, so far as is known, ranges from beginning Tazewell to the Recent.

Occurrence. — Localities 3, 4, 5, 6, 7.

Measurements of Anguispira alternata in m m.

Locality	Shell Height	Shell Width	Shell H/W	Aperture Height	Aperture Width	Aperture H/W	Whorls
3	17.60	9.15	1.92	6.75	6.20	1.09	5 1/2
3	17.05	8.40	2.04	5.85	6.00	.97	5 5/8
4	19.00	10.50	1.81	7.55	7.25	1.08	6
4	18.50	9.75	1.90	6.92	5.95	1.16	6
4	17.35	9.55	1.82	6.90	6.15	1.12	5 7/8
4	16.60	9.25	1.80	6.25	6.10	1.02	5 5/8
4	16.10	7.75	2.08	6.00	5.70	1.05	5 1/2
4	14.65	7.95	1.85	5.90	5.45	1.08	5 1/2
4	17.45	9.30	1.88	6.30	6.65	.95	5 5/8
4	18.05	8.00	2.26	5.75	5.90	.97	5 5/8

Genus **DISCUS** Fitzinger, 1833

Subgenus **DISCUS** s. s.

Discus cronkhitei (Newcomb) Pl. 15, figs. 2, 3, 14

Helix cronkhitei Newcomb, 1865, California Acad. Sci., Proc., 3, p. 180 (Klamath Valley, Ore.).

Discus cronkhitei (Newcomb), Pilsbry, 1948, Acad. Nat. Sci., Philadelphia, Monogr., No. 3, vol. 2, pt. 2, p. 600, fig. 328 a-d.

Description. — Shell thin, depressed, with low spire; color white to buff; whorls 3½ - 4½, convex, increasing regularly in size; first 1½ whorls smooth, remainder obliquely rib striate on both surfaces; ribs narrower than intervals; umbilicus broad, deep, contained about three times in diameter of shell, showing coils to apex; sutures impressed; aperture round; peristome thin and sharp.

Geologic range. — Middle Pliocene to Recent.

Recent distribution. — Alaska to the mountains of southern California, Rocky Mountains south into Arizona and New Mexico, Colorado, and northern Canada east to northern Illinois, Maryland, Missouri, Newfoundland, and Labrador.

Fossil distribution. —

Pleistocene — Kansan faunas — Kansas: Norton and Osborne Cos. Texas: Baylor, Knox, and Briscoe Cos. Indiana; Putnam Co. Yarmouth faunas — Kansas: Meade Co. North Dakota: Grant Co. Oklahoma: Beaver and Woodward Cos. Illinoian faunas — Texas: Brisco Co. Indiana: Monroe Co. Sangamon faunas — Kansas: Meade Co. Texas: Foard Co. Wisconsin faunas — Kansas: Doniphan, Republic, Jewel, Smith, Phillips, Norton, Decatur, and Rawlins Cos. Ohio: Defiance, Erie, Butler, Summit, and Portage Cos. Indiana: Johnson, Hendricks and Shelby Cos. Illinois: Carroll, Rock Island, Henry, Bureau, Marshall, Henderson, Woodford, Fulton, Tazewell, Mason, Cass, Menard, Morgan, Pike, Madison, Jackson, and Alexander Cos. Oklahoma (Wisconsin or Illinoian?): Harper Co. Utah: San Pete Co. Texas: Hardeman and Delta Cos. Kentucky: Fulton, Henderson, Crittenden, Union Cos. PostHypsithermal faunas — North Dakota: Richland Co.

C-14 dated records — Texas: Motley Co. 31,400 ± 5,600 years B. P., North Dakota: Richland Co. 2,540 ± 300 years B. P.

Pleistocene — age unknown — Missouri: Holt, Platte, Cooper, St. Louis, St. Charles, and Franklin Cos. Texas: Comal, Swisher, Bexar, Kerr, and Bandera Cos. Indiana: Posey Co. Illinois: Madison, St. Clair, and Monroe Cos.

Habitat. — Lives in humid forest, under dead wood, and among rotting leaves or grass in rather wet situations.

Remarks. — Pilsbry (1948, p. 604) stated concerning *D. cronkhitei*, "It is a common snail in the Canadian and Transition faunas, and occurs sporadically in the Carolinian." Its range, like the subspecies (?) *D. catskillensis,* extended farther south in Pleistocene times. The occurrence in this fauna is the southernmost record for the species in the Pleistocene east of the Mississippi. West of the Mississippi it has been reported from the Pleistocene as far south as Texas by Pilsbry (1948, p. 603), Hubricht (1962a, pp. 1, 2), and Cheatum and Allen (1965, pp. 4, 7, 9, 10). The geologic range is

one of the longest for the species of this fauna with a Tertiary record from Wyoming (U.S.G.S. locality 19105).

Occurrence. — Localities 1, 3, 4, 9.

Measurements of Discus cronkhitei in m m.

Locality	Shell Height	Shell Width	Shell H/W	Aperture Height	Aperture Width	Aperture H/W	Umbilicus	Whorls
9	2.62	4.69	.56	1.68	1.54	1.09	1.54	3 7/8
3	3.05	5.68	.54	1.74	1.68	1.03	2.22	4 1/8
3	2.68	5.18	.52	1.68	1.68	1.00	1.81	3 7/8
3	1.95	4.36	.45	1.48	1.48	1.00	1.34	3 1/2
4	2.86	5.20	.55	1.68	1.44	1.17	1.81	4
4	3.34	5.46	.61	1.61	1.68	.96	1.68	4 1/4
4	2.93	5.27	.56	1.68	1.68	1.00	1.61	4
4	2.66	4.94	.54	1.74	1.48	1.18	1.61	3 3/4
4	2.40	5.46	.44	1.28	1.28	1.00	1.54	3 2/3
4	2.80	5.20	.54	1.68	1.48	1.14	1.61	4

Discus cronkhitei catskillensis (Pilsbry) Pl. 15, figs. 6, 7

Pyramidula striatella catskillensis Pilsbry, 1898, Nautilus vol. 12, p. 86.
Discus cronkhitei catskillensis (Pilsbry), Pilsbry, 1948, Acad. Nat. Sci. Philadelphia, Monogr., No. 3, vol. 2, pt. 2, p. 605, fig. 382, e, f.

Description. — This species differs from *D. cronkhitei* by being distinctly angular at the periphery and flattened below the angle. In this fauna, specimens of this species show (for ten specimens) a somewhat smaller diameter than those of *D. cronkhitei*, averaging 4.678 mm to 5.145 mm for that species. The umbilicus is wider, being contained (for ten specimens) 2.71 times in the diameter to 3 times for *D. cronkhitei*.

Geologic range. — Wisconsin (?) to Recent.

Recent distribution. — Maine and the Adirondacks to Pennsylvania, especially on or near the mountainous districts; westward in the upper peninsula of Michigan, Minnesota, and South Dakota.

Fossil distribution. —

Pleistocene — Wisconsin faunas — Kentucky: Fulton, Henderson, and Daviess Cos.

Pleistocene — age unknown — Mississippi: De Soto and Carroll Cos. Indiana: Posey Co.

Habitat. — Lives on rotten logs and among dead leaves.

Remarks. — Few Pleistocene records are available for *D. catskillensis*. The southernmost limit is a record from Mississippi by Hubricht (1961, pp. 11, 12). Hubricht's report and the record in this fauna extend the range for the species in the Pleistocene farther

south than the range given for the living forms in eastern North America.

Pilsbry (1948, p. 606) stated that *D. catskillensis* is "found on rotten logs and among dead leaves in dryer situations than eastern *D. cronkhitei* generally, often at higher elevations and in hilly or mountainous country." Like the locality given by Hubricht for *D. catskillensis,* the localities given here are in low-lying country with slight elevation. Moreover, the associated fauna indicates a damp environment.

Occurrence. — Localities 2, 5, 6, 7.

Measurements of Discus cronkhitei catskillensis in m m.

Locality	Shell Height	Shell Width	Shell H/W	Aperture Height	Aperture Width	Aperture H/W	Umbilicus	Whorls
5	2.01	4.62	.43	1.41	2.15	.66	1.68	3 7/8
5	2.12	4.50	.47	1.34	1.48	.91	1.48	3 5/8
5	1.95	4.98	.39	1.28	1.34	.95	1.68	3 5/8
5	2.15	4.50	.48	1.34	1.34	1.00	1.54	3 5/8
6	2.28	5.05	.45	1.34	1.54	.87	1.95	4
6	2.15	4.90	.44	1.41	1.48	.95	1.74	3 3/4
6	2.15	4.82	.45	1.41	1.48	.95	1.88	3 7/8
2	1.95	4.17	.47	1.28	1.21	1.05	1.61	3 1/2
2	2.08	4.43	.47	1.28	1.34	.95	1.68	3 5/8
4	1.84	4.82	.38	1.41	1.48	.95	1.81	3 3/4

Subfamily **HELICODISCINAE**

Genus **HELICODISCUS** Morse, 1864

Subgenus **HELICODISCUS** s. s.

Helicodiscus parallelus (Say) Pl. 15, figs. 15-17

Helix lineata Say, 1817, Acad. Nat. Sci. Philadelphia, Jour., vol. 1, p. 18; vol. 2, p. 373.

Helicodiscus parallelus (Say), Pilsbry, 1906, Acad. Nat. Sci., Philadelphia, Proc., p. 156.

Helicodiscus parallelus (Say), Pilsbry, 1948, Acad. Nat. Sci. Philadelphia, Monogr., No. 3, vol. 2, pt. 2, p. 625, fig. 339.

Description. — Shell depressed, upper surface nearly flat; color white to light brown; whorls 4 - 4½, convex, tightly coiled, slowly increasing in size; surface sculptured by thin threadlike spiral striae, faint on initial whorls; sutures impressed; umbilicus broad, shallow, showing coils to apex, contained slightly over two times in diameter; aperture lunate; final whorl occasionally edentulous, normally showing two nodose white denticles — one placed midway within outer wall, the other aligned and placed midway within basal wall; an-

other like pair of denticles may be present situated further back in whorl beyond view from aperture; lip sharp, thin, not reflected.

Geologic range. — Nebraskan or Aftonian to Recent.

Recent distribution. —Eastern North America, from Newfoundland south to Georgia and Alabama; westward to South Dakota and Oklahoma.

Fossil distribution. —

Pleistocene — Nebraskan or Aftonian faunas — Kansas: Kingman Co. Kansan faunas — Kansas: Osborne and Phillips Cos. Texas: Baylor Co. Yarmouth faunas — Kansas: Russell, Lincoln, Dickinson, and Clark Cos. Oklahoma: Beaver, Woodward, and Washita Cos. Illionian faunas — Texas: Brisco Co. Oklahoma: Canadian and Caddo Cos. (Illinoian?). Sangamon faunas — Kansas: Meade Co. Wisconsin faunas — Kansas: Phillips, Decatur, and Rawlins Cos. Ohio: Erie and Hamilton (?) Cos. Illinois: Marshall, Cass, Menard, Greene, Jersey, Madison, and Alexander Cos. Wisconsin: Marinette Co. Texas: Delta, Clay, and Hardeman Cos. Oklahoma: Caddo and Harper Cos. (Wisconsin or Illinoian?). Kentucky: Fulton, Crittenden,[3] Union, Henderson, and Jefferson Cos. PostHypsithermal faunas — North Dakota: Richland Co.

C-14 dated records — Texas: Motley Co. 31,400 ± 5,600 years B. P., Denton Co. 28, 840 years B. P. and Dallas Co. slightly more than 37,000 years B. P. North Dakota: Richland Co. 2,540 ± 300 years B. P.

Pleistocene — age unknown — Mississippi: De Soto, Panola, Tate, Warren, Hinds, and Adams Cos. Louisiana: West Feliciana Parish. Missouri: St. Louis, Holt, Platte, and Callaway Cos. Illinois: Madison, St. Clair, and Union Cos. Tennessee: Jackson Co. Indiana: Posey Co. Texas: Ward, Terrell, and Brooks Cos.

Habitat. — *H. parallelus* is primarily a woodland species, living under bark, decaying wood or in damp leaves. Tolerates dry conditions, living in grassy fields, on rocky ledges or on sparsely timbered slopes. Favorite habitat is on limestone ledges in forest debris among stands of oak and hickory.

Remarks. — *Helicodiscus parallelus* is easily recognized and distinctive with its flat shape and spirally striated surface. It is a wood-

[3]Reported here by the authors.

land snail, living only rarely in exposed places. Specimens found in association, from both sites where it was recovered, are woodland species viz., *Haplotrema concavum*, *Strobilops labyrinthica*, *Punctum minutissimum*.

Occurrence. — Localities 8, 9.

Measurements of Helicodiscus parallelus in m m.

Locality	Shell Height	Width	H/W	Aperture Height	Width	H/W	Umbilicus	Whorls
8	1.41	3.22	.44	1.00	.87	1.15	1.41	4 1/4
8	1.51	3.36	.45	1.08	.80	1.34	1.54	4 1/4
8	1.34	3.36	.40	.94	.87	1.08	1.51	4 1/2
8	1.34	3.19	.42	.94	.60	1.56	1.41	4 1/8
8	1.34	3.12	.43	1.00	.87	1.15	1.48	4 1/8
8	1.28	3.19	.40	1.00	.80	1.24	1.34	4
9	1.38	3.61	.38	1.00	.87	1.15	1.74	4 1/2
9	1.28	3.39	.38	1.00	.80	1.24	1.68	4 1/2
9	1.34	3.36	.40	.94	.74	1.27	1.74	4 1/8
9	1.28	3.29	.39	.90	.87	1.04	1.61	4 1/4

Subfamily **PUNCTINAE**

Genus **PUNCTUM** Morse, 1864

Punctum minutissimum (Lea) Pl. 17, figs. 12-14

Helix minutissimum Lea, 1841, Amer. Philos. Soc., Trans., 9, p. 17.
Punctum minutissimum (Lea), Morse, 1864, Terr. Pulm. Maine, Portland Soc. Nat. Hist., Jour., 1, p. 27, pl. 7, figs. 69, 70, pl. 8, fig. 71.
Punctum minutissimum (Lea), Pilsbry, 1948, Acad. Nat. Sci. Philadelphia, Monogr., No. 3, vol. 2, pt. 2, p. 644, fig. 350.

Description. — Shell thin, silky, subglobose with elevated spire; color white; whorls 3 - 3¾, convex; first 1½ whorls smooth, remainder marked with fine, closely set rib striae; sutures deeply impressed, suture of final whorl descending almost to periphery of preceding whorl; umbilicus broad, deep, contained approximately four times in diameter of the shell, showing coils to apex; aperture round; peristome thin, sharp, and not reflected.

Geologic range. — Kansan to Recent.

Recent distribution. — Distributed over much of North America from southern Canada to Mexico.

Fossil distribution. —

Pleistocene — Kansan faunas — Indiana: Putnam and Parke Cos. Illinoian faunas — Indiana: Monroe and Wayne Cos. Sangamon faunas — Kansas: Meade Co. Wisconsin faunas — Ohio: Sandusky or Erie? Co. Indiana: Morgan, Vigo, Johnson, and Wayne Cos. Illinois: Rock Island, Cass, Brown, Jackson, and Alexander

Cos. Kentucky: Fulton, Crittenden, Union, Henderson, Daviess, and Jefferson Cos.

Pleistocene — age unknown — Mississippi: De Soto, Warren, Hinds, Adams, and Wilkinson Cos. Louisiana: West Feliciana Parish. Missouri: St. Louis Co. Illinois: Madison, St. Clair, Monroe, and Union Cos. Indiana: Posey Co.

Habitat. — *P. minutissium* is a forest species which favors dense hardwood growths. Found frequently in the large forms of fungi, such as *Polyporus* and *Boletus* and in the bark of beech trees.

Remarks. — This fragile shell, recovered from the fauna in greater numbers than any other species, is the pygmy of the fauna. It was missing from only one of the sites studied. This attests to the woodland nature of the area.

Occurrence. — Localities 2, 3, 4, 5, 6, 7, 8, 9.

Measurements of Punctum minutissimum in m m.

Locality	Shell Height	Shell Width	Shell H/W	Aperture Height	Aperture Width	Aperture H/W	Whorls
5	.84	1.38	.61	.34	.50	.67	3 1/2
6	.91	1.35	.67	.54	.54	1.00	3
6	.77	1.17	.66	.34	.44	.77	3 1/8
6	.81	1.42	.57	.50	.57	.88	3 3/4
7	.77	1.24	.62	.37	.44	.84	3
7	.67	1.14	.59	.34	.40	.85	3
7	.81	1.31	.62	.44	.47	.94	3 1/4
8	.87	1.35	.64	.40	.47	.86	3 1/8
8	.84	1.28	.66	.40	.47	.86	3 1/3
8	.74	1.21	.61	.37	.44	.84	3 1/8

Family **SUCCINEIDAE**

Species belonging to the family Succineidae, with few exceptions, cannot be accurately identified without resorting to a study of the soft anatomy. The shells of various species, even genera, show similarities that do not permit specific diagnosis. Miles (1958) in a detailed study of the family Succineidae in Kansas confirmed this observation made by earlier workers (Pilsbry, 1948; Lee, 1951).

This being the case, the fossil forms described below, while they are distinct and readily separable, must be considered "form" species. Specification may, at some future time, be possible with addition of detailed anatonomical studies on Recent forms.

Genus **SUCCINEA** Draparnaud, 1801

Succinea grosvenori Lea Pl. 17, figs. 10, 11

Succinea lineata Binney, 1857, Acad. Nat. Sci. Philadelphia, Proc., p. 19.

Succinea grosvenori Lea, 1864, Acad. Nat. Sci. Philadelphia, Proc., p. 109.
Succinea bakeri Hubricht, 1963, Nautilus, vol. 76, No. 4, p. 136, pl. 8, 3 figs.

Description. — Shell obliquely conic, thin, fragile; color pale yellow; whorls 3 - 3½, convex, rapidly increasing in size; initial whorl smooth, remainder marked by irregular, somewhat wrinkled growth striae; body whorl large, approximately two-thirds the length of shell; sutures deeply impressed; aperture ovoid; peristome thin, connected across parietal wall by a thin callus.

Geologic range. — Aftonian to Recent.

Recent distribution. — Because more than one species may be involved, distributional records are not too significant. *S. grosvenori* has been widely reported over North America from the Gulf states to the semiaid areas of the plains and mountain states.

Fossil distribution. —

Pleistocene — Kansan faunas — Kansas: Osborne Co. Texas: Crane Co. Yarmouth faunas — Iowa: Harrison and Monona Cos. Nebraska: Knox and Harlan Cos. Kansas: Jewel, Gove, Russell, Lincoln, Clark, Meade, and Seward Cos. Oklahoma: Beaver, Woodward, and Washita Cos. Texas: Roberts and Hartley Cos. Illinoian faunas — Texas: Briscoe Co. (*S. grosvenori?*) Sangamon faunas — Kansas: Meade Co. Wisconsin faunas — Kansas: Jewel, Smith, Phillips, Norton, Decatur, and Rawlins Cos. Ohio: Shelby and Cuyahoga Cos. Indiana: Johnson Co. Illinois: Carroll, Marshall, Fulton, Mason, Schuyler, Menard, Brown, Pike, Scott, Jersey, Madison, and Alexander Cos. Texas: Reeves and Hardeman Cos. (*S.* cf. *S. grosvenori*), Kentucky: Fulton, Crittenden, Henderson, and Jefferson Cos.

Pleistocene — age unknown — Texas: Crane, Ward, Reeves, and Pecos Cos. Missouri: St. Louis Co. Illinois: Madison, St. Clair, and Monroe Cos.

Habitat. — Members of the genus *Succinea* seem to thrive in moist habitats; however, species identified as *S. grosvenori* "tolerate an astonishing wide range in practically all external conditions." (Pilsbry 1948, p. 821).

Remarks. — Many species of *Succinea* intermediate in size between the larger forms like *S. ovalis* Say and the smaller forms like *S. avara* Say and *S. gelida* Baker have probably been included under the name *S. grosvenori*. Hubricht (1963, pp. 135-137), after a study

of Recent specimens from the type locality at Alexandria, Louisiana, concluded that the shells from the loess of the upper Mississippi valley, usually identified as *S. grosvenori* Lea are, in reality, a different species. Hubricht elected to give a new name, *S. bakeri,* to these forms. Anatomical studies were, of necessity, impossible. The authors are unable to draw distinctions either in measurements or form of shell, from some specimens of this fauna and forms described by Lea, Pilsbry, and others, as *S. grosvenori.* Therefore, we desire to retain, for the time being, the "form species" name, *S. grosvenori.*

Occurrence. — Localities 3, 4, 5, 6, 7, 9.

Measurements of Succinea grosvenori in m m.

Locality	Shell Height	Shell Width	Shell H/W	Aperture Height	Aperture Width	Aperture H/W	Whorls
5	11.30	6.20	1.82	6.75	4.40	1.53	3 1/8
5	11.60	7.00	1.66	8.00	4.30	1.86	3
5	11.30	6.60	1.71	7.10	4.60	1.54	3
5	10.00	6.60	1.51	6.30	4.30	1.47	3
5	12.80	7.30	1.75	8.10	5.00	1.62	3
6	10.80	6.60	1.64	6.90	4.20	1.64	3
6	10.70	6.50	1.65	6.50	3.80	1.71	3
7	12.90	7.10	1.82	7.70	5.50	1.54	3 1/2
9	15.70	8.40	1.87	8.95	5.60	1.60	3 3/8
9	11.35	6.40	1.77	7.20	4.60	1.56	3 1/8

Succinea gelida (F. C. Baker) Pl. 17, figs. 15, 16

Succinea grosvenorii gelida Baker, 1927, Nautilus, vol. 40, No. 4, p. 118.
Succinea grosvenori gelida Baker, Pilsbry, 1948, Acad. Nat. Sci. Philadelphia, Monogr., No. 3, vol. 2, pt. 2, p. 823, fig. 444 g, h.
Catinella gelida (Baker), Hubricht, 1963, Nautilus, vol. 76, No. 4, p. 137.

Description. — Shell obliquely conic, small, narrow, thin and fragile; spire acute, slightly less than half the height of shell; color pale yellow; whorls 3 - 3½, initial whorl smooth, remainder marked by irregular growth striae; body whorl slightly flattened; suture deeply impressed; aperture round; peristome thin, inner margin curving in to parietal wall; thin callus present on parietal wall.

Geologic range. — Yarmouth to Recent (?).

Recent distribution. — Unknown.

Fossil distribution. —

Pleistocene — Kansan faunas — Indiana: Putnam and Parke Cos. (both *Succinea gelida* "var.") Yarmouth faunas — Illinois: Bureau Co. Illinoian faunas — Indiana: Monroe Co. (*S. gelida* "var."). Parke and Wayne Cos. Sangamon faunas — Illinois: Boone Co. Wis-

consin faunas — Ohio: Cuyahoga Co. Indiana: Morgan, Johnson, Hendricks, Rush, Shelby, Wayne, Noble, and Marion Cos. Illinois: Stevenson, Carroll, Rock Island, Henry, Bureau, Marshall, Henderson, Peoria, Woodford, Fulton, Tazewell, Mason, Schuyler, Cass, Menard, Brown, Morgan, Pike, Scott, Jersey, Madison, Mercer, Warren, Whiteside, Boone, Adams, Ogle, and Gallatin Cos. Kentucky: Fulton, Crittenden, Daviess, Henderson, and Jefferson Cos.

Pleistocene — age unknown — Texas: Crane, Ward, Reeves, and Pecos Cos.

Habitat. — Lives in cool to cold climate. The normal association of this species with the faunas of this study which require a moist situation not far from water leads the authors to conclude that *S. gelida* prefers a similar situation.

Remarks. — Use of the specific name *gelida* is employed here because the shells conform to those Baker described from the loess of Illinois. It is possible as Hubricht (1963) suggested that the name has been applied to more than one species.

Wayne (1959, p. 93, 1963, p. 137) considered Recent specimens found at Churchill, Manitoba, identical (in shell characteristics) to this species, as found in Wisconsin sediments in Indiana. No anatomical studies were made on the Churchill specimens.

Occurrence. — Localities 1, 2, 4, 8, 9.

Measurements of Succinea gelida in m m.

Locality	Shell			Aperture			Whorls
	Height	Width	H/W	Height	Width	H/W	
2	5.68	3.96	1.44	3.29	2.41	1.36	3 1/8
2	4.56	3.12	1.61	2.70	2.01	1.34	3 1/8
2	5.89	3.49	1.69	3.19	2.41	1.32	3 1/4
2	5.40	3.49	1.55	3.22	2.25	1.43	3 1/2
4	6.10	4.82	1.26	4.02	2.91	1.39	3
4	6.72	4.30	1.56	4.10	2.84	1.46	3 1/8
8	6.51	4.50	1.45	3.82	2.84	1.34	3 1/4
8	6.53	4.50	1.45	3.49	2.62	1.33	3
9	7.04	4.98	1.42	3.49	2.56	1.36	3 1/4
9	6.38	3.82	1.67	3.62	2.77	1.30	3

Family **STROBILOPSIDAE**

Genus **STROBILOPS** Pilsbry, 1893

Subgenus **STROBILOPS** s. s.

Strobilops labyrinthica (Say) Pl. 16, figs. 22-24

Helix labyrinthica Say, 1817, Acad. Nat. Sci. Philadelphia, Jour., No. 1, p. 121.
Strobilops labyrinthica (Say), Pilsbry, 1948, Acad. Nat. Sci. Philadelphia. Monogr., No. 3, vol. 2, pt. 2, p. 851, fig. 163.

Description. — Shell dome-shaped with periphery subangular, narrowly perforate; color light brown to white with first 1½ whorls paler; whorls five - six convex, widening slowly and regularly; initial whorls smooth, remainder obliquely rib striate with ribs pronounced on upper surface and weakening on base of shell; sutures well impressed; aperture semilunate; lip thick, reflected; two teeth externally visible on parietal wall, a strong parietal and a smaller infraparietal; parietal tooth emerges from shell to edge of parietal callus; infraparietal shows only slightly in basal view; internal teeth consist of an interpalatal and five to six basopalatals.

Geologic range. — Late Pliocene to Recent.

Recent distribution. — Maine and Quebec west to Manitoba, Minnesota, Kansas, and Arkansas, south to Georgia and Alabama.

Fossil distribution. —

Pliocene — Kansas: Seward Co.

Pleistocene — Kansan faunas — Indiana: Putnam Co. Texas: Knox Co. Illinoian faunas — Indiana: Monroe Co. Oklahoma: Canadian and Caddo Cos. (Illinoian?), Wisconsin faunas — Ohio: Erie and Cuyahoga Cos. Illinois: Madison, Alexander, and Cass Cos. Kentucky: Fulton, Henderson, Union, and Jefferson Cos. Wisconsin: Marinette and Waupaca Cos. Oklahoma: Caddo and Harper Cos. (Wisconsin or Illinoian?)

Pleistocene — age unknown — Mississippi: Tate, Tallahatchie, Grenada, Carroll, Yazoo, Hinds, and De Soto Cos. Missouri: St. Louis Co. Tennessee: Jackson Co. Illinois: Madison and St. Clair Cos. Indiana: Posey Co.

Habitat. — Generally confined to moist woodland habitats and only rarely found far from the edge of the forest. Occurs most often in moist leaves and moist logs, and in sod at the foot of trees. Occasionally lives close to the water line under sticks, crawling on old stumps, and in mossy crevices. Often associated with *Zonitoides arboreus* and *Nesovitrea electrina*.

Remarks. — This is the common *Strobilops* of the late Pleistocene and Recent in the Kentucky, Illinois, and Indiana area. It is a long ranging species dating back to the late Pliocene. It differs from *S. sparsicostata* Baker which has been reported only as a fossil, in the slightly larger size, the coarser and more widely spaced riblets, and the deeper penetration of the parietal lamella. *S.*

sparsicostata ranges from the middle Pliocene to the lower and perhaps middle Pleistocene.

Some specimens of this fauna are large for the species and number up to six whorls.

Occurrence. — Localities 2, 7, 8, 9.

Measurements of Strobilops labyrinthica in m m.

Locality	Shell Height	Shell Width	Shell H/W	Aperture Height	Aperture Width	Aperture H/W	Whorls
2	1.54	2.22	.69	.47	.80	.59	5
8	1.88	2.41	.78	.67	.87	.77	5 1/2
8	1.88	2.38	.79	.60	.87	.69	5 1/2
8	1.68	2.48	.68	.54	.74	.72	5 1/4
9	1.81	2.77	.65	.60	.90	.67	5 5/8
9	1.61	2.34	.69	.54	.67	.80	5 1/2
9	1.95	2.77	.70	.67	1.00	.67	5 3/4
9	1.61	2.56	.63	.60	.87	.70	5 1/2
9	1.48	2.48	.60	.54	.94	.57	6
9	1.71	2.41	.71	.60	.80	.75	5 3/4

Family **PUPILLIDAE**

Subfamily **GASTROCOPTINAE**

Genus **GASTROCOPTA** Wollaston, 1878

Subgenus **ALBINULA** Sterki, 1892

Gastrocopta armifera (Say) Pl. 15, fig. 5

Pupa armifera Say, 1821, Acad. Nat. Sci. Philadelphia, Jour., vol. 2, p. 162.
Bifidaria armifera (Say), Sterki, 1909, Nautilus, vol. 23, No. 4, p. 52 with var. *interpres* (p. 52) *similis, affinis, abbreviata* (p. 53).
Gastrocopta armifera (Say), Pilsbry, 1948, Acad. Nat. Sci. Philadelphia, Monogr., No. 3, vol. 2, pt. 2, p. 874, fig. 472, Nos. 1-4.

Description. — Shell large for genus, ovate, rimate; color chalky white; whorls six-seven, swollen; body whorl half the height of shell, contracted at the base; nuclear whorls smooth, remainder finely rib striate; sutures well impressed; denticles five-six, angulo-parietal lamella bifed, joined to outer lip near its insertion; folds situated on a low callus, a tubercular suprapalatal, a short upper palatal, a somewhat longer, entering lower palatal; basal lamella, if present, inconspicuous; columellar lamella prominent, triangular and directed outwardly; aperture imperfectly rounded; peristome thin, reflected but not connected across parietal wall.

Geologic range. — Early Pliocene to Recent.

Recent distribution. — Quebec to northern Florida, west to the Rocky Mountains.

Fossil distribution. —

Pliocene — Okahoma: Beaver Co.

Pleistocene — Nebraskan or Aftonian faunas — Kansas: Kingman Co. Aftonian faunas — Kansas: Meade Co. Indiana: Putnam Co. Kansan faunas — Texas: Knox and Baylor Cos. Yarmouth faunas — Nebraska: Knox Co. North Dakota: Grant Co. Kansas: Dickinson and Meade Cos. Texas: Roberts and Hartley Cos. Illinoian faunas — Texas: Briscoe Co. Oklahoma: Caddo and Canadian Cos. (Illinoian?), Kansas: Phillips Co. Indiana: Monroe Co. Sangamon faunas — Kansas: Meade Co. Texas: Foard Co. Wisconsin faunas — Kansas: Phillips Co. Ohio: Erie, Butler, and Hamilton (?) Cos. Indiana: Morgan, Johnson, Wayne, and Dearborn (?) Cos. Illinois: Mason, Cass, Menard, Brown, Pike, Jersey, and Madison Cos. Kentucky: Fulton, Henderson, Daviess, Union, and Jefferson Cos. Texas: Hardeman, Clay, and Delta Cos. Oklahoma: Caddo and Harper Cos. (Wisconsin or Illinoian?). PostHypsithermal faunas — North Dakota: Richland Co.

C-14 dated records — Texas: Motley Co. 31,400 ± 5,600 years B. P., Dallas Co. slightly more than 37,000 years B. P. and Denton Co. 28,840 years B. P., North Dakota: Richland Co. 2,540 ± 300 years B. P.

Pleistocene — age unknown — Missouri: Boone, St. Charles, Franklin, and St. Louis Cos. Mississippi: Tallahatchie, Carroll, Hinds, Warren, Claiborne, and Adams Cos. Illinois: Madison, St. Clair, and Union Cos. Tennessee: Jackson Co. Texas: Comal, Bexar, Kerr, and Bandera Cos. Indiana: Posey Co.

Habitat. — *G. armifera* is a gregarious species, occurring commonly on wooded slopes, near or removed from a stream. Found under dead wood, limestone rocks, or a light cover of leaf mold or other debris. Generally prefers woodlands, but a single tree with dead wood above it often supports an entire colony.

Remarks. — This is the largest pupillid and *Gastrocopta* of the fauna. Pilsbry (1940, pp. 878-879) listed a variety of named forms of this species, giving the data "for what they may be worth." These infraspecific forms are not known to be confined to definite geographic areas or show variations in morphology that would restrict

them to a particular habitat. It seems wiser to consider them as one species until such time as a specific habitat or range might be assigned. Specimens of this fauna resemble Sterki's form *G. similis*, being somewhat smaller in size than the type, more cylindric, and without a continuous peristome.

Occurrence. — Localities 5 (?), 7, 8.

Measurements of Gastrocopta armifera in m m.

Locality	Shell			Aperture			Whorls
	Height	Width	H/W	Height	Width	H/W	
7	3.60	2.08	1.76	1.21	1.08	1.12	6 1/2
7	3.80	2.01	1.89	1.14	1.00	1.14	6 1/4
8	3.86	2.15	1.80	1.14	1.14	1.00	6 1/2
8	4.00	2.08	1.92	1.21	1.14	1.06	6 1/2
8	3.86	2.01	1.92	1.14	1.14	1.00	6 1/4
8	3.93	2.05	1.92	1.21	1.08	1.12	6 1/4
8	3.86	2.01	1.92	1.00	1.00	1.00	6 1/8
8	3.93	2.15	1.83	1.21	1.21	1.00	6 3/4
8	3.45	2.01	1.72	1.08	1.00	1.08	6 1/3
8	4.30	2.15	2.00	1.21	1.14	1.06	6 3/4

Subgenus **VERTIGOPSIS** Sterki, 1893

Gastrocopta tappaniana (C. B. Adams) Pl. 17, fig. 3

Pupa tappaniana "Ward" C. B. Adams, 1842, *in* Thompson's History of Vermont, p. 158.

Gastrocopta tappaniana (C. B. Adams), Pilsbry, 1918, Acad. Nat. Sci. Philadelphia, Monogr., No. 3, vol. 2, pt. 2, p. 889, fig. 477, No. 9.

Description. — Shell ovate-conic with obtuse apex, minutely perforate; color white; whorls 4½ - 5, swollen; body whorl over half the height of shell; nuclear whorls smooth, remainder rib striate; sutures well impressed; denticles six - eight; parietal lamella straight, situated midway on parietal wall; folds situated on a low but prominent callus, usually six in number, a tubercular suprapalatal, an upper palatal, an interpalatal, a lower palatal, an infrapalatal and a basal; lower palatal entering only slightly more than upper palatal; columellar lamela ascends slightly toward axis; peristome thin, narrowly reflected and connected across the parietal wall by a thin callus; a heavy crest paralleling the peristome is separated from it by a groove.

Geologic range. — Late Pliocene to Recent.

Recent distribution. — Ontario and Maine to Virginia and Alabama, west to South Dakota and Kansas, southwest to Arizona, but not known from southeastern Atlantic States, Virginia to Florida.

Fossil distribution. —

Pliocene — Kansas: Seward and Meade Cos.

Pleistocene — Nebraskan or Aftonian faunas — Nebraska: Brown Co. Yarmouth faunas — Iowa: Harrison Co. Nebraska: Knox and Harlan Cos. Kansas: Jewel, Gove, Lincoln, Dickinson, Clark, Meade, and Seward Cos. Oklahoma: Woodward and Washita Cos. Texas: Roberts and Hartley Cos. Illinoian faunas — Texas: Brisco Co. Indiana: Wayne Co. Oklahoma: Caddo and Canadian Cos. (Illinoian?). Sangamon faunas — Kansas: Meade Co. Wisconsin faunas — Ohio: Erie, Stark, and Sandusky (?) Cos. Indiana: Wayne Co. Texas: Clay Co. Oklahoma: Harper Co. (Wisconsin or Illinoian?). Kentucky: Fulton and Henderson Cos.

C-14 dated records — Texas: Motley Co. 31,400 ± 5,600 years B. P.

Pleistocene — age unknown — Texas: Brooks Co. Mississippi: Warren Co. Missouri: St. Louis Co. Illinois: Madison and St. Clair Cos.

Habitat. — Lives under logs and bark or among leaves, moss or grass in moist situations close to water. *G. tappaniana* is often found with *Vertigo ovata.*

Remarks. — Specimens of *G. tappaniana* are typical for the species and are recorded here from their recognized habitat. Habitat, as well as range, separates the two species *G. tappaniana* and *G. pentodon* — species considered one by some authors. Pilsbry (1948, p. 889) stated, "While it must be admitted that occasional individuals are intermediate between *tappaniana* and *pentodon* yet the two forms are readily separable in the great majority of lots. They differ in station, *tappaniana* being found in low moist places, under wood, often with *Vertigo ovata* while *pentodon* lives in dryer situations, as Dr. Sterki noted." The fact that Oughton (1948, p. 53) noted different ranges for the two species would seem to indicate they are separate and valid species rather than ecological forms.

Occurrence. — Locality 2.

Gastrocopta contracta (Say) Pl. 17, fig. 8

Pupa contracta Say, 1822, Acad. Nat. Sci. Philadelphia, Jour., vol. 2, p. 374.
Gastrocopta contracta (Say), Pilsbry, 1948, Acad. Nat. Sci. Philadelphia, Monogr., No. 3, vol. 2, pt. 2, p. 880, fig. 471, Nos. 9-12.

Measurements of Gastrocopta tappaniana in m m.

Locality	Shell Height	Shell Width	Shell H/W	Aperture Height	Aperture Width	Aperture H/W	Whorls
2	1.88	1.21	1.55	.60	.60	1.00	4 3/4
2	1.81	1.14	1.59	.47	.54	.88	4 1/2
2	1.74	1.14	1.52	.47	.54	.88	4 1/2
2	1.98	1.28	1.55	.60	.60	1.00	4 1/2
2	1.74	1.21	1.44	.54	.54	1.00	4 1/2
2	1.74	1.14	1.53	.40	.47	.87	4 1/2
2	1.81	1.21	1.50	.47	.47	1.00	4 1/2
2	1.70	1.14	1.49	.54	.47	1.14	4 1/2
2	1.88	1.14	1.65	.54	.60	.89	4 3/8
2	1.81	1.21	1.50	.47	.54	.88	4 1/2

Description. — Shell ovate-conic, rimate; color white; whorls five, increasing regularly in size; body whorl slightly more than half the height of shell, contracted at the base, in the latter half descending to the aperture where it expands, impressed over the lower palatal; crest present behind outer lip, paralleling peristome; peristome reflected, callus on inner columella margin; denticles four, large, almost filling aperture; a fused angulo-parietal joining the lip at its juncture with the peristome bends, about midway, forming a right angle towards the outer lip, descending dorsally and curving inward; a broad lamelliform inwardly descending columellar; a tubercular immersed upper palatal resting on a slight callus and an obliquely descending deeply immersed lower palatal.

Geologic range. — Pliocene to Recent.

Recent distribution. — Maine to Florida; west to Manitoba, South Dakota, central Kansas, western Texas, and Sonora; southward in Mexico to the states of Morelos and Vera Cruz. In the Gulf Coastal Plain from Alabama to Texas, and northward in the Mississippi lowlands to Arkansas the typical form is replaced by another subspecies.

Fossil distribution. —

Pliocene — Oklahoma: Beaver Co.

Pleistocene — Kansan faunas — Kansas: Meade Co. Yarmouth faunas — Kansas: Lincoln and Dickinson Cos. Oklahoma: Washita Co. Illinoian (?) faunas — Oklahoma: Canadian and Caddo Cos. Sangamon faunas — Kansas: Meade Co. Texas: Foard Co. Wisconsin faunas — Ohio: Erie, Hamilton, and Defiance Cos. Illinois: Cass and Madison Cos. Kentucky: Union, Fulton, and Henderson Cos. Oklahoma: Harper Co. (Wisconsin or Illinoian?), Texas: Delta Co. PostHypsithermal faunas — North Dakota: Richland Co.

C-14 dated records — Texas: Denton Co. 28,840 years B. P., Dallas Co., slightly more than 37,000 years B. P., North Dakota: Richland Co. 2,540 ± 300 years B. P.

Pleistocene — age unknown — Mississippi: De Soto, Tate, Tallahatchie, Grenada, Carroll, Hinds, Warren, and Adams Cos. Missouri: Callaway, St. Louis, Boone, and St. Charles Cos. Louisiana: West Feliciana Parish. Illinois: Madison and Union Cos. Tennessee: Jackson Co. Texas: Comal, Kendall, Kerr, Bandara, and Brooks Cos.

Habitat. — On shaded slopes along the water courses, under dead wood, leaf mold and grass.

Remarks. — The single specimen of this species recovered from the fauna corresponds well with type specimens. Apparently, the species was not a dominant representative of the genus *Gastrocopta*. The number of individuals recovered is in small proportion to other representatives, not only in this assemblage but in those from other areas.

Occurrence. — Locality 9.

Measurement of Gastrocopta contracta in m m.

Locality	Shell			Aperture			Whorls
	Height	Width	H/W	Height	Width	H/W	
9	2.31	1.38	1.68	.94	.74	1.27	5

Subfamily **VERTIGININAE**

Genus **VERTIGO** Müller, 1774

Subgenus **VERTIGO** s. s.

Vertigo gouldi (Binney) Pl. 17, fig. 2

Pupa gouldi Binney, 1843, Boston Soc. Nat. Hist., Proc., vol. 1, p. 105.
Vertigo gouldi (Binney), Binney, Terr. Moll., 2, p. 332, p. 51, fig. 2.
Vertigo gouldi (Binney), Pilsbry, 1948, Acad. Nat. Sci. Philadelphia, Monogr., No. 3, vol. 2, pt. 2, p. 971, fig. 515: 1, 5, 8.

Description. — Shell ovate with obtuse apex, rimate; color light brown; whorls 4½ - 5, sharply striate, convex, with swollen appearance, increasing regularly and rapidly in size, body whorl at least half the length of shell; denticles five; parietal lamella strong, situated midway on parietal wall; columellar lamella strong; basal fold tubercular; upper and lower palatal folds present, both somewhat elongate with the lower fold entering slightly more deeply

than the upper; aperture biarcuate; peristome not reflected, connected across parietal wall by a thin callus; crest behind lip and impressions on body whorl over the upper and lower palatals.

Geologic range. — Yarmouth to Recent.

Recent distribution. — Prince Edward and Magdalen Islands, British Columbia, and Montana; Potomac River, North Carolina; mountains of Tennessee, Alabama.

Fossil distribution. —

Pleistocene — Yarmouth faunas — Kansas: Gove, Lincoln, and Meade Cos. Sangamon faunas — Kansas: Meade Co. Wisconsin faunas — Ohio: Butler Co. Kentucky: Fulton and Henderson Cos.

Pleistocene — age unknown — Kansas: Phillips Co. Mississippi: Warren, Hinds, Adams, and Wilkinson Cos. Louisiana: West Feliciana Parish. Missouri: St. Louis Co. Tennessee: Jackson Co.

Habitat. — Lives under logs and bark or among leaves, moss, or grass in moist situations not far from water.

Remarks. — *V. gouldi* is a species limited today to regions of cool and somewhat humid climate. Southward it follows the mountains of Tennessee and Alabama. Oughton (1948 p. 58) in referring to Canadian distribution stated, "probably all Ontario. Our records show it ranges from Lake Erie and Ontario north to James Bay and northwest to Borthwick Lake . . ."

Pleistocene distribution extended to states bordering the Mississippi — Louisiana, Mississippi, Tennessee, Missouri, and here reported from Kentucky. Franzen and Leonard (1947, p. 358) reported it from Kansas and as being limited to the lower Pleistocene (Meade Formation). In Kentucky and Ohio it has not been reported from sediments older than Wisconsin. Pleistocene records from other states do not give a specific age.

Hibbard and Taylor (1960, p. 135) stated, "The present classification of the *Vertigo gouldi* group is unsatisfactory. Until it has been revised, the relationship of the fossils from Kansas to similar Recent snails will remain uncertain and inferences about details of habitat will not be reliable." Species associated with *V. gouldi* in the present fauna are forms favoring a moist habitat.

Kentucky specimens of *V. gouldi* compare well with Kansas forms in number and structure of denticles. Both possess a tubercular basal fold.

In three of the localities studied (4, 8, 9) the specimens range from 1.8 to 2.1 mm in length, tending to the larger size. In the fourth locality (2) the range in length is from 1.6 to 1.9 mm, tending to the smaller size.

Occurrence. — Localities 2, 4, 8, 9.

Measurements of Vertigo gouldi in m m.

Locality	Shell Height	Shell Width	Shell H/W	Aperture Height	Aperture Width	Aperture H/W	Whorls
8	1.95	1.21	1.61	.47	.54	.87	5
8	2.05	1.21	1.69	.54	.54	1.00	4 7/8
8	2.15	1.14	1.89	.47	.47	1.00	5
8	1.81	1.18	1.53	.47	.50	.94	4 1/2
8	1.88	1.14	1.65	.47	.47	1.00	4 1/2
9	2.15	1.14	1.88	.54	.47	1.15	4 7/8
9	2.12	1.21	1.75	.47	.54	.87	4 1/4
9	2.08	1.24	1.68	.47	.54	.87	4 1/2
9	2.85	1.18	2.41	.40	.54	.74	4 1/2
9	1.95	1.14	1.71	.47	.47	1.00	4 3/4

Vertigo hubrichti Pilsbry Pl. 17, fig. 1

Vertigo gouldi hubrichti Pilsbry, 1934, Man. Conch., vol. 28, p. 99, pl. 22, figs. 12-14.

Vertigo gouldi hubrichti ? Pilsbry, 1948, Acad. Nat. Sci. Philadelphia, Monogr., No. 3, vol. 2, pt. 2, p. 973, fig. 521.

Description. — Shell subcylindrical with obtuse apex, rimate; color light brown with white apex; whorls 5 - 5½, convex, increasing rapidly in size, nuclear whorls smooth, remainder marked by sharp striae; body whorl large, slightly over half the height of shell, constricted somewhat at the base; denticles four; parietal lamella strong, situated midway on parietal wall; two strong elongate palatals, both entering obliquely, the lower deeply immersed; columellar lamella, nodose, prominent; aperture biarcuate; peristome simple, connected across parietal wall by a callus; long, deep impressions on body whorl mark the position of the upper and lower palatals.

Geologic range. — Kansan (?) through late Wisconsin.

Recent distribution. — Recorded as a Pleistocene fossil only.

Fossil distribution. —

Pleistocene — Kansan faunas — Indiana: Putnam Co. Wisconsin faunas — Indiana: Morgan and Johnson Cos. Illinois: Pike, Green, Jersey, Fulton, Menard, Mason, Brown, Jackson, and Alexander Cos. Kentucky: Fulton,[4] Henderson,[4] Union, Daviess, and Jefferson Cos.

[4]Reported previously by authors as *Vertigo gouldi paradoxa.*

Pleistocene — age unknown — Missouri: St. Charles and St. Louis Cos. Illinois: Madison, St. Clair and Monroe Cos. Indiana: Posey Co.

Habitat. — Lives under dead wood and leaves in humid places.

Remarks. — *V. hubrichti* is known only as a fossil. With one exception, this form has been recorded only from sediments of Wisconsin age. Wayne (1959, pp. 14, 16) reported it from Kansan sediments in Indiana. The fossil distribution, as presently known, limits this species to the east central states of Missouri, Illinois, Indiana, and Kentucky. In the area of Kansas and the High Plains, it is apparently replaced by *Vertigo gouldi paradoxa*.

V. hubrichti has affinities with both *V. gouldi paradoxa* and *V. nylanderi*. If differs from the former in having the basal fold well developed and deep external impressions over the palatal folds. In *V. gouldi paradoxa* the basal fold is often absent. *V. nylanderi* is smaller than *V. hubrichti* and has an angular lamella.

Occurrence. — Localities 2, 4, 5, 6, 7.

Measurements of Vertigo hubrichti in m m.

Locality	Shell Height	Shell Width	Shell H/W	Aperture Height	Aperture Width	Aperture H/W	Whorls
5	2.15	1.08	1.99	.54	.50	1.08	5 1/8
5	1.95	1.04	1.87	.50	.40	1.25	4 7/8
5	1.95	1.14	1.71	.54	.47	1.15	5
5	2.08	1.08	1.93	.54	.47	1.15	5
5	2.01	1.08	1.86	.54	.47	1.15	4 7/8
6	2.22	1.08	2.06	.60	.40	1.50	5 1/2
6	2.08	1.04	2.00	.54	.47	1.15	5
6	2.01	1.14	1.76	.54	.54	1.00	4 7/8
6	2.15	1.08	1.99	.50	.50	1.00	4 2/3
6	2.22	1.14	1.95	.60	.47	1.28	5 1/4

Vertigo modesta (Say) Pl. 17, fig. 9

Pupa modesta Say, 1821, Long's Second Exped., Appendix, p. 259, pl. 15, fig. 5.
Vertigo modesta (Say), Pilsbry and Vanatta, 1900, Acad. Nat. Sci. Philadelphia, Proc., p. 600, pl. 23, figs. 2, 3, 6.
Vertigo modesta (Say), Pilsbry, 1948, Acad. Nat. Sci. Philadelphia, Monogr., No. 3, vol. 2, pt. 2, p. 982, fig. 527; p. 991, fig. 531, 1-2, fig. 528, 1-3.

Description. — Shell oblong-cylindrical with obtuse apex; color light tan with nuclear whorl pale to white; whorls 5 - 5½, notably striate, convex, body whorl over half the height of shell; denticles three-four; parietal, columellar and basal lamellas low and of subequal prominence; tubercular upper palatal frequently but not always present; aperture ovate; lip slightly reflected with outer

margin nearly straight, connected across parietal wall by thin callus; low crest usually present behind outer lip.

Geologic range. — Kansan to Recent.

Recent distribution. — Labrador to Victoria and Nanaimo, Alaska. Reported from Maine, Vermont, and Connecticut.

Fossil distribution. —

Pleistocene — Kansan faunas — Kansas: Phillips Co. Indiana: Putnam Co. Yarmouth faunas — North Dakota: Grant Co. Iowa: Monona Co. Kansas: Russell Co. Illinoian faunas — Indiana: Monroe and Wayne Cos. Wisconsin faunas — Kansas: Republic, Jewel, Smith, Norton, Decatur, and Rawlins Cos. Indiana: Morgan, Johnson, Hendricks, and Shelby Cos. Illinois: Carroll Rock Island, Bureau, Henderson, Peoria, Woodford, Fulton, Tazewell, Mason, Schuyler, Cass, Menard, Brown, Morgan, Pike, Scott, Jersey, Madison, Jackson, and Alexander Cos. Kentucky: Union, Henderson, Daviess, and Jefferson Cos.

Pleistocene — age unknown — Indiana: Posey Co. Missouri: St. Louis Co. Illinois: Madison, St. Clair and Monroe Cos. Indiana; Posey Co.

Habitat. — Thrives in cool, humid climates.

Remarks. — *Vertigo modesta* is a species with a preference for a cool and humid climate. Hence, its distributional pattern has changed since Pleistocene times. It has receded from the Mid-Continental regions of Kansas and Missouri and the east-central area of Kentucky and Indiana (the southern limit) to the northern United States, ranging today from Maine to California.

This is a common species in this fauna with specimens running somewhat larger than those reported elsewhere. Individuals measuring 2.7 mm in length were found at all the sites. Numerous large forms were recovered from locality 4 with one specimen attaining a length of 2.9 mm. Optimum habitat conditions must have prevailed at the time of deposition.

Occurrence. — Localities 3, 4, 5, 6, 7.

Genus **COLUMELLA** Westerlund, 1878

Columella alticola (Ingersoll) Pl. 17, fig. 4

Pupilla alticola Ingersoll, 1875, Bull. U.S. Geol. Sur. Geogr. Sur. Terr. 1, p. 128.
Columella alticola (Ingersoll), Pilsbry, 1948, Acad. Nat. Sci. Philadelphia, Monogr., No. 3, vol. 2, pt. 2, p. 1003, fig. 536.

Measurements of Vertigo modesta in m m.

Locality	Shell Height	Shell Width	Shell H/W	Aperture Height	Aperture Width	Aperture H/W	Whorls
4	2.63	1.48	1.78	.67	.60	1.11	5 1/8
4	2.80	1.41	1.99	.67	.67	1.00	5 1/4
4	2.41	1.34	1.80	.67	.60	1.11	5
4	2.84	1.48	1.93	.80	.67	1.20	5 1/8
4	2.91	1.41	2.07	.80	.67	1.20	5 1/2
4	2.59	1.38	1.88	.74	.67	1.10	4 7/8
6	2.48	1.34	1.85	.70	.60	1.16	5
6	2.56	1.44	1.78	.74	.60	1.22	5
7	2.28	1.34	1.70	.67	.67	1.00	4 7/8
7	2.62	1.28	2.05	.74	.67	1.10	5 1/8

Description. — Shell cylindrical or barrel-shaped with obtuse apex, perforate; color pale brown with nuclear whorls white; whorls 6½ - 7½, convex, wider than high, of equal size except for apical and body whorls; body whorl markedly larger, expanding toward aperture; nuclear whorls smooth, remainder finely and irregularly rib striate; sutures well impressed; aperture edentulous, oblique and ovate; peristome thin and sharp, reflected slightly over columellar region.

Geologic range. — Wisconsin (Tazewell) to Recent.

Recent distribution. — Alberta and British Columbia; mountainous regions of New Mexico, Arizona, Colorado, and Wyoming; Illinois, Iowa, and Kansas.

Fossil distribution. —

Pleistocene — Wisconsin faunas — Kansas: Jewel, Norton, Phillips, and Decatur Cos. Ohio: Shelby, Cuyahoga and Butler Cos. Indiana: Johnson, Hendricks, Shelby, Vigo, and Morton Cos. Illinois: Stevenson, Carroll, Henry, Bureau, Marshall, Henderson, Peoria, Woodford, Fulton, Tazewell, Schuyler, Cass, Menard, and Brown Cos. Kentucky: Daviess, Henderson, and Jefferson Cos.

Pleistocene — age unknown — Missouri: St. Charles and St. Louis Cos. Mississippi: Adams and Warren Cos. Illinois: Madison and St. Clair Cos.

Habitat. — Restricted to areas with cool temperature and humid climate.

Remarks. — *Columella alticola* may be distinguished from other species of the genus by its cylindric shape, its rounded summit, and more swollen final whorl.

The species seems to have been more widespread in Pleistocene times since it has been reported as far south as Missouri and Mississippi. Browne and McDonald (1960, p. 174) reported it previously from Kentucky. *C. alticola* is intolerant of low humidity and high temperatures which probably accounts for its disappearance from the more southerly areas of its former distribution.

In Kentucky, this species is restricted to the upper part of the Tazewell. Other reported occurrences place it at a corresponding stratigraphic horizon.

Occurrence. — Localities 5, 6, 7, 9.

Measurements of Columella alticola in m m.

Locality	Shell Height	Shell Width	Shell H/W	Aperture Height	Aperture Width	Aperture H/W	Whorls
5	2.48	1.21	2.04	.60	.60	1.00	6 1/4
5	2.62	1.28	2.04	.60	.60	1.00	6 1/2
5	2.80	1.28	2.18	.60	.60	1.00	6 1/2
5	3.05	1.34	2.28	.67	.64	1.05	7
5	2.77	1.34	2.06	.67	.67	1.00	6 1/2
5	3.12	1.41	2.20	.74	.67	1.10	7
5	3.36	1.41	2.38	.70	.67	1.05	7 1/2
7	2.98	1.34	2.22	.67	.54	1.24	6 1/2
7	3.05	1.21	2.52	.67	.54	1.24	6 1/2
7	3.05	1.28	2.38	.67	.60	1.12	7

Family **VALLONIIDAE**

Genus **VALLONIA** Risso, 1826

Vallonia albula Sterki — Pl. 15, figs. 9, 10

Vallonia gracilicosta Sterki, July 1893, in part, Man. Conch., vol. 8, p. 265.
Vallonia albula Sterki, Sept. 1893, Acad. Nat. Sci. Philadelphia, Proc., p. 263, pl. 8, figs. D. O.
Vallonia albula (Sterki) Pilsbry, 1948, Acad. Nat. Sci. Philadelphia, Monogr., No. 3, vol. 2, pt. 2, p. 1031, fig. 550.

Description. — Shell thin, silky appearing, with slightly elevated spire; color white; whorls 3½ - 4, convex, nuclear whorls smooth, remainder marked by fine oblique striae; striae number about 55 on final whorl and extend to umbilicus; final whorl rapidly enlarging and descending to aperture; sutures impressed; umbilicus broad, deep, and showing coils to apex; aperture round; peristome reflected and thickened, margins approach across parietal wall where they are connected by a thin callus.

Geologic range. — Illinoian to Recent.

Recent distribution. — Newfoundland, Manitoba, Massachusetts, Maine, New York, Idaho, Wyoming, South Dakota, Colorado, New Mexico, and California.

Fossil distribution. —

Pleistocene — Illinoian faunas — Indiana: Wayne Co. Wisconsin faunas — Indiana: Johnson, Hendricks, and Shelby Cos. Kentucky: Henderson, Crittenden, Daviess, and Jefferson Cos. Utah: St. Pete Co. (Wisconsin?).

Habitat. — Lives in moss and among dead leaves, under decaying wood and stones. *V. albula* is sensitive to light.

Remarks. — Pilsbry (1948, p. 1032) mentioned the difficulty of distinguishing between *V. gracilicosta* and *V. albula*. He separated *V. gracilicosta* from *V. albula* by the narrower lip of the latter species. However, his detailed accounts of these two species (1948, pp. 1029 - 1032) listed other distinguishing characteristics. *V. gracilicosta* is described as having 3½ whorls and 45 to 50 ribs on the final whorl whereas 3½ to four whorls and 55 crowded ribs on the final whorl are recorded for *V. albula*. The containment of the umbilicus in the diameter is not given for *V. gracilicosta,* but for *V. albula* the ratio is given as slightly over three.

Forms of this fauna are identified as *V. albula*. Whorls number 3½ - 4 and have the requisite 55 crowded ribs. The umbilicus is contained from 3 to slightly over 3½ times in the diameter.

Data on the distributional record for *V. gracilicosta* are given by Hibbard and Taylor (1960, p. 138) as follows: "Rocky Mountains from southern Arizona and New Mexico (at high elevations) northward to Montana; Nebraska eastward to Minnesota and Iowa. A single California record was given by Pilsbry (1948, p. 1030). Shells from farther south (Texas, Oklahoma, Kansas, Missouri) are apparently all fossil. The northern and northeastern limits are uncertain." *V. albula* has not been recorded from the southeastern states either living or fossil. Apparently, it is a more northerly form.

The association of *V. albula* with such forms as *Columella alticola* and *Vertigo modesta* in this fauna seems logical. Both the latter species are now restricted to northern regions.

Occurrence. — Localities 1, 3, 4, 5, 6, 7.

Measurements of Vallonia albula in m m.

Locality	Shell Height	Shell Width	Shell H/W	Aperture Height	Aperture Width	Aperture H/W	Umbilicus	Whorls
3	1.08	2.77	.39	.67	.80	.83	.80	3 3/8
3	1.08	2.70	.40	.60	.74	.82	.80	3 1/2
4	1.31	2.77	.47	.80	.80	1.00	.87	3 3/4
4	1.28	2.77	.46	.70	.80	.88	.87	3 5/8
5	1.14	2.56	.45	.64	.74	.87	.70	3 1/4
6	1.18	2.77	.43	.67	.84	.80	.80	3 1/2
6	1.14	2.49	.46	.67	.80	.83	.77	3 3/8
7	1.14	2.80	.41	.70	.80	.88	.80	3 1/2
7	1.14	2.63	.43	.67	.80	.83	.67	3 1/2
5	1.14	2.56	.45	.77	.74	1.04	.74	3 1/2

Order **BOSOMMATOPHORA**

Family **CARYCHIIDAE**

Genus **CARYCHIUM** Müller, 1774

Carychium exile canadense Clapp — Pl. 17, figs. 5-7

Carychium exile canadense Clapp, 1906, Nautilus, vol. 19, No. 12, p. 139, pl. 8, figs. 1, 2, 6, 7.
Carychium exile canadense Clapp, Pilsbry, 1948, Acad. Nat. Sci. Philadelphia, Monogr., No. 3, vol. 2, pt. 2, p. 1059, figs. 561 d, 566 b.

Description. — Shell thin, slender, narrow, tapering slightly to obtuse apex, rimate; color white; whorls 5 - 5½, convex, shouldered, width about twice the height, regularly increasing in size; rib striae, closely set, distinctly visible on all except initial whorls; aperture oblique, about ⅓ length of shell; peristome thickened, expanded, connected across parietal wall by a callus; horizontal lamella present at junction of parietal and columellar margins, curves inwardly where it expands and bends sharply downward.

Geologic range. — Kansan to Recent.

Recent distribution. — Canadian zone, Maine and Ontario to Michigan and Manitoba, Vancouver Island.

Fossil distribution. —

Kansan faunas — Indiana: Putnam Co. Illinoian faunas — Indiana: Monroe and Parke Cos. Wisconsin faunas — Ohio: Shelby, Erie, and Cuyahoga Cos. Indiana: Johnson Co. Illinois: Henry, Fulton, and Menard Cos. Kentucky: Fulton, Henderson, and Union Cos.

Habitat. — Lives most often in low marshy wet woods on the forest floor where it may be found under bark, debris, and rotting stumps. This species is also found on forested hillsides.

Remarks. — Kentucky records for this species mark the southern limit reported for Pleistocene distribution. *C. exile canadense* today replaces *C. exile* in the north where it is living as a Canadian zone species.

C. exile canadense differs externally from *C. exile* in being somewhat larger. The downward bend of the columellar lamella occurs farther from the aperture in the subspecies.

Occurrence. — Localities 2, 9.

Measurements of Carychium exile canadense in m m.

Locality	Shell Height	Shell Width	Shell H/W	Aperture Height	Aperture Width	Aperture H/W	Whorls
2	2.28	.87	2.61	.54	.47	1.15	5 1/2
2	2.01	.80	2.50	.54	.40	1.35	5
2	2.15	.80	2.68	.54	.40	1.35	5 1/4
9	2.22	.84	2.64	.50	.40	1.25	5 1/2
9	2.15	.87	2.46	.54	.40	1.35	5
9	2.08	.80	2.60	.54	.40	1.35	5 1/3
9	1.95	.84	2.32	.47	.37	1.27	5
9	2.38	.77	3.08	.54	.34	1.59	5 1/4
9	2.34	.90	2.60	.54	.40	1.35	5 1/4
9	2.28	.87	2.61	.54	.40	1.35	5 1/4

Order ARCHAEOGASTROPODA

Family **HELICINIDAE**

Genus **HENDERSONIA** Wagner, 1905

Hendersonia occulta (Say) Pl. 16, figs. 13-15

Helicina occulta Say, 1831, Transylvania Jour. of Medicine, vol. 4, p. 528, fig. 581.

Hendersonia occulta (Say), Pilsbry, 1948, Acad. Nat. Sci. Philadelphia, Monogr., No. 3, vol. 2, pt. 2, p. 1088, fig. 581.

Description. — Shell thick, depressed globose with conic spire and convex base, imperforate; color buff to white; whorls 4½ - 5, increasing slowly in size, embryonic whorl smooth, remainder sharply and obliquely rib striate; periphery bounded by a sharp keel which may or may not disappear toward latter half of final whorl; aperture oblique and roundly lunate; peristome thickened and narrowly reflected over the outer and basal margins of the shell which are connected by a callus.

Geologic range. — Kansan to Recent.

Recent distribution. — Reported as far north as Minnesota, Illinois, and Wisconsin, in the Middle Atlantic states from Tennessee, Virginia, and North Carolina and in plain states of Nebraska and Iowa.

Fossil distribution. —

Pleistocene — Kansan faunas — Kansas: Phillips and Osborne Cos. Indiana: Putnam Co. Yarmouth faunas — Iowa: Harrison and Monona Cos. Kansas: Russell Co. Illinoian faunas — Indiana: Monroe Co. Sangamon faunas — Ohio: Cuyahoga Co. Wisconsin faunas —Kansas: Republic and Jewel Cos. Ohio: Butler and Cuyahoga Cos. Indiana: Morgan, Johnson, and Posey Cos. Illinois: Stevenson, Carroll, Rock Island, Bureau, Marshall, Fulton, Tazewell, Mason, Schuyler, Cass, Menard, Brown, Pike, Scott, Greene, Jersey, Madison, and Alexander Cos. Kentucky: Fulton, Daviess, Crittenden, Union, Henderson, and Jefferson Cos.

Pleistocene — age unknown — Missouri: Cooper, Callaway, St. Louis, Atchison, Jackson, Howard, St. Charles, and Franklin Cos. Illinois: Madison, St. Clair, and Monroe Cos. Mississippi: Jefferson, Adams, De Soto, Tate, Panola, Grenada, Carroll, and Yazoo Cos. Tennessee: Cheatum and Smith Cos. Indiana: Posey Co.

Shimek (1920) studied *H. occulta* and investigated its fossil distribution. Pilsbry (1948, p. 1089) quoted the following extracts from Shimek (1919):

"The northern limit of the fossils, so far as observed, is approximately indicated by a series of loops drawn from Ponca, Nebraska, to Carroll, Des Moines, Colfax, Iowa City, Muscatine, and Davenport, Iowa; Rock Island and Joy, Illinois, and Sullivan Co., Indiana . . . Westward the fossils extend into eastern Nebraska to a line drawn from Ponca through West Point, Bruno and Lincoln to Peru . . . The known southern limit of the fossils has been extended along the east side of the Mississippi almost to the south line of Tennessee . . ."

Habitat. — Confined to situations near water, along streams, and lakes, often in positions that allow submergence at times of high water.

Remarks. — This widespread species was collected from all but one of the sites studied. Shimek (1904, p. 176) considered this a key fossil for interpreting conditions at the time of loess deposition. He reported the habitat as being well-wooded territory in loose-leaf mould. Van der Schalie's findings in Michigan (1939, pp. 1-8) gave data to show that the species is restricted to areas not only close to water but often on grounds subject to overflow.

Recent specimens show no differences from the fossil forms. Somewhat smaller forms from the Iowa loess (Pilsbry, 1948, p. 1089) are attributed to a prevailing drier climate at the time they lived.

Occurence. — Localities 2, 3, 4, 5, 6, 7, 9.

Measurements of Hendersonia occulta in m.m.

Locality	Shell Height	Shell Width	Shell H/W	Aperture Height	Aperture Width	Aperture H/W	Whorls
2	4.25	6.20	.69	1.68	2.22	.76	5
2	4.10	6.15	.67	1.61	2.08	.77	4 3/4
4	3.70	5.90	.63	1.95	2.01	.97	5
5	3.50	5.50	.64	1.61	2.01	.80	4 1/2
5	3.70	5.50	.67	1.48	1.95	.76	4 1/2+
6	3.70	5.70	.65	1.81	2.28	.79	4 3/4
6	3.50	5.75	.61	1.48	2.08	.70	4 1/2
6	4.10	5.70	.72	1.54	2.22	.70	4 3/4
7	3.70	5.85	.63	1.61	1.88	.86	4 3/4
7	3.80	5.80	.66	1.88	2.28	.82	4 3/4

Subclass STREPTONEURA Spengel

Order CTENOBRANCHIATA Scheigger

Family **POMATIOPSIDAE** Stimpson

Genus **POMATIOPSIS** Tryon

Pomatiopsis lapidaria (Say) Pl. 15, fig. 8

Cyclostoma lapidaria Say, 1817, Acad. Nat. Sci. Philadelphia, Jour., vol. 1, p. 13.
Pomatiopsis lapidaria (Say), Baker, 1928, Wisconsin Geol. Nat. Hist. Sur., Bull. 70, pt. 1, pp. 162-168, pl. 7, figs. 42-45.

Description. — Shell shiny, elongate, turreted; spire acute, about two-thirds length of shell; color ivory to light tan; whorls 6½ - 7½, convex, regularly increasing in size, marked by closely set, wrinkled growth striae; nuclear whorl granular, flattened at apex and partially enveloped by succeeding whorl; sutures deeply impressed; aperture ovate with rounded base, set at an angle to axis of shell; peristome simple, somewhat thickened, connected across parietal wall; inner margin erect, slightly reflected over a distinct and open umbilicus.

Geologic range. —Wisconsin (?) to Recent.

Recent distribution. — New York to northeastern Kansas and Iowa, Michigan, and Wisconsin south to Missouri, Alabama, and Georgia. Recorded from the Pleistocene in Illinois, Indiana, Ohio, Missouri, Mississippi, Louisiana, Texas, and Oklahoma.

Fossil distribution. —

Pleistocene — Illinoian (?) faunas — Oklahoma: Caddo Co. Wisconsin faunas — Ohio: Erie Co. Kentucky: Fulton and Henderson Cos.

Pleistocene — age unknown — Missouri: St. Louis Co. Texas: Comal Co. Tennessee: Cheatham, Jackson, and Smith Cos. Kentucky: Franklin Co. Mississippi: Panola, Tallahatchie, Carroll, Yazoo, Warren, Claiborne, Jefferson, and Adams Cos. Louisiana: West Feliciana Parish. Illinois: St. Clair, Madison, and Union Cos.

Habitat. — *P. lapidaria* is a more or less amphibious species. Prefers wet ground to actual immersion in water. Reported from a variety of habitats such as marshes, temporary pools on floodplains of small creeks, grassy hummocks in wet pastures, upland artesian fed marshes, and from fairly large rivers. Features common to all habitats are a moist substratum with sufficient sand to prevent the bottom from becoming mucky and an abundance of shade.

Remarks. — *P. lapidaria* was found, in small numbers, at only one site in the study area. It is associated with several woodland species, indicating a moist woodland habitat. The pH of the water in which living forms are found varies from 7.5 to 8.0 (Clark, 1961, p. 22).

Occurrence. — Locality 8.

Measurements of Pomatiopsis lapidaria in m m.

Locality	Shell			Aperture			Whorls
	Height	Width	H/W	Height	Width	H/W	
8	5.54	2.56	2.16	1.61	1.28	1.26	1/2
8	4.90	2.41	2.03	1.48	1.11	1.34	1/8
8	7.86	3.36	2.34	1.88	1.41	1.33	5/8

Subclass EUTHYNEURA Spengel
Order PULMONATA Cuvier
Suborder BASOMMATOPHORA

Family **LYMNAEIDAE** Broderick

Genus **FOSSARIA** Westerlund, 1885

Fossaria dalli (Baker) Pl. 15, fig. 1

Lymnaea parva Baker, 1905, Nautilus, vol. 19, No. 5, p. 52 (not of Lea).
Fossaria dalli Baker, 1906, Illinois State Lab. Nat. Hist., Bull., vol. 7, p. 101.
Fossaria dalli Baker, Baker, 1928, Wisconsin Geol. Nat. Hist. Sur., Bull. 70, pt. 1, pp. 288, 289, pl. 16, fig. 11.

Description. — Shell ovate-conic, thin, shiny, slender, translu-

cent; spire turreted with obtuse apex; nucleus smooth, small, flatly rounded; color white to yellowish white; whorls 4-4½, shouldered, all except smooth protoconch marked by closely set, sometimes wrinkled growth striae; sutures impressed; aperture elongate ovate; outer lip sharp, inner lip erect, reflected over umbilical opening, closely appressed at junction with parietal wall.

Geologic range. — Pliocene to Recent.

Recent distribution. — Ohio to northern Michigan and Montana, south to Kansas and Arizona.

Fossil distribution. —

Pliocene — Oklahoma: Beaver Co. Kansas: Seward and Meade Cos.

Pleistocene — Nebraskan or Aftonian faunas — Nebraska: Brown Co. Kansas: Kingman Co. Aftonian faunas — Kansas: Meade Co. Kansan faunas — Texas: Knox Co. Illinoian (?) faunas — Oklahoma: Caddo and Canadian Cos. Sangamon faunas — Kansas: Meade Co. Texas: Foard Co. Wisconsin faunas — Illinois: Carroll, Bureau, Fulton, Tazewell, McLean, Brown, and Pike Cos. Oklahoma (Wisconsin or Illinoian?): Harper Co. Texas: Hardeman Co. Utah: Co? Kentucky: Fulton and Henderson Cos.

C-14 dated records — Texas: Dallas Co., slightly more than 37,000 years B. P., Denton Co., 28,840 years B. P. and Motley Co., 31,400 ± 5,600 years B. P.

Habitat. — Inhabits wet marshy places, generally out of the water, on sticks, stones, or muddy flats.

Remarks. — *Fossaria dalli* is the smaller, longer ranging (Pliocene to Recent) *Fossaria* of the two recovered in this study. *F. dalli* and *F. obrussa decampi* (Streng) were not found in association or even at the same locality. *F. dalli* is a semiaquatic species, often found out of water. Taylor (1960, p. 55) stated, "In northern Nebraska it was found in seepage areas, in the water or in wet leaves or debris at the water's edge." *F. obrussa decampi,* however, lives in small bodies of water.

Lymnaea turritella Leonard was originally distinguished from *F. dalli* by its somewhat greater size and more slender form. Taylor (1960, p. 94) stated, "Comparison of a large series of topotypes with other large series of similar fossils from Pliocene and Pleistocene deposits, and with Recent specimens in the U.S. National Museum

identified by F. C. Baker, shows that these differences are not constant." The descriptions and illustrations are based on long, narrow specimens of *F. dalli*.

Specimens of *F. dalli* described here represent typical *F. dalli* as conceived by Baker and similar specimens catalogued in the U.S. National Museum listed by Taylor (1960, p. 55).

Occurrence. — Locality 4.

Measurements of Fossaria dalli in m m.

Locality	Shell			Aperture			Whorls
	Height	Width	H/W	Height	Width	H/W	
4	4.72	2.15	2.20	1.95	1.14	1.71	4 1/2
4	4.36	2.15	2.03	1.74	1.08	1.62	4 1/4
4	3.96	2.08	1.90	1.88	1.21	1.56	4 1/2

Fossaria obrussa decampi (Streng) Pl. 15, fig. 4

Limnaea desidiosa var. decampi Streng, 1906, Nautilus, vol. 9, No. 11, p. 123, text fig.

Fossaria obrussa decampi (Streng), Baker, 1928, Wisconsin Geol. Nat. Hist. Sur., Bull. 70, pt. 1, pp. 299-301.

Description. — Shell solid, subconic; spire short and turreted; color brown; whorls 4 - 4½, convex, increasing noticeably in size, shouldered near the suture, body whorl large, swollen, flattened near the middle; surface sculptured by fine growth striae, spiral striae present on some specimens, notably on the body whorl; aperture elongate, elliptical, rounded at base, making a shoulder at junction with body whorl; peristome sharp, inner margin narrowly reflected over open umbilical chink, not much appressed at junction with parietal wall, lower half erect.

Geologic range. — Wisconsin to Recent.

Recent distribution. — Maine west to Wisconsin, northern Michigan south to northern Illinois.

Fossil distribution. —

Pleistocene — Wisconsin faunas — Ohio: Ross, Franklin, Logan, Stark, and Erie Cos. Indiana: Steuben Co. Illinois: Tazewell, McLean, and Menard Cos. Wisconsin: Langlade, Marinette, Oconto, and Waupaca Cos. Kentucky: Henderson Co.

Habitat. — Lives in small bodies of water such as creeks, ponds, sloughs, bays, and marshy spots along river banks. The water is shal-

low and the bottom of soft, sticky mud filled with algae. *F. obrussa decampi* is found on sticks, stones, and other debris in the water or along its edge.

Remarks. — Specimens of *F. obrussa decampi* recovered are small, with a maximum of 4½ whorls. Shell dimensions for this number of whorls compares favorably with larger five-whorled specimens described by Baker (1928, p. 300).

This species is distinct with its turreted spire, shouldered whorls and the manner in which the outer lip is arched at its junction with the body whorl.

Occurrence. — Localities 8, 9.

Measurements of Fossaria obrussa decampi in m m.

Locality	Shell			Aperture			Whorls
	Height	Width	H/W	Height	Width	H/W	
8	3.22	2.08	1.55	1.74	1.28	1.36	3 3/4
8	4.82	3.05	1.58	2.48	1.61	1.54	4 1/2
9	5.89	3.55	1.66	2.98	1.88	1.59	4 1/2
9	4.30	2.77	1.55	2.22	1.54	1.44	4
9	4.19	2.84	1.48	3.62	1.54	2.35	4 1/4
9	5.40	3.00	1.80	2.70	1.60	1.69	4 1/2

REFERENCES

Archer, A. F.

1948. *Land snails of the genus Stenotrema in the Alabama Region.* Geol. Sur. Alabama, Museum Paper 28, pp. 1-85, 10 pls.

Baker, F. C.

1927. *Description of new forms of Pleistocene land mollusks from Illinois with remarks on other species.* Nautilus vol. 40, No. 4, pp. 114-120.

1928. *The fresh water Mollusca of Wisconsin.* Wisconsin Geol. Nat. Hist. Sur., Bull. 70, pt. 1, Gastropoda, i - xvii, pp. 1-507, 28 pls., 202 figs.

1935. *Land and freshwater Mollusca from North Star Lake and vicinity, Itasca County, Minnesota.* Amer. Midl. Nat., vol. 16, pp. 257-274, figs. 1-7.

1939. *Fieldbook of Illinois land snails.* Illinois Nat. Hist. Sur. Div., Man. 2, 166 pp., 200 figs.

Branson, B. A., Taylor, J., and Taylor, C.

1962. *A Pleistocene local fauna from Caddo and Canadian Cos., Oklahoma.* Oklahoma Geol. Sur., vol. 22, No. 11, pp. 280-295.

Browne, R. G., and McDonald, Donald

1960. *Wisconsin molluscan faunas from Jefferson County, Kentucky.* Bull. Amer. Paleont., vol. 41, No. 189, pp. 161-183, pls. 21, 22.

Burch, J. B.

1962. *How to know the eastern land snails.* Wm. C. Brown Co., Publishers, pp. 1-214, figs. 1-519.

Call, R. E.

1900. *A descriptive illustrated Catalogue of the Mollusca of Indiana.* Dept. Geol. Nat. Res., Indiana, 24th Ann. Rept. pp. 335-535, 78 pls.

1959. *Handbook of gastropods in Kansas.* Univ. Kansas Mus. Nat. Hist. Misc. Publ., No. 20, pp. 1-244.

Cheatum, E. J., and Allen, Don
1965. *Pleistocene land and fresh water mollusks from North Texas.* Sterkiana, No. 18, pp. 1-16, 2 pls.

Clark, A. L.
1961. *Pleistocene molluscan faunas of the Castalia deposit, Erie Co., Ohio.,* Sterkiana, No. 3, pp. 19-39, 10 figs.

Conkin, J. E., and Conkin, B. M.
1962. *Pleistocene Berclair Terrace of Medio Creek, Bee Co., Texas.* Bull. Amer. Assoc. Petro. Geol., vol. 46, No. 3, pp. 344-353, 2 pls.

Franzen, D. S., and Leonard, A. B.
1947. *Fossil and living Pupillidae (Gastropoda-Pulmonata) in Kansas.* Univ. Kansas Sci. Bull. vol. 31, pt. 2, No. 15, pp. 311-399, pls. 17-22, 15 figs., 1 table.

Frye, J. C., and Leonard, A. B.
1952. *Pleistocene geology of Kansas.* Kansas Geol. Sur., Bull. No. 99, pp. 1-230, 19 pls.

Getz, Lowell L., and Hibbard, Claude M.
1965. *A molluscan faunule from the Seymour Formation of Baylor and Knox Counties, Texas.* Papers Michigan Acad. Sci., Arts Letters, vol. L, (1964), pp. 275-297, 1 pl., 3 tables, 1 fig.

Hibbard, C. W., and Taylor, D. W.
1960. *Two late Pleistocene faunas from southwestern Kansas.* Contrib. Mus. Paleont. Univ. of Michigan, vol. 16, No. 1, pp. 1-223, 16 pls., 18 figs.

Hubricht, L.
1961. *Land snails from the loess of Mississippi.* Sterkiana, No. 3, pp. 11-14.
1962a. *Land snails from the Pleistocene of southern Texas.* Sterkiana, No. 7, pp. 1-3.
1962b. *Land snails from the loess in the vicinity of New Harmony, Posey Co., Indiana.* Sterkiana, No. 7, pp. 3-4.
1962c. *Pleistocene land snails of southern Mississippi and adjacent Louisiana.* Sterkiana, No. 8, pp. 1-10.
1963. *Some Succineidae, with a new species.* Nautilus., vol. 76, No. 4, pp. 135-138, 1 fig.
1964a. *Some Pleistocene land snail records from Missouri and Illinois.* Sterkiana, No. 13, pp. 7-17.
1964b. *Pleistocene land snails from the talus of Kentucky and Tennessee.* Sterkiana, No. 16, pp. 3-4.
1965. *Pleistocene land snails from Muddy Creek, Mississippi.* Sterkiana, No. 17, p. 6.

La Rocque, Aurele
1963. *Late Cenozoic non-marine molluscan associations in eastern North America.* Sterkiana, No. 11, pp. 1-50.

La Rocque, A., and Conley, J. F.
1956. *Two Pleistocene molluscan faunules from Hunter's Run, Fairfield Co., Ohio.* Ohio Jour. Sci., vol. 56, pp. 325-328, 1 fig.

Lee, C. B.
1951. *The molluscan family Succineidae in Michigan. Considerations of anatomy, early embryology, and distribution.* Unpublished Doctor's Dissertation. Univ. Michigan, pp. 1-269.

Leonard, A. B.
1950. *A Yarmouthian molluscan fauna in the Midcontinent Region of the United States.* Univ. Kansas Paleont. Contr., Mollusca, Art. 3, pp. 1-48, 6 pls., 4 figs.
1952. *Illinoian and Wisconsinan molluscan faunas in Kansas.* Univ. Kansas Paleont. Contr. Mollusca, Art. 4, pp. 1-38, 5 pls., 15 figs.

Leonard, A. B., and Franzen, D. S.
1944. *Mollusca of the Laverne Formation (lower Pliocene) of Beaver Co., Oklahoma*: Kansas, Univ. Sci. Bull., vol. 30, pp. 15-39.

Leonard, A. B., and Frye, J. C.
1960. *Wisconsin molluscan faunas of the Illinois valley region.* Illinois State Geol. Sur., Cir. 304, pp. 1-32, 4 pls., 3 figs.

Miles, C. D.
1958. *The fossil Succineidae (Gastropoda: Pulmonata) in Kansas.* Kansas Univ. Sci. Bull., Vol. 38, pp. 1499-1543, 1 pl., 10 figs.

Müller, O. F.
1773, 1774. *Vermium terrestrium et fluviatilium seu animalium Infusoriorum, Helminthicorum et Testaceorum, non marinorum, succincta historia. . .* Two vols., Harniae and Lipsiae.

Oughton, J.
1948. *A zoogeographical study of the land snails of Ontario.* Univ. Toronto Studies, Biol. Ser., No. 57, i-xi, pp. 1-128, 2 tables.

Pilsbry, H. A.
1940. *Land Mollusca of North America (north of Mexico).* Acad. Nat. Sci., Philadelphia, Mon. No. 3, vol. 1, pt. 2, pp. 574-994, figs. 378-580.
1946. *Land Mollusca of North America (north of Mexico).* Acad. Nat. Sci., Philadelphia, Mon. No. 3, vol. 2, pt. 1, pp. 1-520, figs. 1-281.
1948. *Land Mollusca of North America (north of Mexico).* Acad. Nat. Sci., Philadelphia, Mon. No. 3, vol. 2, pt. 2, pp. 521-1113, figs. 282-585.

Roscoe, E. J.
1961. *Preliminary checklist of Lake Bonneville Mollusca.* Sterkiana, No. 4, pp. 23-28.
1963. *Stratigraphic Summary of Quaternary Bonneville Basin Mollusca.* Sterkiana, No. 9, pp. 1-23.

Roy, E. C.
1962. *Molluscan faunas of the Gunnison Reservoir Deposit, Sanpete Co., Utah.* Sterkiana, No. 6, pp. 5-13.
1963. *Checklist of Pleistocene and living Mollusca of Wisconsin.* Sterkiana, No. 10, pp. 5-21.
1964. *Pleistocene non-marine Mollusca of northeastern Wisconsin.* Sterkiana, No. 15, pp. 5-75, 19 pls.

Shimek, B.
1904. *Helicina occulta Say.* Davenport Acad. Sci., Proc. vol. 9, pp. 173-180.
1920. *Further notes on Helicina occulta Say.* Iowa Acad. Sci., Proc. 26, pp. 385-390.

Sterki, V.
1920. *Marl deposits in Ohio and their fossil Mollusca.* Ohio Jour. Sci., vol. 20, No. 6, pp. 173-184.

Taylor, D. W.
1960. *Late Cenozoic molluscan faunas from the High Plains.* U.S. Geol. Sur. Prof. Paper No. 337, pp. 1-94, 4 pls., 2 figs.

Tuthill, S. J., Laird, W. M., and Frye, C. I.
1964. *Fossil molluscan fauna from the upper terrace of the Cannonball River, Grant Co., North Dakota.* Proc. North Dakota Acad. Sci., vol. 18, pp. 140-156, 5 figs., 4 tables.

van der Schalie, Henry
1939. *Hendersonia occulta (Say) in Michigan; Its distribution, ecology, and geological significance.* Univ. Michigan Press, No. 399, pp. 1-8.

Wayne, W. J.
1959. *Inland mollusks from Hudson Bay, Manitoba.* Nautilus, vol. 72, No. 3, pp. 90-95, 1 pl., 2 tables.
1963. *Geology of Marion County, Indiana.* Indiana Geol. Sur., Bull. 28, pp. 40-46.

PLATES

EXPLANATION OF PLATE 15

All magnifications approximate

Figure — Page

1. **Fossaria dalli** (Baker) — 263
Apertural view. No. 27576 PRI; X 8; locality 4.

2, 3, 14. **Discus cronkhitei** (Newcomb) — 235
Umbilical, spiral and apertural views respectively. No. 27577 PRI; X 8; locality 4.

4. **Fossaria obrussa decampi** (Streng) — 265
Apertural view. No. 27578 PRI; X 8; locality 8.

5. **Gastrocopta armifera** (Say) — 246
Apertural view No. 27579 PRI; X 8; locality 8.

6, 7. **Discus cronkhitei catskillensis** Pilsbry — 237
Apertural and spiral views respectively. No. 27580 PRI; both X 8; locality 5.

8. **Pomatiopsis lapidaria** (Say) — 262
Apertural view. No. 27581 PRI; X 4; locality 8.

9, 10. **Vallonia albula** Sterki — 257
Spiral and umbilical views respectively. No. 27582 PRI; both X 8; locality 6.

11-13. **Retinella indentata** Say — 227
Spiral, umbilical and apertural views respectively. No. 27583 PRI; all X 8; locality 9.

15-17. **Helicodiscus parallelus** (Say) — 238
Spiral umbilical and apertural views respectively. No. 27584 PRI; all X 8; locality 9.

18-20. **Anquispira alternata** (Say) — 234
Apertural umbilical and spiral views respectively. No. 27585 PRI; all X 1.5; locality 4.

21-23. **Zonitoides arboreus** (Say) — 230
Spiral, umbilical and apertural views respectively. No. 27586 PRI; all X 8; locality 4.

24-26. **Haplotrema concavum** (Say) — 222
Umbilical, spiral and apertural views respectively. No. 27587 PRI; all X 2; locality 4.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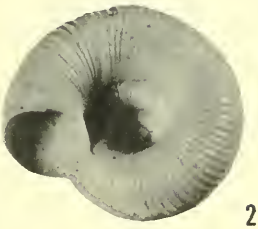
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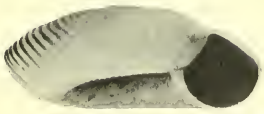
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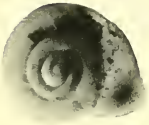
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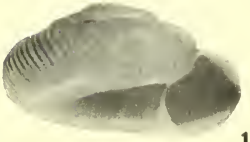
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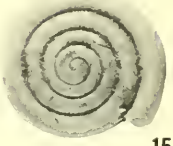
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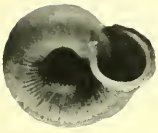
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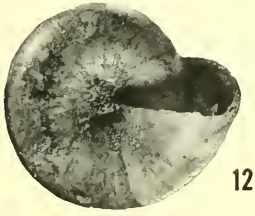
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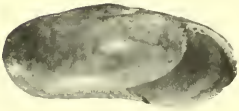
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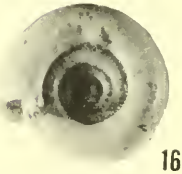
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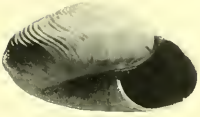
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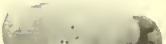
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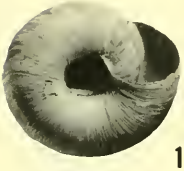
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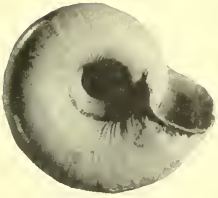
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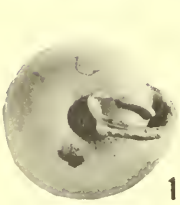
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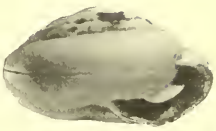
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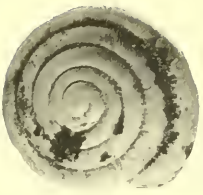
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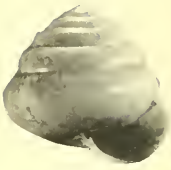
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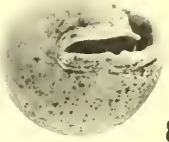
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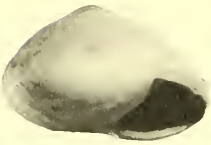
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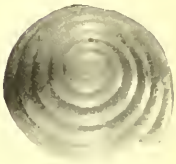
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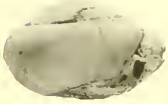
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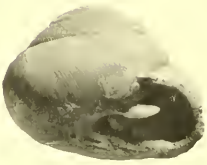
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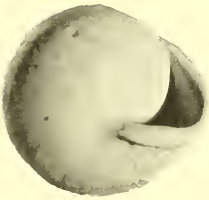
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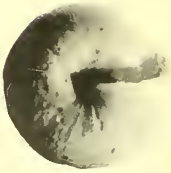
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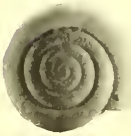
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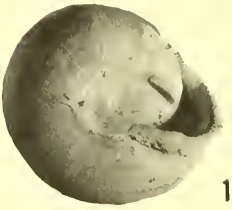
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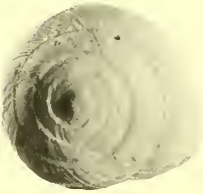
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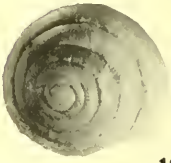
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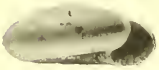
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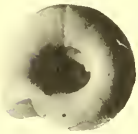
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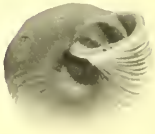
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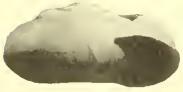
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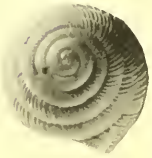
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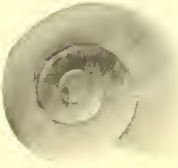
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EXPLANATION OF PLATE 16

All magifications approximate

Figure — Page

1-3. **Stenotrema leai** (Binney) 218
Umbilical, apertural and spiral views respectively. No. 27588 PRI; 1 X 3, 2 and 3 X 8; locality 8.

4-6. **Euconulus fulvus** (Müller) 224
Apertural, spiral and umbilical views respectively. No. 27589 PRI; all X 8; locality 6.

7-9. **Stenotrema barbatum** (Clapp) 215
Spiral, umbilical and apertural views respectively. No. 27590 PRI; all X 3; locality 2.

10-12. **Mesodon elevatus** (Say) 219
Apertural, umbilical and spiral views respectively. No. 27591 PRI; all X 1; locality 4.

13-15. **Hendersonia occulta** (Say) 260
Apertural, umbilical and spiral views respectively. No. 27592 PRI; all X 4. locality 4.

16-18. **Hawaiia minuscula** (Binney) 228
Spiral, apertural and umbilical views respectively. No. 27593 PRI; all X 8; locality 7.

19-21. **Triodopsis multilineata** (Say) 220
Spiral, umbilical and apertural views respectively. No. 27594 PRI; all X 1.25; locality 9. Photographs retouched.

22-24. **Strobilops labyrinthica** (Say) 244
Umbilical, spiral and apertural views respectively. No. 27595 PRI; all X 8; locality 8.

25-27. **Nesovitrea binneyana** (Morse) 226
Apertural, spiral and umbilical views respectively. No. 27596 PRI; all X 8; locality 3.

EXPLANATION OF PLATE 17

All magnifications approximate

Figure — Page

1. **Vertigo hubrichti** Pilsbry — 253
Apertural view. No. 27597 PRI; X 16; locality 5.

2. **Vertigo gouldi** (Binney) — 251
Apertural view. No. 27598 PRI; X 16; locality 9.

3. **Gastrocopta tappaniana** (C. B. Adams) — 248
Apertural view. No. 27599 PRI; X 16; locality 2.

4. **Columella alticola** (Ingersoll) — 255
Apertural view. No. 27600 PRI; X 16; locality 5.

5-7. **Carychium exile canadense** Clapp — 259
Apertural, side and columellar plate views respectively. 5. No. 27601 PRI; X 16; locality 9. 6. No. 27601A PRI, broken to show expanded and downward bent columellar lamella; X 16; locality 9. 7. No. 27601B PRI, showing strong, downbending, columellar lamella with whorls broken off; X 16; locality 9.

8. **Gastrocopta contracta** (Say) — 249
Apertural view. No. 27602 PRI; X 16; locality 9.

9. **Vertigo modesta** (Say) — 254
Apertural view. No. 27603 PRI; X 16; locality 8.

10,11. **Succinea grosvenori** Lea — 241
Apertural and side views respectively. No. 27604 PRI; X 3.75; locality 5.

12-14. **Punctum minutissimum** (Lea) — 240
Apertural, umbilical and side views respectively. No. 27605 PRI; X 16; locality 8.

15,16. **Succinea gelida** (F. C. Baker) — 243
Apertural and side views respectively. No. 27606 PRI; X 6; locality 8.

17,18. **Deroceras laeve** Müller — 232
Dorsal and ventral views respectively. No. 27607 PRI; X 16; locality 9.


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4


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6


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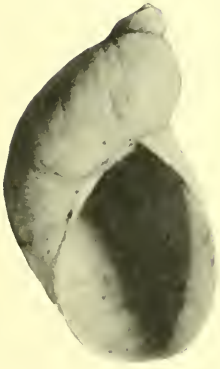
8


9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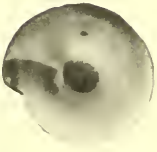
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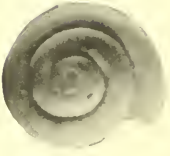
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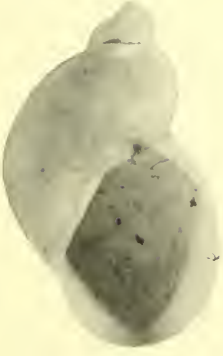
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