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ANNOUNCEMENT

STERKIANA is named after Dr. Victor Sterki (1846-1933) of New Philadelphia, Ohio, famed for his work on the Sphaeriidae, Pupillidae, and Valloniidae. It is fitting that this serial should bear his name both because of his association with the Midwest and his lifelong interest in non-marine Mollusca.

The purpose of STERKIANA is to serve malacologists and paleontologists interested in the living and fossil non-marine Mollusca of North and South America by disseminating information in that special field. Since its resources are modest, STERKIANA is not printed by conventional means. Costs are kept at a minimum by utilizing various talents and services available to the Editor. Subscription and reprint prices are based on cost of paper and mailing charges.

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STRATIGRAPHIC SUMMARY OF QUATERNARY BONNEVILLE BASIN MOLLUSCA

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ABSTRACT

This is the first stratigraphic summary of the Bonneville Basin Quaternary molluscan fauna since 1884. The development of Quaternary stratigraphy in the Basin is briefly reviewed, and work in progress is noted. Stratigraphic and systematic catalogs are presented. Related deposits in the Snake River drainage are briefly mentioned. No attempt is made to include a discussion of problems relating to relative or absolute chronology or of correlation with either montane or continental glaciation. The references cited comprise a selected bibliography on Basin Quaternary research.

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INTRODUCTION

The drainage of the Bonneville Basin covers an area of about 55,000 square miles. Four-fifths of this area is located in Utah, with slightly more than 10,000 square miles in the contiguous states of Nevada, Idaho, and Wyoming. The Basin is approximately delimited by the geographical coordinates of 110° - 115° West Longitude and 37° - 43° North Latitude. Physiographically most of the area falls within the Great Basin Division of the Basin and Range Province, with relatively small but important portions along the eastern margin belonging to the Rocky Mountain and Colorado Plateaus Province (Fenneman, 1931).

The study of the Quaternary history of the Bonneville Basin may be divided into two periods. Beginning in 1849 with the recognition of the existence of an ancient lake in the Basin by Howard Stansbury, the first period reached its zenith with the publication of G. K. Gilbert's monograph on Lake Bonneville in 1890. For over fifty years "Lake Bonneville" was the unchallenged classic and basic reference work. The second period, beginning about 1945 when Ernst Antevs made the first significant modification of the Gilbertian explanation of Lake Bonneville history, owes its chief stimulus to the critical post-World War II need for information on the underground water resources of the Basin. About 80 percent of the papers dealing with the Basin Quaternary have been published during this period.

Gilbert was the first to recognize the value of studies of the Basin molluscan fauna in deciphering Quaternary climatic changes. At his instigation R. E. Call was appointed to investigate and report on the Quaternary mollusks of the entire Great Basin. The present paper is the first to summarize the stratigraphic distribution of the Bonneville Basin fauna in light of the work accomplished since Call's report of 1884.

ACKNOWLEDGMENTS

In a very real sense whatever merit this paper may have is due to all those who have labored with the problem of the Bonneville Basin Quaternary. My chief capacity has been that of brain-picker. Without exception, all those to whom I have turned for assistance of one sort or another have wholeheartedly responded. In alphabetical order these persons include: E. Antevs, R. C. Bright (U. Minnesota), A. J. Eardley (U. Utah), J. H. Feth (USGS); H. D. Goode (USGS); C. B. Hunt (USGS); D. J. Jones (U. Utah); R. E. Marsell (U. Utah); R. Morrison (USGS); W. L. Stokes (U. Utah); D. W. Taylor (USGS); and J. S. Williams (Utah State U.).

Two of my colleagues at the Museum, Joanne L. Evenson and E. S. Richardson, Jr., have given the manuscript the benefit of their criticism, resulting in substantial improvement in both organization and content. For remaining errors of fact and ineptitude of expression I alone must be held responsible. To my wife, Lottie, I owe much for assistance with several revisions and the typing of the final draft of the manuscript.

DEVELOPMENT OF QUATERNARY STRATIGRAPHY IN THE BONNEVILLE BASIN

Gilbertian Period

The chief deterrent to the study of the Quaternary of the Basin has been the lack of extensive natural surface exposures. Investigations at a few favorable localities led Gilbert (1874, 1890) to propose a sequence of deposits which he interpreted as indicating two lacustrine periods. Gilbert's stratigraphy, which was followed by almost every writer up to 1953, is summarized in Table 1. Also indicated are correlations with strand lines, lake history, and time units as used during this period.

Gilbert took pains to point out that his scheme was probably an over-simplification. He fully realized that both Lake Bonneville and the unnamed pre-Bonneville lake together did not represent the whole of the Quaternary history of the Basin.

Table 1. Summary of Gilbertian Stratigraphy

Stratigraphy	Strand Line	Lake	Time Unit
Post-Bonneville deposits	no lake	----	Post-Bonneville (Post-Provo)
none given	Stansbury	Stansbury stage	
White Marl	Provo Bonneville	Bonneville	Bonneville
unnamed gravel	no lake	----	
Yellow Clay	Intermediate	Pre-Bonneville	Pre-Bonneville
not named	none	other lakes ?	

Post-Gilbertian Period

To overcome the lack fo surface exposures attention was directed to well logs in an effort to get a detailed history of Lake Bonneville as a complete Quaternary history of the Basin. Over the years a considerable number of drillings were made in the Basin, primarily for water, but some for gas and oil. Unfortunately, these proved to be of slight assistance in the study of the Quaternary. Drilling tended to be concentrated in the extreme eastern margin of the Basin near the mountain front. Here near-shore deposits reach their maximum thickness, but are discontinuous, representing only the higher lake levels. The deepest log known, that of the Guffey and Galey well near Farmington, Davis Co., Utah, penetrated about 2000 feet of Quaternary sediments without reaching bedrock (Boutwell, 1904). Also, drillers' terminology and the drilling technique itself are apt to be unsuitable for stratigraphic work.

An extensive test of the value of drillers' logs was made by Feth in 1953. Study of a peg model of about 300 logs from the Ogden Valley area revealed that "... it was impossible to correlate individual beds across significant distances in an east to west direction underground, except in a few places. It is possible, however, to make reasonable correlations of strata, or at least of zones, in directions approximately parallel to the mountain front ..."

More recently attention has been turned to cores to supply the missing chapters in the Basin Quaternary story. In 1951 and 1952 a series of relatively shallow cores were obtained from beneath Great Salt Lake, none of which penetrated beyond the Stansbury (post-Provo) stage sediments (Schreiber, 1958, 1961).

The results of a study of the first deep core made in the Basin appeared in 1960. Eardley and Gvosdetsky believe that a 650 foot core from near the southeast margin of Great Salt Lake penetrated sediments corresponding to the second interglacial (Aftonian) stage. Although it was not possible to correlate any portion of the "Saltair" core with either Gilbertian or later stratigraphic units, it has clearly demonstrated the complex Quaternary history of the Basin. A tentative correlation with deep-sea core chronology of Emiliani (1958) was offered. It is hoped that subsequent cores (a second is now under study) will resolve many of the correlation problems.

Modern Bonneville Basin Stratigraphy

Present Basin Quaternary stratigraphy is based on exposures due to the operation of sand and gravel pits, reclamation, and other construction projects. Much more information has thus been available than prior workers had at their disposal.

Study of such exposures in northern Utah Valley in the late 40's and early 50's as part of a continuing program of investigations by the U. S. Geological Survey resulted in the establishment (Hunt, Varnes, and Thomas, 1953) of a stratigraphic sequence which has been generally adopted for other areas by most subsequent workers. This Utah Valley sequence is summarized in Table 2. An additional pre-Alpine unit, the Green Clay Series, has been proposed by Marsell and Jones (1955) as a result of studies in Jordan (Salt Lake) Valley. Studies in the Promontory Range at the north end of Great Salt Lake has led to the discovery of what is said in a preliminary report (Goode, 1960) to be the most complete sequence of Lake Bonneville deposits to be found.

A concluding report on southern Utah Valley, as well as reports on several other areas in the Basin, are in various stages of completion (C. B. Hunt, personal communication, June 7, 1960). These are referred to in appropriate places in the stratigraphic catalog section of the present paper. It is not known at this time whether any of these reports will lead to further modifications in stratigraphic nomenclature.

Studies in the two-thirds of the Basin not occupied by the waters of Lake Bonneville have been scant. A notable exception is the work on Bear Lake Valley by Williams, Willard, and Parker (1962), in which the Bear Lake formation is named and described.

Despite the considerable progress made in the study of the Bonneville Basin Quaternary in the past decade, much remains to be accomplished. Many new techniques and disciplines, such as C-14 dating, fossil pollen analyses, paleosols, have not yet been, or are only beginning to be, applied to the problem. There are many problems relating to absolute and relative dating of events; of correlation of lake sediments to the abandoned strand lines; of correlation to the montane glacial stages thought to be concurrent with the pluvial phenomena; of correlation to the standard Pleistocene section as developed in the eastern part of the continent. The next decade may well see equalled or exceeded all that has gone before.

Should an attempt be made at this time to summarize the Basin Quaternary molluscan fauna? Somewhere H. E. Gregory has written that "Geology has to choose between the rashness of using imperfect evidence or the sterility of uncorrelated, unexplained facts." It is a choice and a challenge I could not resist. If the scaffold erected here proves of some use in the construction of the permanent edifice, I will feel amply rewarded for the labor.

STRATIGRAPHIC CATALOG

This section includes all published reports of mollusks which can be assigned to a specific stratigraphic unit, whether of known or uncertain stratigraphic position. Many of the molluscan records lack context *, and the locality data are so inexact as to make it impossible to recover this vital information now. For this reason some papers cited in my previous report (Roscoe, 1961) are not included in the present one. It should be stressed that the collecting of masses of material by persons with no training in stratigraphic

* A term borrowed from archaeology. An artifact is said to have context when its position, both horizontally and vertically, is known. A specimen lacking this information is "out of context," and its scientific value materially decreased. It is possible for a specimen to have precise horizontal context, but lack vertical context. The converse is rarely, if ever, encountered in paleontological work.

Table 2. Summary of Northern Utah Valley Bonneville Stratigraphy. (From Hunt, Varnes, and Thomas, 1953)

NOMENCLATURE			SEDIMENTS
Pleistocene?		Post-Provo deposits	Mostly uncemented fanglomerate, alluvial gravel or alluvial sand; some eolian (?) silt and thin lake deposits. Maximum thickness about 50 feet.
		Unconformity	
Pleistocene	Lake Bonneville Group	Provo formation	Extensive gravel member, as much as 50 feet thick, occurs in deltas and embankments; a thinner and less extensive sand member occurs as facies in the deltas and forms bars in front of them; a silt member and a clay member comprise the deep water deposits, but they generally are less than 20 feet thick.
		Unconformity	
		Bonneville fm.	Gravel and sand, restricted to embankment deposits
		Unconformity	
		Alpine formation	Mostly silt and clay; some gravel and sand near canyon mouths. Maximum thickness about 25 feet.
		Unconformity	
Pre-Lake Bonneville deposits (glacial, lacustrine, and fluvial).			Includes at least one moraine of pre-Lake Bonneville age. Includes deposits of several lakes that, in size and duration apparently were comparable to Lake Bonneville; these lake deposits are separated by fanglomerate and other fluviatile deposits. Total thickness 680 feet or more.
		Unconformity	
Pliocene?	Salt Lake formation		Water-laid pyroclastics, fanglomerate.

techniques (and this includes the majority of biologists) will be of little aid. Where deposits are found, competent geological assistance should be sought. It has been my experience that such assistance is readily given.

The organization of this section of the paper has proved to be a difficult problem. Because of lack of exact correlation of Gilbertian units with modern stratigraphic terminology, a straightforward bottom-to-top presentation is unfeasible at present. Reference to the table of contents will show the relationship of any particular unit to the over-all organization of this section of the paper.

Deposits Within the Lake Bonneville Area

The following section includes a discussion of all deposits from within the one-third of the Basin covered by the waters of Lake Bonneville, whether laid down in that body of water or not. The section is thus divided into (1) pre-Lake Bonneville deposits, (2) Lake Bonneville deposits proper, and (3) post-Lake Bonneville (post-Provo) deposits.

Pre-Lake Bonneville Deposits

The term "pre-Lake Bonneville" is here used in its modern, not Gilbertian, sense. The only record definitely known from this time period has been obtained from a 650 foot coring made near the edge of Great Salt Lake and reported upon by Eardley and Gvosdetsky (1960). Although not penetrating to the base of the Quaternary, this core has revealed the existence, since the second (Kansan) glacial epoch, of several large open water stages of lakes of a size comparable to that of the Provo stage of Lake Bonneville.

Unfortunately, it was found impossible to correlate any portion of the Saltair core with either the various strand lines named and described by Gilbert, or with the stratigraphy developed for Utah and Jordan valleys (discussed in a subsequent section). A summary of the mollusks reported from the Saltair core, together with the tentative correlation with the standard Pleistocene stages is given in Table 3. It will be noted that only five taxa are restricted to any given stage, and all of these are known to range throughout the Pleistocene, and hence cannot be said to be index fossils.

A second deep core has subsequently been obtained (Eardley, oral communication, April, 1961) and will be reported upon in due course. Eardley says that the molluscan fauna from this second core is negligible.

Lake Bonneville Deposits

At the present time it seems prudent to present first, and separately, a discussion of Gilbertian stratigraphic units. Assignment of these units to their proper place in the modern Bonneville sequence is still under investigation by geologists (Varnes and van Horn, 1961). Aside from this segment, the presentation proceeds from the base of the stratigraphic column to the top. All units are noted, although mollusks are not known to occur in some of them and specific determinations are lacking for others. Several impending reports, mentioned in appropriate places, promise to fill in some of the gaps.

Gilbertian Units:

Yellow Clay. No mollusks have been specifically reported from Gilbert's Yellow Clay. Varnes and van Horn (1961) assign a portion of the Yellow Clay to the Alpine of the Utah Valley sequence. The Alpine is known to be fossiliferous (Feth, unpublished MS; Goode, 1961), but no identified material has yet been reported from the formation. Varnes and van Horn (1961: 99) state that the Alpine or Yellow Clay comprises more than three-fourths of the Lake Bonneville sediments.

White Marl and Equivalents. The Upper Bonneville Beds of Call (1884) and the Bonneville Marl of Berry and Crawford (1932) are here taken as equivalent to Gilbert's White Marl. Varnes and van Horn (1961) indicate that the White Marl is partly to be assigned to the Alpine formation, partly to the Bonneville-Provo formation. No faunal comparisons are possible at

Table 3. Mollusks reported from the Saltair Core (Data from Eardley and Gvosdetsky, 1960)

MOLLUSK[1]	STAGE[2]					
	Kansan	Yarmouth	Illinoian	Sangamon	Wisconsinan[3] (Würm 1)	(Laufen)
(5) Anodonta sp.	X*					
(7) Pisidium sp.	X	X				
(10) Sphaerium striatinum					X*	
(11) Sphaerium sp.				X	X	
(17) Physa sp.	X				X	
(20) Stagnicola caperata	X	X		X		
(22) Stagnicola cockerelli	X*					
(23) Fossaria dalli					X*	
(20) Stagnicola palustris		X			X	
(34) Stagnicola sp.	X	X	X			X
(35) Armiger crista				X*		
(30) Gyraulus circumstriatus	X	X			X	X
(40) Gyraulus parvus		X	X	X	X	X
(42) Gyraulus sp.		X	X	X	X	X
(45) Helisoma sp.	X	X			X	X
(47) Promenetus exacuous				X*		
(48) Promenetus umbilicatellus	X*					
(49) Ferrissia sp.			X*			
(55) Amnicola sp.		X			X	
(62) Valvata humeralis	X	X		X	X	X
(64) Valvata utahensis		X			X	X
(79) Succinea sp.				X		
Total	10	11	3	7	12	7
Peculiar (asterisk)	3	0	1	3	2	0

1. The nomenclature is that of Eardley and Gvosdetsky. Numbers in parentheses follow my previous list (1961).
2. No mollusks were reported from either the Aftonian or Würm II.
3. I retain the terminology of Eardley and Gvosdetsky in parentheses.

present. The Bonneville formation, so far as known, is an unfossiliferous near-shore deposit, while no specific identifications have been reported from the Alpine. About one-third of the mollusks known from the White Marl are also known from the Provo formation. These are indicated by an asterisk. The following 16 species have been reported from the White Marl or its equivalents. Numbers in parentheses are those used in my 1961 checklist.

(9) Sphaerium pilsbryanum Sterki. Berry and Crawford (1932).

*(13) Physa ampullacea (Gould. Berry

and Crawford (1932).
(14) Physa gyrina Say. Call (1884).
(19) Lymnaea bonnevillensis (Call). Call (1884); Hassler and Crawford (1938); Ives (1946).
(26) Lymnaea kingii (Meek). Berry and Crawford (1932).
(29) Lymnaea palustris (Müller). Call (1884); Berry and Crawford (1932).
(31) Lymnaea stagnalis appressa (Say). Baker (1911).
*(33) Lymnaea utahensis (Call). Berry and Crawford (1932).
(41) Gyraulus vermicularis (Gould). Berry and Crawford (1932).
(44) Helisoma trivolvis (Say). Call (1884); Berry and Crawford (1932).
(50) Amnicola cincinnatiensis (Anthony). Call (1884); Hasler and Crawford (1938).
(53) Amnicola longinqua Gould. Ives (1946, 1951).
(54) Amnicola porata (Say). Call (1884).
*(57) Fluminicola fusca (Haldeman). Call (1884); Berry and Crawford (1932).
(63) Valvata humeralis californica Pilsbry. Berry and Crawford (1932).
*(64) Valvata utahensis (Call). Berry and Crawford (1932).

Bonneville Beds. This designation has been used by several authors, presumably for cases in which it was not known whether the material came from the Yellow Clay (Lower Bonneville Beds) or White Marl (Upper Bonneville Beds). Comparisons with the Utah valley sequence are of slight value at present, since the faunas of all units are not known. Four species (indicated by an asterisk) are not known from any of the Utah valley formations, although this absence may be nomenclatural rather than biological. The term "Bonneville Beds" may be taken as equivalent, in whole or part, to the Bonneville Group of modern terminology.

(19) Lymnaea bonnevillensis (Call). Call (1886); Baker (1911).
*(24) Lymnaea desidiosa Say. (Gilbert, 1875).
(31) Lymnaea stagnalis appressa Say. Hannibal (1912).
*(32) Lymnaea sumassi Baird. Call (1884).
(50) Amnicola cincinnatiensis (Anthony). Gilbert (1875); Hannibal (1912).
(57) Fluminicola fusca (Haldeman). Hannibal (1912).
*(59) Pomatiopsis lustrica Say. Gilbert (1875).
*(78) Succinea lineata Binney. Gilbert (1875).

Bonneville Terrace. Although not a stratigraphic unit, it should be noted that two genera, Lymnaea and Planorbis (=Helisoma), were reported by Crawford and Chroney (1944) from travertine deposits of the "uppermost"(Bonneville) terrace. So far as known, Lake Bonneville reached this level only once in its history; hence this travertine is presumably referable to the Bonneville formation. If this assumption is correct, these two generic records represent the only known mollusks recorded from the Bonneville formation.

Modern Stratigraphic Units.

Modern stratigraphic terminology of the Bonneville deposits began with investigations by the U. S. Geological Survey on the Quaternary System of the Basin, at first in Utah Valley and later studies on other areas (see map in Hunt et al., 1953: 3). In the following discussion I have attempted to summarize the progress of this work. Such molluscan finds as have been reported are noted, as well as an indication of those areas expected to yield important information in the near future. The Survey has greatly simplified the task of keeping abreast of its progress by the inauguration in 1960 of annual summaries of research work (see Prof. Papers 400-a, b, 1960; 424 a-d, 1961).

Green Clay Series. Established as the basal Pleistocene formation in the lower Jordan (Salt Lake) Valley by Jones and Marsell (1955), surface exposures of this formation are rare. Two facies are recognized, a near-shore conglomerate and an off-shore claystone and siltstone. The stratigraphy of Jordan Valley and its Pleistocene history are discussed in two joint papers by Jones and Marsell in 1955. The Utah Geological and Mineralogical Survey has in preparation a volume dealing with this area in its Geological Atlas series. To date only the geological map is available.

Molluscan fauna. Molluscan records referable to definite stratigraphic units from Jordan Valley are surprisingly few. None have been reported from the Green Clay series. Ostracodes have been found in the off-shore facies.

Alpine Formation. Originally described from near-shore deposits at Alpine, Utah County, in Utah Valley, by Hunt et al. (1953), this formation has subsequently been found in Jordan Valley by Jones and Marsell (1955) where it unconformably overlies the Green Clay series. It has been recognized in Ogden Valley by J. H. Feth of the U. S. Geological Survey, whose report is undergoing editorial revision at this writing (H. D. Goode, personal communication, January, 1962), and in the East Tintic area, where it is reported to contain abundant remains of unspecified gastropods and ostracodes (Goode, 1961). The Alpine is definitely associated with Gilbert's Intermediate Terrace (5050 ft. elev.), which was formed by Gilbert's "pre-Bonneville" high water stage. Varnes and van Horn (1961) correlate the whole of Gilbert's Yellow Clay and a portion of his White Marl with the Alpine. On the basis of prevailing texture the formation is divided into three members bearing lithologic names, although none are homogeneous units.

Molluscan fauna. No fossils were recovered from the Alpine in Utah Valley (Hunt et al., 1953), but the formation is known to be fossiliferous in Ogden Valley (J. H. Feth, personal communication, 1955) and the Tintic area (Goode, 1961). It is anticipated that Feth's forthcoming report will include the first identifications from the formation.

Bonneville Formation. Described by Hunt, Varnes, and Thomas (1955) from Utah Valley, this formation is represented only by a thin, discontinuous beach deposit of the highest (Bonneville) lake stage of Gilbert. The formation has not been recognized in Jordan Valley (Jones and Marsell, 1953). Goode (1961) reports the formation as sparse in the East Tintic area. Varnes and van Horn (1961) correlate a portion of Gilbert's White Marl with the Bonneville formation.

Molluscan fauna. It is impossible at present to say which of the records from the White Marl properly belong to the Bonneville Formation. The genera *Lymnaea* and *Planorbis* (=*Helisoma*) were reported by Crawford and Chroney (1944) from travertine deposits of the "uppermost" [Bonneville] terrace, presumably equivalent to this formation.

Provo Formation. Described by Hunt, Varnes, and Thomas (1953), the Provo is the most extensive formation known from the Basin. It is divided into four members distinguished by prevailing lithologies. In both Utah and Jordan valleys (Bissell, 1952; Jones and Marsell, 1955) the dual nature of the Provo shore deposits has been recognized. Many exposures show two nearly identical deposits associated with the two Provo shore lines (4800 and 4700 ft. elev.), with a well-developed soil profile between. Goode (1961) reports deposits in the East Tintic area tentatively referred to this formation. The sequence in Utah Valley, as outlined by Hunt, Varnes, and Thomas (1953) is as follows:

Gravel member. Occurs principally as delta deposits. Gastropods are plentiful in this member at Point of Mountain (near Utah-Salt Lake County line), while elsewhere few shells have been observed.

Sand member. Gastropods are abundant in this member where it grades into the finer-grained lake bottom sediments.

Silt member. Gastropods and ostracodes are abundant in this member in front of deltas, where in places they form almost a coquina.

Clay member. Represents deposits of the interior of the lake. Ostracodes seem to be

Table 4. Summary of Provo Formation Molluscan Fauna.
(Data from Hunt, Varnes, and Thomas, 1953).

Gravel	Sand	Silt	Clay
Unidentified gastropods	Unidentified gastropods		
			(7) Pisidium sp.
			(13) Physa ampullacea
			(16) Physa lordi
		(33) Lymnaea utahensis	
		(37) Carinifex newberryi	(37) Carinifex newberryi
			(46) Pompholopsis whitei
		(53) Amnicola longinqua	
			(55) Amnicola sp.
		(57) Fluminicola fusca	(57) Fluminicola fusca
	(64) Valvata utahensis	(64) Valvata utahensis	(64) Valvata utahensis
		(68) Oreohelix strigosa depressa	
		(77) Succinea avara	

more abundant and gastropods fewer in the clay than in the silt member. Commonly there is a concentration of shells about a foot above the base of the clay. Yen (in Hunt et al., 1953) believes that the environmental conditions were much the same as they are now in Utah Lake, suggesting a habitat of rich aquatic shore vegetation, possibly a somewhat marshy area.

Molluscan fauna. All of the published records specifically referable to the Provo formation are contained in the paper by Hunt, Varnes, and Thomas (1953). Table 4 summarizes this fauna.

Post-Bonneville (Post-Provo) Deposits

Which of these two terms is the correct one hinges upon a sharper delineation of the term "Lake Bonneville." It is clear that both Gilbert (1890) and Call (1884) considered the Stansbury and all later stages as post-Bonneville, thus delimiting Lake Bonneville at the Provo stage. Some later writers have used the term "Lake Bonneville" to apply to all but the historical fluctuations of the lake. In recent years the term "post-Provo" has come into wide usage in the same sense as Gilbert's "post-Bonneville." A complication arises from the fact that it has been demonstrated that the Provo shore line was reoccupied a second time. The term "post-Provo" is here taken to mean post-Provo II.

A satisfactory post-Provo stratigraphic nomenclature is yet to be devised. In all probability the period of time represented falls into the Deglacial and Neothermal of Antevs (1948). Ives (1951) has proposed several lake stages in this interval without corresponding stratigraphic terminology. Generally, three broad categories of sediments are recognized (Hunt et al., 1953; Jones and Marsell, 1955): (1) Alluvial deposits, (2) Eolian ? silt, and (3) lake deposits.

During the summers of 1951 and 1952 six coring stations were occupied by the University of Utah investigators in the southern part of Great Salt Lake. From these stations a total of 111 feet of relatively undisturbed sediments were recovered. The deepest core penetrated 43 feet 5 inches beneath the bottom of Great Salt Lake. The stratigraphy of these cores was reported by Schreiber (1958, published abstract, 1961) as a series of "lithic types" summarized in Table 5.

Table 5. Summary of Cores from beneath Great Salt Lake
(Data from Schreiber, 1961)

Lithic Type	Environmental Characteristics	Fauna
I	Typical of a very saline environment such as the present Great Salt Lake. High carbonate content.	Abundant fecal pellets, brine shrimp egg capsules.
II	Typical of deeper core intervals. Deposited in a fresh-water to slightly brackish lake. Carbonate percentages about 1/3 those of Type I.	Abundant ostracode fauna and lesser numbers of gastropods. Chara oogonia.
III	Observed in bottom of core 4 only. Believed deposited in a low level lake stage of 2 to 3 percent salinity.	None.

Schreiber believes that the sediments of Type II were deposited during the Stansbury stage, and he reports C-14 dating of this stage as from 23,000 to 13,500 years B. P. He also believes the Type III sediments were probably deposited during the pre-Stansbury interpluvial which was a low lake stage possibly near the Gilbert level. All of Schreiber's material, therefore, belongs to the post-Provo period.

Molluscan fauna. Undoubtedly much of the earlier molluscan records which lack context belong to the post-Provo sequence. There is no reason to doubt that the post-Provo fauna will ultimately prove to be very similar to the "Recent" fauna. In the meantime only the following can be assigned to this time interval.

(3) Anodonta nuttalliana Lea. "Post-Bonneville," Call (1884).
(8) Sphaerium dentatum (Haldeman). "Post-Bonneville," Call (1884).
(15) Physa heterostropha (Say). "Semi-fossil," Call (1884).
(33) Lymnaea stagnalis (L.) "Semi-fossil," Call (1884).
(44) Helisoma trivolvis (Say). "Post-Bonneville," Call (1884).

Stratigraphic Units of Uncertain Position

Little Valley, Promontory Mountains. Excavations in Little Valley at the south end of the Promontory Range, Box Elder County, to provide fill for a railroad causeway across Great Salt Lake revealed what is believed to be the most complete exposure of Lake Bonneville deposits to be discovered to date. A mimeographed report on this area was prepared by H. D. Goode for the Sixth Annual Field Trip of the Rocky Mountain Section, Friends of the Pleistocene, September 1960. Subsequently a brief account, without diagrams, was published by Goode and Eardley (1960). The section contains "a pink marker bed, three or more buried soils, and two or three ash beds, one of which may be equivalent to the Pearlette ash (of the mid-continent region), [which] render the section extremely attractive for deciphering of Quaternary chronology in the eastern Great Basin." One of the ash deposits is said to be very similar to the ash found in the Saltair core at a depth of 550 feet. The mollusks from the Little Valley deposits have not yet been reported upon, but are in the hands of D. W. Taylor (H. D. Goode, personal communication, March 1961).

San Pete Valley. The stratigraphy and contained molluscan faunas from the Gunnison Reservoir deposit, Sanpete County (1.75 miles west of Sterling) is discussed by Roy (1962). The age of these deposits is not known, and at present cannot be correlated with the Utah Valley sequence. Roy assumes the deposit to be of Wisconsin age, probably of latest Wisconsin. However, he states (p. 12) that "Because of the similarity of the Gunnison Reservoir assemblage to that collected at a depth of 271 feet in the Great Salt Lake (Saltair) core, it may be possible to consider these two assemblages as of the same age." This would contradict his assignment of these deposits to the Wisconsin since Eardley and Gvosdetsky (1960) correlate this depth with the Sangamon Interglacial. The mollusks reported from the Gunnison deposits are:

Pisidium nitidum pauperculum Sterki
Sphaerium sp.
Valvata humeralis californica Pilsbry
Gyraulus parvus (Say)
Armiger crista (L.)
Fossaria parva (Lea)
Physa gyrina Say
Promenetus exacuous (Say)
Stagnicola palustris (Müller)
Ferrissia parallela (Haldeman)
Helisoma trivolvis (Say)
Succinea avara Say
Oxyloma retusa (Lea)
Vertigo ovata Say
Discus cronkhitei (Pilsbry)
Retinella binneyana occidentalis H. B. Baker
Vallonia albula Sterki

The mollusks occur at irregular intervals and in unequal distribution throughout the deposit. They occur in clay units in the lower two-thirds of the deposit and in a sand unit in the upper third. No mollusks were found in any of the marl units. This material is deposited in the collections of the Geology Department, Ohio State University.

Deposits Outside the Lake Bonneville Area: Bear Lake Deposits

Only one other Pleistocene lake is known in the two-thirds of the Basin lying outside of the area covered by the maximum state of Lake Bonneville. For many years the peculiarly darkened shells of several species of mollusks found in great abundance on the beaches of Bear Lake (northeastern Utah and southeastern Idaho) have attracted attention and speculation as to their age. A fairly detailed history of this region is now available (Williams, Willard, and Parker, 1962). Three high level stages are described and named. Evidence is presented to show that they were produced by physical rather than climatic causes. A new formation, the Bear Lake, is named and described. C-14 dating indicates that the mollusks were killed in great numbers about 8,000 years B. P. and the authors believe that this time closely corresponds to the period of high-level stages of the lake. The "great dying" of the mollusk population appears to have taken place at the rapid shrinkage of the lake, shortly after its greatest expansion. This date would seem to place the stages of Bear Lake discussed by Williams and coworkers in the post-Provo portion of the Bonneville sequence. Shells from a depth of 92-95 feet in a test hole in the Bear Lake sediments gave a C-14 date of 27,400 ± 2,500 years. Further study is necessary before correlation of the Bear Lake history and deposits can be made with those of Lake Bonneville. Bear Lake is unusual today in that it represents practically an aquatic desert.

Molluscan fauna. Over the years a number of forms have been recorded from the Bear Lake region as "fossil" because of their peculiar bluish coloration. The following is a summary of this material.

(2) Anodonta californiensis Lea. Henderson 1931b: 109-113.
(3) Anodonta nuttalliana Lea. Chamberlin and Jones 1929: 23, 26.
(4) Anodonta oregonensis Lea. Chamberlin and Jones 1929: 24-25.

(9) Sphaerium pilsbryanum Sterki. Sterki 1909: 141; Chamberlin and Jones 1929: 32; Henderson 1931b: 109-113.

(13) Physa ampullacea Gould. Henderson and Daniels 1917: 58; Henderson 1931b: 109-113.

(29) Lymnaea palustris (Müller). Henderson 1931b: 109-113.

(30) Lymnaea proxima Lea. Henderson and Daniels 1917: 58.

(33) Lymnaea utahensis (Call). Sterki 1909: 142; Henderson 1924: 173; Chamberlin and Jones 1929: 143-144; Henderson 1931a: 77-79; 1931b: 109-113.

(36) Carinifex atopus Chamberlin and Jones. Chamberlin and Jones 1929: 156-157; Henderson 1931a: 77-79.

(37) Carinifex newberryi (Lea). Chamberlin and Jones 1929: 155-156; Henderson 1931a: 77-79; 1931b: 109-113.

(40) Gyraulus parvus (Say). Henderson and Daniels 1917: 50.

(41) Gyraulus vermicularis Gould. Henderson 1931b: 109-113.

(44) Helisoma trivolvis (Say). Henderson 1931b: 109-113.

(47) Promenetus exacuous (Say). Henderson 1931b: 109-113.

(53) Amnicola longinqua Gould. Henderson 1931b: 109-113.

(57) Fluminicola fusca (Haldeman). Sterki 1909: 142; Henderson 1931b: 109-113.

(63) Valvata humeralis californica Pilsbry. Henderson 1931b: 109-113.

(64) Valvata utahensis Call. Henderson 1931b: 109-113.

(73) Discus cronkhitei anthonyi Pilsbry. Henderson and Daniels 1917: 58; Henderson 1931b: 109-113.

(76) Vertigo ovata (Say). Henderson and Daniels 1917: 58.

(79) Succinea sp. Henderson 1931b: 109-113.

Related Deposits in the Snake River Drainage

During the Pleistocene the Bonneville Basin was an appendage to the Snake River drainage. The point of overflow, Red Rock Pass, was early detected by Gilbert (1874; 1890). Excellent photographs of this area are available in Williams (1958). A series of studies now under way by the U. S. Geological Survey in southern Idaho has a direct bearing on the Bonneville problem.

American Falls Area

Erosional and depositional features produced by the Bonneville overflow are discussed in short papers by Malde (1960) and Trimble and Carr (1961a). A detailed report is available in Trimble and Carr (1961b). Something of the magnitude reached by this Bonneville river can be realized by the fact that boulders up to 8 feet in diameter were found in a delta deposit near Pocatello, Idaho. According to Trimble and Carr, current velocity of between 16 and 48 miles per hour is indicated. "These are very broad and approximate limits," these authors state, "but when this general order of magnitude is compared with a median velocity of 3.54 miles per hour for the Mississippi River during one of its greatest floods, and with a maximum recorded velocity of about 16 miles per hour for any natural stream, it is evident that the stream responsible for the Michaud gravel attained abnormal size and velocity, at least temporarily." (Trimble and Carr, 1961b). These authors also include a list of the mollusks recovered from the American Falls deposits. C-14 dating indicates that the Michaud gravel was deposited about 30,000 to 40,000 years B. P.

Cleveland Area

Lake beds in the Cleveland area (Gentile and Mound Valleys) of southeastern Idaho were recognized as early as 1879 by Peale. Some authors have thought that they represent deposits in an arm of Lake Bonneville.

In a M. S. thesis Bright (1960) interprets these deposits to represent a Pleistocene lake, essentially contemporaneous with Lake Bonneville, which was formed as a result of damming of basaltic flows and of diversion of the Bear River into the newly created depression. According to Bright this lake, named Lake Thatcher, rose to an elevation of 5,484 feet (some 350 feet above the maximum level of Lake Bonneville), then spilled over into the Bonneville system. He believes that this spillover could have accounted for the rise and overflow of Lake Bonneville through Red Rock Pass. Two strand lines and associated deposits are named and described, both of which contain mollusks. A preliminary faunal list is given by Bright based on material identified by D. W. Taylor. Taylor has tentatively suggested that the dissimilarity of the Thatcher assemblage from the Bonneville deposits reported by Call indicates a difference in age.

Bright is continuing his studies of the Cleveland area as a Ph. D. thesis at the University of Minnesota (R. C. Bright, personal communication, November 4, 1960). In this connection it is expected that he will make the first application of palynology to the Bonneville problem.

SYSTEMATIC CATALOG

The general arrangement of this section follows my previous (1961) checklist, to which the numbers in parentheses are keyed. Only primary sources are cited, and only those records having stratigraphic significance are included except those of material from the Bear Lake area which lack context.

Margaritiferidae

(1) Margaritifera margaritifera (L.) Post-Bonneville (Post-Provo), Sevier Desert. Call 1884: 14.

Unionidae

(2) Anodonta californiensis Lea. "Fossil" at Bear Lake, Utah. Henderson 1931b: 109-113.

(3) Anodonta nuttalliana Lea. Post-Bonneville (Post-Provo), Sevier Desert. Call 1884: 14-15. "Fossil" at Bear Lake, Utah. Chamberlin and Jones 1929: 23, 26.

(4) Anodonta oregonensis Lea. "Fossil" at Bear Lake, Utah. Chamberlin and Jones 1929: 24-25.

(5) Anodonta sp. Kansan stage. Saltair core, sample 140, 433-433 ft. 2.5 in. Eardley and Gvosdetsky 1960: 1336-1338.

Sphaeriidae

(6) Pisidium compressum Prime. "Fossil" at Bear Lake, Idaho and Utah. Henderson 1931b: 109-113.

(7) Pisidium sp. Provo fm., clay member. Near Utah Lake, NE 1/4 Sec. 35, T. 5 S., R. 1 W. Hunt, Varnes, and Thomas 1953:25. -- Yarmouthian stage. Saltair core, sample 127, 397'5" - 397'7". Eardley and Gvosdetsky 1960: 1336-1338. --- Kansan stage. Saltair core, sample 151, 463'10.5" - 464'0.5". Eardley and Gvosdetsky 1960: 1336-1338.

(8) Sphaerium dentatum (Haldeman). Post-Bonneville (Post-Provo), Sevier Desert; near mouth of Jordan River. Call 1884: 15.

(9) Sphaerium pilsbryanum Sterki. "Fossil" at Bear Lake, Utah. Sterki 1909: 141; Chamberlin and Jones 1929: 32; Henderson 1931b: 109-113. -- Bonneville marl (White Marl). Salt Lake City, west side of Jordan River. Berry and Crawford 1932: 55-54. -- Provo fm., clay member. Near Utah Lake, NE 1/4 Sec. 35, T. 5 S., R. 1 W. Hunt, Varnes, and Thomas 1953: 25.

(10) Sphaerium striatinum (Lamarck). Wisconsinan I stage. Saltair core, sample 59, 186'8"-187'. Eardley and Gvosdetsky 1960: 1336-1338.

(11) Sphaerium sp. Wisconsin I stage. Saltair core, sample 50, 155'6.5"-155'8.5". Eardley and Gvosdetsky 1960: 1336-1338. -- Sangamon stage. Saltair core, sample 82, 271'4"-271'6". Eardley and Gvosdetsky 1960: 1336-1338.

Physidae

(13) Physa ampullacea Gould. "Fossil" at Bear Lake, Utah and Idaho. Henderson and Daniels 1917: 58; Henderson 1931b: 109-113. -- Bonneville marl (White Marl). Salt Lake City, west side of Jordan River. Berry and Crawford 1932: 53-54. -- Provo fm., clay member. Near Utah Lake, NE 1/4 Sec. 35,

T. 5 S., R. 1 W. Hunt, Varnes, and Thomas 1953: 25.

(14) Physa gyrina Say. Upper Bonneville beds (White Marl). Salt Spring Creek, Utah. Call 1884: 18.

(15) Physa heterostropha (Say). Semi-fossil (Post-Provo), Sevier Desert. Call 1884: 18.

(16) Physa lordi Baird. Provo fm., clay member. Near Utah Lake, NE 1/4 Sec. 35, T. 5 S., R. 1 W. Hunt, Varnes, and Thomas 1953: 25.

(17) Physa sp. (spp.). Wisconsinan I stage. Saltair core, sample 57, 178'8"-178'10". Eardley and Gvosdetsky 1960: 1336-1338. -- Kansan stage. Saltair core, sample 140, 433' - 433'2.5". Eardley and Gvosdetsky 1960: 1336-1338.

Lymnaeidae

(19) Lymnaea bonnevillensis (Call). Upper Bonneville beds (White Marl). Kelton, Fish Spring Valley, and near Willow Springs. Call 1884: 18, 24, 28; Call 1886: 5-6. -- Marl deposit (White Marl). South of Sevier Lake, Millard Co., Utah. Hasler and Crawford 1938: 25-26. -- White Marl. Whirlwind Valley, Tooele Co., Utah. Ives 1946: 195-199. -- White Marl. Gilbert's Upper River bed site. T. 10 S., R. 9 W., Tooele Co., Utah. Ives 1951: 787.

(20) Lymnaea caperata Say. -- Sangamonian stage. Sample 82, 271'4" - 271'6". Eardley and Gvosdetsky 1960: 1336-1338. -- Yarmouthian stage. Sample 139, 428'7" - 428' 10". Eardley and Gvosdetsky, 1960: 1336-1338.--Kansan stage. Sample 151, 463'10.5" - 464'0.5". Sample 141, 435' 11" - 436' 1". Eardley and Gvosdetsky 1960: 1336-1338.

(21) Lymnaea catascopium Say. Bonneville Marl (White Marl). Packard 1877: 166.

(22) Lymnaea cockerelli (Pilsbry and Ferriss). Kansan stage. Saltair core, sample 141, 435' 11" - 436' 1". Eardley and Gvosdetsky 1960: 1336-1338.

(23) Lymnaea dalli (Baker). Wisconsinan I stage. Saltair core, sample 57, 178' 8" - 178' 10". Eardley and Gvosdetsky 1960: 1336-1338.

(24) Lymnaea desidiosa Say. Bonneville Marl (White Marl). Packard 1877: 166.

(26) Lymnaea kingi (Meek). Bonneville Marl (White Marl). Salt Lake City, west side of Jordan River. Berry and Crawford 1932: 53-54.

(29) Lymnaea palustris (Müller). Upper Bonneville Beds (White Marl). Near Salt Spring Creek, Utah. Call 1884: 17. -- "Fossil" at Bear Lake, Idaho. Henderson 1931b: 109-113. -- Bonneville marl (White Marl). Salt Lake City, west side of Jordan River. Berry and Crawford 1932: 53-54. -- Wisconsinan I stage. Saltair core, sample 57, 178' 8" - 178' 10". Eardley and Gvosdetsky 1960: 1336-1338. -- Yarmouthian stage. Saltair core, sample 127, 397' 5" - 397' 7". Eardley and Gvosdetsky 1960: 1336-1338.

(30) Lymnaea proxima Lea. "Fossil" at Bear Lake, Idaho. Henderson and Daniels 1917: 58.

(-) Lymnaea stagnalis. Semi-fossil (Post-Provo). Call 1884: 17.

(31) Lymnaea stagnalis appressa (Say). White Marl, Sevier Desert. Baker 1911: 146-147.

(32) Lymnaea sumassi Baird. Upper Bonneville beds (White Marl). Matlin Pass. Call 1884: 18.

(33) Lymnaea utahensis (Call). "Fossil" at Bear Lake, Idaho and Utah. Sterki 1909: 142; Henderson 1924: 173; Chamberlin and Jones 1929: 143-144; Henderson 1931a: 77-79; Henderson 1931b: 109-113. -- Bonneville Marl (White Marl). Salt Lake City, west side of Jordan River. Berry and Crawford 1932: 53-54. -- Provo fm., silt member. Denver and Rio Grande R. R. cut, SE corner Sec. 26, T. 6 S., R. 1 W. Hunt, Varnes, and Thomas 1953: 23.

(34) Lymnaea sp. (spp.). Uppermost Bonneville Terrace (Bonneville fm. ?) 0.5 mile NW Camp Williams, near Utah-Salt Lake Co. line. Crawford and Chorney 1944: 135-138. -- Laufen stage. Saltair core, sample 19, 33' 10" - 33' 11". Eardley and Gvosdetsky 1960:

1336-1338. -- Illinoian stage. Saltair core, sample 115, 358' 8" - 358' 10". Eardley and Gvosdetsky 1960: 1336-1338. -- Yarmouth stage. Saltair core, sample 137, 425' 1" - 425' 3", (2 species). Eardley and Gvosdetsky 1960: 1336-1338. -- Kansan stage. Saltair core, sample 140, 433' - 433' 2.5"; sample 151, 463' 10.5" - 464' 0.5"; sample 162, 493' 8" - 493' 11". Eardley and Gvosdetsky 1960: 1336-1338.

Planorbidae

(35) Armiger crista (L.). Sangamon stage. Saltair core, sample 82, 271' 4" - 271' 6". Eardley and Gvosdetsky 1960: 1336-1338.

(36) Carinifex atopus Chamberlin and Jones. "Fossil" at Bear Lake, Utah. Chamberlin and Jones 1929: 156-157; Henderson 1931a: 77-79.

(37) Carinifex newberryi (Lea). "Fossil" at Bear Lake, Utah. Sterki 1909: 147; Chamberlin and Jones 1929: 155-156; Henderson 1931a: 77-79; Henderson 1931b: 109-113. -- Provo fm., clay member. Near Utah Lake, NE 1/4 Sec. 35, T. 5 S., R. 1 W. Hunt, Varnes, and Thomas 1953: 25.

(39) Gyraulus circumstriatus (Tryon). Laufen stage. Saltair core, sample 25, 44'-44' 2". Eardley and Gvosdetsky 1960: 1336-1338. -- Wisconsinan I stage. Saltair core, sample 57, 178' 8" - 178' 10". Eardley and Gvosdetsky 1960: 1336-1338. -- Yarmouthian stage. Saltair core, sample 119, 366' - 366' 2". Eardley and Gvosdetsky 1960: 1336-1338. -- Kansan stage. Saltair core, samples 140, 141, 153, 162. Eardley and Gvosdetsky 1960: 1336-1338.

(40) Gyraulus parvus (Say). "Fossil" at Bear Lake, Idaho. Henderson and Daniels 1917: 50. -- Laufen stage. Saltair core, sample 33, 75' 10" - 75' 12". Eardley and Gvosdetsky 1960: 1336-1338. -- Wisconsinan I stage. Saltair core, sample 50, 155' 6.5" - 155' 8.5". Eardley and Gvosdetsky, 1960: 1336-1338. -- Yarmouthian stage. Saltair core, sample 129, 402' 1.5" - 402' 3.5". Eardley and Gvosdetsky, 1960: 1336-1338.

(41) Gyraulus vermicularis (Gould). "Fossil at Bear Lake, Utah and Idaho. Henderson 1931b: 109-113. Bonneville Marl (White Marl). Salt Lake City, west side of Jordan River. Berry and Crawford 1932: 53-54.

(42) Gyraulus sp. (spp.). Wisconsinan I stage. Saltair core, sample 49, 145' - 145' 2". Eardley and Gvosdetsky 1960: 1336-1338. Sangamon stage. Saltair core, sample 82, 271'4" - 271' 6". Eardley and Gvosdetsky 1960: 1336-1338. Illinoian stage. Saltair core, sample 115, 358' 8" - 358' 10". Eardley and Gvosdetsky 1960: 1336-1338. -- Yarmouthian stage. Saltair core, sample 127, 397' 5" - 397' 7"; sample 128, 399' 5". Eardley and Gvosdetsky 1960: 1336-1338. -- Kansan stage. Saltair core, sample 142, 437' 2" - 437' 4"; sample 151, 463' 10.5" - 464' 0.5". Eardley and Gvosdetsky 1960: 1336-1338.

(44) Helisoma trivolvis (Say). "Fossil" at Bear Lake, Idaho. Henderson 1931b: 109-113. -- Post-Bonneville (Post-Provo), Sevier Desert, Utah. Call, 1884: 16. -- Upper Bonneville beds (White Marl). Near Salt Spring Creek, Utah. Call 1884: 16. -- Bonneville Marl (White Marl). Salt Lake City, west side of Jordan River. Berry and Crawford 1932: 53-54.

(45) Helisoma sp. Uppermost Bonneville terrace (Bonneville fm.?). Half mile NW Camp Williams, near Utah-Salt Lake Co. line. Crawford and Chorney 1944: 135-138. -- Laufen stage. Saltair core, sample 33, 75' 10" - 75' 12". Eardley and Gvosdetsky 1960: 1336-1338. -- Wisconsinan I stage. Saltair core, sample 49, 145' - 145' 2". Eardley and Gvosdetsky 1960: 1336-1338. -- Yarmouthian stage. Saltair core, sample 128, 399' 5"; sample 139, 428' 7" - 428' 10". Eardley and Gvosdetsky 1960: 1336-1338. -- Kansan stage. Saltair core, sample 140, 433' - 433' 2.5"; sample 141, 435' 11" - 436' 1"; sample 151, 463' 10.5" - 464' 0.5"; sample 162, 493' 8" - 493' 11". Eardley and Gvosdetsky 1960: 1336-1338.

(46) Pompholopsis whitei Call. Provo fm., clay member. Near Utah Lake, NE 1/4 Sec. 35, T. 5 S., R. 1 W. Hunt, Varnes and Thomas 1953: 25.

(47) Promenetus exacuous (Say). Sangamon stage. Saltair core, sample 82, 271' 4" - 271' 6". Eardley and Gvosdetsky 1960: 1336-1338. "Fossil" at Bear Lake, Idaho, Henderson 1931b: 109-113.

(48) Promenetus umbilicatellus (Cockerell). Kansan stage. Saltair core, sample 140, 433' - 433' 2.5". Eardley and Gvosdetksy 1960: 1336-1338.

Ancylidae

(49) Ferrissia sp. Illinoian stage. Saltair core, sample 115, 358' 8" - 358' 10". Eardley and Gvosdetsky 1960: 1336-1338.

Amnicolidae

(50) Amnicola cincinnatiensis (Anthony). Bonneville Marl (White Marl). Floor of Clinton's Cave near Lake Point, Tooele Co., Utah. Packard 1887: 166.-- Upper Bonneville beds (White Marl). "Various localities in Utah." Call 1884: 20-21.-- Marl (White Marl). South of Sevier Lake, Millard Co., Utah, Hasler and Crawford 1938: 25-26. -- Bonneville Terraces (Bonneville fm.?). Pilsbry 1899: 122.

(-) Amnicola decisa Haldeman. Bonneville Marl (White Marl). Bottom of Clinton's Cave, near Lake Point, Tooele Co., Utah. Packard 1877: 165.

(52) Amnicola limosa Say. Bonneville Marl (White Marl). Packard 1877: 166.

(53) Amnicola longinqua Gould. "Fossil" at Bear Lake, Utah and Idaho. Henderson 1931b: 109-113. -- White Marl. Whirlwind Valley, Tooele Co., Utah. Ives 1946: 195-199. -- White Marl. Gilbert's Upper River Bed site, T. 10 S., R. 9 W., Tooele Co., Utah. Ives 1951: 787. -- Provo fm., silt member. Denver & Rio Grande R.R. cut, SE corner Sec. 26, T. 6 S., R. 1 W., Utah Co. Hunt, Varnes, and Thomas 1953: 23.

(54) Amnicola porata (Say). Upper Bonneville Beds (White Marl). "Various localities." Call 1884: 21.

(55) Amnicola sp. (spp.). Wisconsinan I stage. Saltair core, sample 59, 186' 8" - 187'. Eardley and Gvosdetsky 1960: 1336-1338. -- Yarmouthian stage. Saltair core, sample 128, 399' 5"; sample 129, 402' 3.5". Eardley and Gvosdetsky 1960: 1336-1338. -- Provo fm., clay member. Near Utah Lake, NE 1/4 Sec. 35, T. 5 S., R. 1 W. Hunt, Varnes, and Thomas 1953: 25.

(57) Fluminicola fusca (Haldeman). "Fossil" at Bear Lake. Sterki 1909: 142; Henderson 1931b: 109-113. -- Bonneville Marl (White Marl). Packard 1877: 166. -- Upper Bonneville beds (White Marl). Kelton; Snowville, Box Elder Co., Utah. Call 1884: 21. -- Bonneville Marl (White Marl). West side of Jordan River, Salt Lake City. Berry and Crawford 1932: 53-54. -- Provo fm., silt member. Denver & Rio Grande R.R. cut, SE corner Sec. 26, T. 6 S., R. 1 W. Hunt, Varnes, and Thomas 1953: 23, 25. -- Provo fm., clay member. Near Utah Lake, NE 1/4 Sec. 35, T. 5 S., R. 1 W. Hunt, Varnes, and Thomas 1953: 23-25.

(-) Pomatiopsis lapidaria Say. Bonneville Marl (White Marl). Bottom of Clinton's Cave, near Lake Point, Tooele Co., Utah. Packard 1877: 166.

(59) Pomatiopsis lustrica Say. Bonneville Marl (White Marl). Packard 1877: 166.

Valvatidae

(62) Valvata humeralis (Say). Laufen stage. Sample 33, 75' 19" - 75' 12"; sample 37, 88' 6" - 88' 8". Eardley and Gvosdetsky 1960: 1336-1338. -- Wisconsinan I stage. Sample 49, 145' - 145' 2"; sample 50, 155' 6.5" - 155' 8.5"; sample 55, 173' 4" - 173' 6"; sample 57, 178' 8" - 178' 10". Eardley and Gvosdetsky 1960: 1336-1338. -- Sangamonian stage. Sample 82, 271' 4" - 271' 6". Eardley and Gvosdetsky 1960: 1336-1338. Yarmouthian stage. Sample 117, 363' - 363' 2"; sample 119, 366' - 366' 2"; sample 127, 397' 5" - 397' 7"; sample 128, 399' 5"; sample 129, 402' 1.5" - 402' 3.5"; sample 139, 428' 7" - 428' 10". Eardley and Gvosdetsky 1960: 1336-1338. -- Kansan stage. Sample 140, 433' - 433' 2.5"; sample 142, 437' 2" -

437' 4"; sample 151, 463' 10.5" - 464' 0.5"; sample 153, 469' 10" - 470'; sample 162, 493' 8" - 493' 11"; sample 174, 534' 10.5"-535'. Eardley and Gvosdetsky 1960: 1336-1338.

(63) Valvata humeralis californica Pilsbry. "Fossil" at Bear Lake, Utah and Idaho. Henderson 1931b: 109-113. Bonneville Marl (White Marl). Packard 1877: 166. Salt Lake City, west side of Jordan River. Berry and Crawford 1932: 53-54.

(64) Valvata utahensis (Call). "Fossil" at Bear Lake, Idaho and Utah. Henderson 1931b: 109-113. Bonneville Marl (White Marl). Salt Lake City, west side of Jordan River. Berry and Crawford 1932: 53-54. -- Laufen stage. Sample 33, 75' 10" - 75' 12". Eardley and Gvosdetsky 1960: 1336-1338. -- Wisconsinan I stage. Sample 49, 145' -145' 2"; sample 50, 155' 5.5" - 155' 8.5". Eardley and Gvosdetsky 1960: 1336-1338. -- Yarmouthian stage. Sample 129, 402' 1.5" - 402' 3.5". Eardley and Gvosdetsky 1960: 1336-1338. -- Provo fm., sand member. Utah Co., Sec. 32, T. 4 S., R. 1 E. Hunt, Varnes, and Thomas 1953: 23. -- Provo fm., clay member. Near Utah Lake, NE 1/4 Sec. 35, T. 5 S., R. 1 W. Hunt, Varnes, and Thomas 1953: 25.

(66) Valvata virens Tryon. Semi-fossil (Post-Provo), Sevier Desert. Call 1884: 21.

Camaenidae

(68) Oreohelix strigosa depressa (Ckll.). Provo fm., silt member. Dry Creek, just below town of Alpine, Utah Co. Hunt, Varnes, and Thomas 1953: 24.

Endodontidae

(73) Discus cronkhitei anthonyi Pilsbry. "Fossil" at Bear Lake, Idaho and Utah. Henderson and Daniels 1917: 58; Henderson 1931b: 109-113.

Pupillidae

(76) Vertigo ovata (Say). "Fossil"? at Bear Lake, Idaho. Henderson and Daniels 1917: 58.

Succineidae

(77) Succinea avara Say. Provo fm., silt member. Dry Creek, just below town of Alpine, Utah Co. Hunt, Varnes, and Thomas 1953: 24.

(78) Succinea lineata W. G. Binney. Bonneville Marl (White Marl). Packard 1877: 166.

(79) Succinea sp. (spp.). "Fossil" ? at Bear Lake, Idaho. Henderson 1931b: 109-113. -- Sangamon stage. Saltair core, sample 82, 271' 4" - 271' 6". Eardley and Gvosdetsky 1960: 1336-1338.

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HELICODISCUS ROUNDYI (MORRISON)

LESLIE HUBRICHT

In my recent paper "Drift land shells from the Red River, Arkansas" (Sterkiana 8: 33-34) I listed two new species of *Helicodiscus*. One of these, of which there were five specimens, was a very small, tightly coiled species, only slightly larger than *Punctum minutissimum* (Lea). While the above paper was in press I succeeded in removing the dirt from the apertures of the shells and discovered that there was a pair of teeth within the aperture. This discovery enabled me to identify them as *Paravitrea roundyi* Morrison. Having examined these specimens I feel that this species belongs in *Helicodiscus* rather than *Paravitrea*.

Three shells which I had collected in 1934 from Pleistocene silt, one mile northwest of Collinsville, Madison County, Illinois were found to be *Helicodiscus roundyi*. One specimen had three pairs of teeth within the aperture.

REPRINTS FROM AMU NEWS BULLETIN AND ANNUAL REPORT

DISTRIBUTION OF MOLLUSKS IN A BASIC BOG LAKE AND ITS MARGINS. -- BY RALPH W. DEXTER

(Reprinted from American Malacological Union News Bulletin and Annual Report, 1948, pp. 4-5).

Over a period of ten years, mollusks were collected from a small bog lake located on the divide between Lake Erie drainage and Ohio River drainage at Twin Lakes, Ohio. This glacial lake has an area of about 6 acres, with a maximum depth of 23 feet. It is circular in outline with concentric zones of submerged, floating, and emergent vegetation. On one side is a bog shelf of sphagnum moss with leatherleaf, poison sumac, huckleberry bushes, and tamarack trees. On the other is a swamp-type shelf with cattails, buttonbush, alder, willows and on the upland hardwood forest. The temperature range is from 0°C. to 28°C. The range of hydrogen ion concentration is from pH 6.7 to pH 8.6. Curves were presented to show the monthly fluctuation of temperature and hydrogen ion concentration at depths of two-feet intervals for two and one-half years. There is a complete "overturn" in the spring and fall, resulting in uniform conditions from top to bottom, with stratification of temperature and pH during the summer and winter seasons. The water is usually alkaline which explains the presence of such a rich molluscan population in a lake which is otherwise largely glacial bog in character. Nineteen species of gastropods and three genera of sphaeriids have been found, each one confined to a rather narrow margin in the water or shoreline zones. Details on the distribution of each species were given.

This paper was greatly enhanced by colored slides of the lake studied by Dr. Dexter, so that the audience obtained a graphic view of the habitats. Dr. Jennings asked if the soil substrate of the lake had been tested for percentage of hydrogen ion concentration, and Dr. Dexter replied that though this examination was beset with technical difficulties, such tests as he had made indicated it is slightly acid. At Presque Isle in Lake Erie, Dr. Jennings noted, the sandy peninsula at the east end is continually added to by sand bars; at each successive addition, a freshwater pond is formed behind the marginal dune. The ponds are of increasing age as one proceeds westward, the oldest dating back to perhaps forty years ago. The younger ponds are alkaline, but older ones are acid, and have a thin layer of acid soil over a deeper substrate which is alkaline. Dr. Dexter replied that he did not know the depth of the bottom ooze material in the lake which he studied; the organic nature of this material is probably the cause of (page 4) the acid condition, while photosynthesis of the phytoplankton and vascular aquatic plants probably push the pH balance toward the alkaline side. Dr. van der Schalie noted that silting would be a drain of the available supply of dissolved oxygen, and thus perhaps a primary factor in explaining the absence of mollusca in certain areas of the lake, as well as being important in the pH balance. He further inquired about the finding of larger land snails in the oak zone, noting that in his experience oak woods have been unproductive of larger snail forms. Dr. Dexter replied that the wooded area consists of a rather narrow strip on the edge of the bog, with no transitional zone of vegetation; this area of hardwood trees is never flooded, and consists of red and white oak, as well as elm, maple and others. Some trees are large enough to suggest that they are of the original forest.

AUTHOR'S NOTE: This paper was published in full in Nautilus 64 (1): 19-26, 1950. R.W.D.

REPRINTS FROM AMU NEWS BULLETIN AND ANNUAL REPORT

COMPARISON OF THE MOLLUSKS IN ADJACENT OHIO RIVER AND LAKE ERIE DRAINAGE SYSTEMS. -- BY R. W. DEXTER, L. H. SWART, and A. F. DAVIS. Kent State University, Kent, Ohio. (Reprinted from American Malacological Union News Bulletin and Annual Report, 1951, pp. 2-3).

An ecological survey of the mollusks inhabiting adjacent watersheds was made by two graduate students working under the direction of the senior writer. Swart collected between August 1939 and August 1940 from 11 stations in the West Branch of the Mahoning River, some 30 miles long with a 300 ft. gradient and which empties into the Mahoning of the Ohio River (page 3) system. Specimens were identified by W. J. Clench and Calvin Goodrich. Additional collections were made by Dexter and Swart in August of 1951. Davis collected from 43 stations in the Cuyahoga River drainage from June to December, 1950. This watershed is over 80 miles long with a gradient of 727 ft. and flows into Lake Erie. Specimens were identified by H. van der Schalie. Pollution is more serious in the Cuyahoga River, especially in the lower half of the stream, but otherwise the habitats of the two are comparable. Seven habitats were investigated – rock, rubble, gravel, sand, mud, submerged and floating vegetation, and emergent vegetation.

In both drainage systems 11 spp. of gastropods, 2 spp. of river clams, and the three genera of finger-nail clams were found as follows: Physa gyrina, P. integra, Amnicola integra, Goniobasis livescens, Ferrissia parallela, Helisoma trivolvis, H. anceps, Gyraulus parvus, Valvata tricarinata, Campeloma integrum, Succinea retussa; Anodontoides ferussacianus, Anodonata grandis; Sphaerium, Pisidium, and Musculium. For the most part these were the abundant and widely distributed spp. of the two rivers and their tributaries.

The West Branch of the Mahoning had in addition one common snail, Lymnaea humilis modicella on mud banks, and two of local distribution, Ferrissia diaphana at one station on rubble and Gyraulus cristus at one station on vegetation. Four bivalves, two of them common and widely distributed (Lampsilis siliquoidea and Obovaria subrotunda), and two less common spp. (Quadrula undulata and Proptera alata), were also collected only from this stream. The greater degree of pollution in the Cuyahoga River is probably responsible for the dearth of unionids in that stream. It was also noted that the bivalves that were present there were less abundant in comparison with the Mahoning.

In the Cuyahoga River 10 spp. of gastropods and 1 clam were found that were not collected from the West Branch of the Mahoning. However, only three of these were common. Lymnaea obrussa, abundant and widely distributed, took the place on mud banks in the Cuyahoga River of L. h. modicella found in the West Branch of the Mahoning. Amnicola limosa and Pseudosuccinea columella were also common in the Cuyahoga but not found in the other drainage. In addition the following six spp. were rarely found, some of them but once: Gyraulus hirsutum, G. deflectus, Planorbula armigera, Menetus exacuous, Amnicola lustrica, and Campeloma decisum. Viviparus malleatus has been introduced into one short section of the Cuyahoga and a single specimen of the clam Alasmidonta calceolus has been collected there.

In general the common and widely distributed spp. were the same in both drainage systems. Pollution has apparently extirpated some mollusks, especially bivalves. Further collecting may possibly prove that most of the spp. inhabit both rivers. Deevey (Bull. Geol. Soc. Amer. 60: 1393. 1949) has pointed out that the fauna of the Great Lakes was derived from the Mississippi waterways. There is also some evidence (personal communication of C. N. Savage, Dept. of Geog. and Geol., Kent State Univ.) that possibly an ice lobe had caused a cross-over between the Cuyahoga and West Branch of the Mahoning Rivers before the retreat of the late Wisconsin glacier. Thus the similarity of the molluscan fauna of the now separate drainage systems would be expected.

Dr. Dexter illustrated his remarks with a map of the area under discussion, and with a list of the molluscan fauna from both sources. As he concluded, Dr. Paul Bartsch reminded him that molluscan distribution is not always due to water connections, and that birds are often instrumental in transplanting small mollusks.

COMPARISON OF THE GASTROPOD FAUNA IN THE DRAINAGE SYSTEMS OF CHAMPAIGN COUNTY, ILLINOIS. - - BY RALPH W. DEXTER, Kent State University, Kent, Ohio. (Reprinted from American Malacological Union News Bulletin and Annual Report, 1954, pp. 1-2).

Champaign County in east-central Illinois is a nearly level upland plain which contains exclusively the headwaters of six streams — the Salt Fork and Middle Fork of the Big Vermilion River, the Sangamon, Kaskaskia, Embarrass, and Little Vermilion Rivers. White the headwaters are in close juxtaposition, the mouths of these rivers are widely separated. Gastropods were collected in the fall of 1934, spring of 1935, spring of 1945 and 1946, fall of 1951, spring of 1952 and 1953. Identifications of early collections were made by Frank Collins Baker and N. T. Mattox. Twelve species (page 2) were collected as follows: Physa gyrina, P. anatina, Fossaria humilis modicella, Ferrissia tarda, Helisoma trivolvis, Goniobasis livescens, Lymnaea obrussa, Campeloma rufum, Pleurocera acuta, Amnicola limosa, Gyraulus parvus, Pseudosuccinea columella. The common species were widely distributed and for the most part found in all drainages. The only notable exception was P. anatina, identified by W. J. Clench, which had presumably been introduced into the drainage of a sewage disposal plant. Dispersal factors other than stream connections, which are far apart in this case, are possible aquatic birds and mammals.

Slides which accompanied Dr. Dexter's paper presented maps of the area under discussion. Pilsbry: "I think that you would have found greater differences in distribution if the Unionidae had been considered; the gastropods are always more widely dispersed." Jacobson: "You mention Campeloma rufum; is that not now considered to be C. decisum?" Morrison: "Those species are entirely distinct; they both live in the James River and cannot interbreed since all of both species are parthenogenic females. However, I question that C. rufum lives in the Illinois area." Dexter: "F. C. Baker and others at the University of Illinois collected extensively there and he was firmly convinced that all of them were C. rufum."

AUTHOR'S NOTE. This paper was published in full in American Midland Naturalist 55 (2): 363-368. 1956. R. W. D.

FOREIGN MOLLUSKS IN ARIZONA. — BY ALBERT R. MEAD, University of Arizona. (Reprinted from American Malacological Union News Bulletin and Annual Report, 1952, p. 30).

Helix aspersa and Limax flavus have been found in many gardens in Tucson, Arizona, and were undoubtedly initially introduced more than ten years ago on infected nursery stock from California. H. aspersa has also established new records in Roswell and Las Cruces, New Mexico. Rumina decollata has recently been discovered in Mesa, Arizona. This record represents a considerable stride in the western march of this European species. It is felt that other foreign mollusks have become established in Arizona; but as in some other areas, these invaders have been overlooked because: there is a paucity of local malacologists; visiting malacologists invariably confine their activities to the wild areas rather than city gardens and nurseries; the snails and slugs are nocturnal in their habits which incidentally permits them to survive in areas where diurnal conditions are unfavorable; and damage to garden plants is often not recognized, or if so, it is associated with insects. Especially through the aid of infected nursery stock, these and other foreign mollusks will continue to spread. In most cases, once they become established, they will not be eradicated in spite of successful localized control programs. It is fortunate that most introduced snails in this country have been able to provide only a harassing effect to gardening and truck crops; this would not be the case for some foreign mollusks not yet introduced into this country.

ADDITIONAL INTRODUCTIONS OF FOREIGN SNAILS INTO ARIZONA. — By ALBERT R. MEAD. (Reprinted from American Malacological Union News Bulletin and Annual Report, 1953, pp. 11-12).

The previously reported Helix aspersa is extending its range in the Tucson area to gardens of ranches in outlying districts. Rumina decollata, earlier reported from Mesa, has recently been found established in Phoenix. Limax flavus still continues to be the most commonly encountered foreign mollusk in Arizona. One collection of several dozen slugs in a Tucson garden yielded two specimens of Limax poirieri Mabille (=L. marginatus auct.). Also found in Tucson was a thriving population of the pale, buff-tan form of Deroceras laeve introduced on nursery stock from the San Francisco Bay area. This is in contrast to the endemic gray-black form in the Arizona mountains.

A Tucson high school teacher brought in a large snail which had been found "on a bunch of bananas from South America" in July 1952 in Greeley, Colorado. A few weeks later it was taken to Tucson and kept alive as a pet until May 1953. It was identified as Porphyrobaphe (Or- (page 11) thalicinae). Dr. Bequaert further identified it as P. iostoma Sowerby, endemic in the tropical lowlands of Ecuador and Peru.

These records have been encountered only incidentally. Others will be found. In spite of the extremes in temperature, areas under cultivation in Arizona afford a surprisingly suitable environment for introduced gastropods.

As he completed his remarks, Dr. Mead displayed the shell of Porphyrobaphe iostoma Sow. of which he had just spoken. Leonard: "Many of the local cellars are walled with imported limestone; we are constantly getting specimens of Limax maximus and L. flavus for identification." Mead: "L. maximus has not as yet turned up in Arizona; it is not difficult to predict that it will be found there before long."

MOLLUSKS AND MEDICINE IN WORLD WAR II. — BY R. TUCKER ABBOTT. (Reprinted from American Malacological Union News Bulletin and Annual Report, 1948, pp. 16-17).

A brief account was presented of the part played by mollusks and malacologists mainly in the Pacific theatre of operations. The snail-carried disease, schistosomiasis or blood fluke, was contracted by over 1700 army and 17 navy men on Leyte Island in the Philippines. An extensive educational campaign was put into operation by the medical corps to prevent our men from swimming in infected waters. The Army sent out to the Philippines, and later Japan, the Commission on Schistosomiasis, headed by Dr. Ernest Carroll Faust and later under the direction of Dr. Willard H. Wright, chief of the Division of Tropical Diseases at the National Institute of Health. From Commodore Thomas Rivers' unit on Guam, the navy dispatched two doctors and a malacologist. The use of the latter, a mollusk man, represented the first time a military organization had employed a malacologist for snail research.

The habits and distribution of the intermediate snail host, Oncomelania quadrasi, was discussed in short. Recognizing the guilty species of snail was done not only by studying the shell, but principally by observing the features of the living animal. Oncomelania snails were found to possess a combination of animal characters not present in any other Philippine or Oriental snail — two delicate gray tentacles at the bases of which is a small black eye surmounted by a bright lunar splotch of yellow color granules. This last distinctive feature was referred to for convenient identification purposes among medical men as "yellow eyebrows."

Locating small endemic areas of Schistosomiasis was made difficult by the migration of thousands of people during and after the war. Tracking down colonies of infected snails was supplemented by trapping and inspecting wild rats which serve as blind reservoir hosts for the blood fluke.

In connection with chemical control experiments, the life history of the Oncomelania snail was worked out in detail. The most difficult task was in finally locating the small, single eggs of the snail which the female lays on moist wood and covers with a tiny sand jacket.

Other trematode diseases of man were discussed in brief with a short account of their life histories and intermediate snail hosts. So far as is known there were no records of fatal cone shell bites among our troops in the Pacific. This article (15 pages and 6 illustrations) will appear in the next issue of the Appendix to the Smithsonian Institution Annual Report.

This splendid paper stimulated several to inquire about the intended place of publication, and Mr. Abbott replied that it would be in the appendix of the Annual Report of the Smithsonian Institution. His paper received very favorable comment in the local press next day.

AUTHOR'S NOTE. The full version of this paper, as mentioned above, appeared in Smithsonian Institution Annual Report for 1947 (1948), pp. 325-338, 3 pls.

NEW PUBLICATIONS.

BRANSON, Branley A. (1962) The Slugs (Gastropoda: Pulmonata) of Oklahoma and Kansas with new records. - - Kansas Acad. Sci., Trans., vol. 65, no. 2, pp. 110-119.

THE MICHIGAN PEARL BUTTON INDUSTRY. -- BY HENRY VAN DER SCHALIE. (Reprinted from American Malacological Union News Bulletin and Annual Report, 1947, p. 8).

The Grand River in Michigan has always been one of the largest single sources for pearl buttons in this state. Prior to the war a special survey, as well as reports from clammers, indicated that the mussels in this river were greatly depleted. During the war few people had time to gather shells for commercial purposes. Approximately five years for repopulation resulted in a substantial increase in the fauna. A measure of this recovery was obtained by travelling about sixty-five miles of the river in a John-boat, making sample hauls at forty-five stations on productive mussel producing beds. A discussion of the methods employed for determining yield, as well as some general remarks on the present and future status of the pearl button industry were included in this report which will appear in print later as a contribution of the Michigan Department of Conservation.

THE LAND AND FRESH-WATER MOLLUSKS OF PUERTO RICO. -- BY HENRY VAN DER SCHALIE. (Reprinted from American Malacological Union News Bulletin and Annual Report, 1947, p. 18).

At present there are approximately one hundred and fourteen species of land shells and about twenty fresh-water species inhabiting Puerto Rico. Although the fauna is not as rich, nor as strikingly endemic as that of Cuba, there are many opportunities for study of this relatively rich mollusk fauna. All of the reported species have been listed and some information bearing on ecology and distribution is included. Detailed information on the mollusks of this island when considered with similar information about the fauna of neighboring islands, may aid considerably in solutions of zoogeographical problems.

THE FRESHWATER MUSSELS OF THE MISSISSIPPI RIVER FROM ST. PAUL TO THE MOUTH OF THE MISSISSIPPI RIVER. -- BY HENRY VAN DER SCHALIE. (Reprinted from American Malacological Union News Bulletin and Annual Report, 1948, p. 16).

Collecting in large rivers is difficult unless one has dredging equipment and motor boats. This report is based on collections made by Dr. M. M. Ellis who made collections and observations at 254 stations in the Mississippi River. The work was done during two summers, 1930 and 1931. The fauna consists of twenty-five genera and thirty-nine species of mussels. The distribution of each species in the 659 miles of river covered was shown graphically by means of a faunal distribution chart. The fauna throughout this extensive portion of the main river is surprisingly uniform.

Dr. Bartsch recalled that in 1907 Congress directed the Federal Bureau of Fisheries to investigate the mussel resources of the Mississippi and Ohio Rivers, and that he was directed to make the survey; because of subsequent matters of pressing importance, he has never published any but the preliminary report of this survey; the material is still stored in the National Museum, and would make a splendid addition to the present study. Dr. Morrison recalled another large series of material from Fairport, Iowa, at the same institution. Dr. van der Schalie cited the value of independent work in the same field, as valuable in substantiating conclusions, and expressed the hope that others might undertake the study of the materials mentioned.

BIOGRAPHIC NOTES ON ARNOLD EDWARD ORTMANN AS REVEALED BY SOME OF HIS LETTERS.-- BY HENRY VAN DER SCHALIE. (Reprinted from American Malacological Union News Bulletin and Annual Report, 1948, pp. 11-12).

Arnold Edward Ortmann was curator of Recent Invertebrates in the Carnegie Museum for almost a quarter century (1903-1927). His distinguished service in this institution is in itself ample reason for brief mention of some of his contributions to malacology. In fact, since 1907, when Ortmann shifted his main interest from studies of the decapod crustaceans to fresh-water mussels, the Carnegie Museum published many of his mollusk papers.

Dr. Ortmann was an unusually industrious man as is well attested by the numerous long and informative letters he carefully penned to his friends and colleagues. Through these letters many of his creative concepts are clearly indicated. His attitude toward his colleagues was unusually constructive and wholesome and his willingness to cooperate with those who asked for aid was usually far beyond what would ordinarily be expected. In systematic work he combined a keen sense for evaluating species and genera with great diligence (p. 12) and fairness in arriving at sound solutions for systematic differences. These qualities are especially noticeable in his contribution towards clarifying certain names proposed by Rafinesque. Throughout all of his work Ortmann showed an intense interest in zoogeography. His contributions in this field are both highly scientific as well as unusually extensive. Some may differ with his conclusions but his work was so thorough and scientifically sound that the facts he submitted will forever stand as a monument to this eminent scholar.

Dr. Pilsbry commented on Dr. Ortmann's extraordinary ability to concentrate all of his mental powers on the immediate problem with which he was concerned. He lived in his work. In the field, he was of indefatigable endurance, and, said Dr. Pilsbry, he carried this to extremes, tiring out all of his companions, including Dr. Pilsbry. Mr. MacMillan regretted that Dr. Ortmann had limited himself to the study of so few groups of animals, and that he had not collected more land shells; he further reminisced that he had attended a lecture by Dr. Ortmann on metrology, when he was a freshman in college; that was shortly before the close of Dr. Ortmann's life. Dr. Jennings also recalled his intimate acquaintance with Dr. Ortmann, and obliged us with a few intimate details of his life: he had been pro-German during the first World War, though an American Citizen; he was a chain smoker of cigars; Mrs. Ortmann often wore, on formal occasions, a long, double string of pearls by which Dr. Ortmann had come in his studies of the Unionidae.

AN OLD PROBLEM IN NAIAD NOMENCLATURE. -- BY HENRY VAN DER SCHALIE. (Reprinted from American Malacological Union News Bulletin and Annual Report, 1951, pp. 4-5).

In 1922 a special effort was made by A. E. Ortmann and Bryant Walker to clarify the status of a number of mussel names which could not be generally accepted until the descriptions given to them by Rafinesque in 1920 and 1931 were reevaluated. L. S. Frierson was invited to collaborate but he preferred to act as a champion for Rafinesque and as a consequence Frierson's own version of what names had validity appeared as a private publication five years later (1927). The latter book makes no direct reference to the work of Ortmann and Walker so that at present there are two systems of names which can be used in referring to many species of mussels. The work of Ortmann and Walker was of an unusually scholarly nature and all of the (page 5) cases in which they failed to find agreement were submitted to Dr. Pilsbry who acted as a judge, weighed the arguments and ruled on them.

Although authors are free to use any system they wish, an appeal is made to encourage a more careful appraisal of the relative merits of these papers in an effort to get more uniformity in the names applied to mussels.

Discussion: Dr. Henry Pilsbry: "I agree that the problems we meet in our present study of fresh water mollusca are more important than the old ones of nomenclature. Unraveling the problems left by Rafinesque intrigues some people; he presents one problem after another!" Dr. van der Schalie: "Rafinesque had the ardor of the explorer without the patience of the investigator. Then too, Modell created a problem which must someday be unscrambled." Dr. Haas: "I am very much interested in Modell since I have been asked to write an article for a treatise on Paleontology and I am following the same system (the Frierson system) he used. He calls his system a natural one, but we know first of all that such a thing as a natural system does not exist." Dr. Morrison: "I'm going to stick my neck out here and suggest that in the three sub-families of the Unionidae, you have a natural classification based on three kinds of sexual dimorphism." Dr. Haas: "Modell could not use those characteristics because he worked mainly with fossils. He used apical sculpture and called it a natural system." Dr. Morrison: "Isn't there a duplication of apical sculpture?" Dr. Haas: Yes, there is.

THE ECOLOGY AND DISTRIBUTION OF LYMNAEA (BULIMNEA) MEGASOMA IN MICHIGAN. -- BY HENRY VAN DER SCHALIE. (Reprinted from American Malacological Union News Bulletin and Annual Report, 1952, p. 14).

In 1948 some mastodon bones were found in a peat bog near Berrien Springs in southwestern Michigan. Among the shells which were taken at this site there was one specimen of *Lymnaea megasoma*. As early as 1908 the late Bryant Walker referred to this interesting Lymnaeid as a species with a decidedly boreal range in Michigan. In this recent excellent monograph, Bengt Hubendick, relying on records in the literature, indicated a more southern range for *L. megasoma*. As recent as 1935, John A. Thompson (see Goodrich, Nautilus, 54: 6-10, 1940) found a colony living in the Mahoning River at Alliance, Ohio. However, in spite of the evidence that *Lymnaea megasoma* was perhaps a common form in southern Michigan at a time contemporaneous with the Mastodon, its ecology and distribution at present is such that it must be considered a boreal form inhabiting only northern Michigan. Its habitat is generally in bayou-like situations adjoining lakes or rivers.

It was observed that there are two records of this species having been found in fossil form in southeastern California, and two more in Oklahoma. Dr. van der Schalie explained that he did not list the Lake Champlain record of Frank Collins Baker, since no late collection substantiates the record. He added that he should be most interested in seeing shells from there.

NOTES ON THE GENUS MONADENIA OF THE COASTAL SECTIONS. -- BY E. P. CHACE. (Reprinted from American Malacological Union News Bulletin and Annual Report, 1949, p. 20).

A colony by colony discussion of the Monadenias of the coastal regions of California, Oregon and Washington, showing the smooth transition from typical infumata Gld. of the San Francisco Bay area to the form called subcarinata by Hemphill. It is suggested that perhaps subcarinata Hemphill should be called a variety of infumata Gld. rather than of fidelis Gray. The change from subcarinata, to true fidelis (in the region around Eureka) on the other hand is an explosion of characters. Certain colonies contain some specimens definitely fidelis in appearance, others just as definitely subcarinata, the rest with a confusing mixture of characters. My conclusion is that here we deal with hybrids. North of Orick, California, in the true fidelis territory, some colonies appear to be made up of representatives of 2 or even 3 named subspecies which were described from fairly homogeneous colonies some distance away. This variability, within a colony, lessens along the coast north of the Umpqua River in Oregon, and almost disappears east of the Coast Range.

LAND SNAILS OF THE NORTH CAROLINA PIEDMONT. -- BY CHARLOTTE DAWLEY. (Reprinted from American Malacological Union News Bulletin and Annual Report, 1951, p. 9).

The piedmont region of North Carolina between the coastal plain and the Blue Ridge mountains occupies about half of the state. It is a region of rolling hills intersected by small streams and is covered in part by mixed pine and hardwood forests. Very little collecting of mollusks has been done here. This paper reported on the mollusks collected from Davidson County in the spring of 1951 by Mrs. Margaret Teskey and from Guilford County over a period of several years by the author. Twenty-six species were reported, three of which Polygyra pustuloides (Bland), Mesodon appressus (Say), and Discus cronkhitei (Newcomb) have not been reported in North Carolina before.

Dr. Henry Pilsbry: "This report covers a section of the country in which too little work has been done; such contributions are most welcome." Dr. Henry van der Schalie: "Lake Waccamaw in North Carolina has been partially worked over, but some interesting investigation remains to be done there."

THE MOLLUSKS INHABITING SOME TEMPORARY POOLS AND PONDS IN ILLINOIS AND OHIO. -- BY RALPH W. DEXTER. (Reprinted from American Malacological Union News Bulletin and Annual Report, 1950, pp. 11-12).

Mollusks were collected from temporary pools and ponds in East Central Illinois and Northeastern Ohio between 1935-50. A total of 208 vernal ponds were examined, 23 in Illinois and 185 in Ohio. Altogether, 137 of these, 67% of the total, were found to contain mollusks. Observations were made during the dry seasons at certain stations, but most of the collecting was carried out in the spring months. Pools of very diverse size, depth, and type of habitat were examined over varying lengths of time. Seventeen species of gastropods and 3 genera of sphaeriids were collected. Mollusks were not usually abundant in these temporary bodies of water with a few exceptions. As many as 8 species have been collected from one pond although seldom were all present at any one collection.

The dry seasons are apparently spent under cover where the soil is kept moist, or they burrow into the ground.

Dr. Dexter's paper was illustrated by color slides picturing various ponds during several seasons. He gave a list of species found with degree of abund- (page 12) ance and explained that taking the mollusks was incidental to his real purpose, that of collecting Fairy Shrimp. Dr. Pilsbry asked if any observations were made as to the length of time the mollusks lived after the pool dried up, having found that adult snails tend to bury themselves in mud and come up when it rains. Dr. Dexter replied that he visits some ponds each month the year round, making it a practice to visit them all in the month of March. Some dry up for 4 months each summer, but how deep the mollusks go he was unable to say; they always are on hand the following spring. Dr. Van Cleave said that repopulation of pools has been thoroughly studied and reported on.

SHELLS AND MASTODON. -- BY GORDON K. MacMILLAN. (Reprinted from American Malacological Union News Bulletin and Annual Report, 1948, p. 18.

The first report of the discovery of the remains of a Mastodon in this country occurred in 1705 at Claverack, Columbia County, New York, was contained in a letter received by Cotton Mather from Gov. Joseph Dudley and an item published in the Boston News Letter on July 30, 1705. Since that time remains of this Proboscidean have been discovered in nearly every state of the Union, and in many cases associated with land and fresh water mollusca. In the early part of February, 1948, there was unearthed a few bones of a Mastodon during the process of the removal of a seam of coal by the strip mining method in Bridgeville, a small community about 10 miles southeast of Pittsburgh, Pennsylvania. Associated with these remains in a grayish clay some 5-10 feet above the coal were 14 species of land and fresh water mollusca. This is the first occurrence in Pennsylvania of the association of a Mastodon with shells. Since this clay, in which the bones of this animal reposed, indicates deposition in a pond or lake, the freshwater forms predominate. The four species of land snails occurring in the balsam forest surrounding the lake indicates that the climate around Bridgeville was not only cold but also damp. The presence of these snails and the balsam trees indicates also that the climate was cooler than at present, not arctic, but more of a cold temperate one. The species of mollusca associated with the Mastodon at Bridgeville are Valvata tricarinata (Say), Helisoma anceps (Menke), Helisoma anceps striatum (FCB), Gyraulus deflectus (Say), Amnicola limosa (Say), Ferrissia rivularis (Say), Ferrissia sp.?, Lasmigona viridis (Raf.)?, Sphaerium simile (Say), Sphaerium simile planatum Sterki, Discus cronkhitei (Newc.), Discus patulus (Desh.), Gastrocopta armifera near variety similis, and Pomatiopsis lapidaria (Say).

(ACCOUNT OF THE 1948 FIELD TRIP). -- BY GORDON K. MacMILLAN. (Reprinted from American Malacological Union News Bulletin and Annual Report, 1948, p. 19).

The field trip scheduled for Ohiopyle, Fayette County, Pennsylvania, for August 27th was cancelled because there were not enough autos for transportation. Instead, a collecting trip was made to Sandy Creek Valley, formed by Sandy Creek running in a northwesterly direction from the small village of Sandy Creek to empty into the Allegheny River nine-tenths of a mile away. This village lies about 6 miles in a northeasterly direction from Pittsburgh.

Dr. J. P. E. Morrison and Dr. E. L. Palmer furnished their cars for transportation, taking with them Frank L. Jeffries, E. Sidney Marks, Mrs. Margaret Teare, Mrs. Margaret Teskey, Gertrude M. Weber, James M. Ross, Eugene H. Schmeck, Dorothea Franzen, Mrs. E. L. Palmer and Gordon K. MacMillan.

The party left the entrance to the Carnegie Museum about 10 o'clock in the morning. Collecting during that part of the day was made along the northeastern flats and hillsides of Sandy Creek just below the village of Sandy Creek. That area was not too overgrown with hardwoods and shrubs, mostly second and third growths. In the more open spaces were many herbs, flowers, and weeds. Lunch was eaten at Futules Cafe in Verona, a borough along the Allegheny River about a mile and a half north of the entrance of Sandy Creek into the Allegheny River. After lunch collecting was continued on a rather steep hillside covered with moderate growths of trees and shrubs. This locality was situated on the southwestern side of Sandy Creek Valley. This place constituted a significant collecting locality as quite a number of specimens of Hendersonia occulta (Say) were found here. This species has a very sporadic distribution throughout the northeastern section of the United States, and this find at Sandy Creek constitutes the fourth locality record for Allegheny County since Jacob Green reported it first in 1832 at Helicina rubella. In the morning, among the loose rocks and stones on the flats of Sandy Creek were gathered specimens of Oxychilus draparnaldi (Beck). Most of the other species of larger and commoner forms found throughout the northeastern section of the United States were collected here by the party.

Since the area around Sandy Creek is within the industrial region of Pittsburgh, the members of the collecting party became quite dirty by the end of the days activities from contact with the smoky and sooty underbrush, leaves and logs. The heat of the day, the thermometer standing at 98 degrees, was another factor contributing towards this condition. In spite of the dirt and heat, I believe that this collecting trip was very successful, as attested by the large number of specimens collected by all participating in this event.

THE OCCURRENCE OF HENDERSONIA OCCULTA (Say) IN PENNSYLVANIA. -- BY GORDON K. MacMILLAN. (Reprinted from American Malacological Union News Bulletin and Annual Report, 1949, pp. 4-5).

During his sojourn in New Harmony, Indiana, Thomas Say discovered a new species of land snail in the ragged and abrupt "bluffs" along the Wabash River one half mile below the town. This shell he described in 1831 as Helicina occulta. One year later, Jacob Green, at that time the first Professor of Chemistry in Jefferson Medical College at Canonsburg, Pennsylvania, found the first living specimens of Hendersonia occulta in the rambling hills of Crafton not far from the mouth of Chartiers Creek. Jacob Green called his species Helicina rubella. At present Hendersonia occulta occurs at only eight localities in southwestern Pennsylvania in Allegheny, Greene, and Washington Counties. This species pre- (page 5) fers a limestone region as made by my observations and attested by those of Prof. B. Shimek, Dr. H. B. Baker, Dr. J. P. E. Morrison, and Dr. H. A. Pilsbry. As also with the observations made by Prof. Shimek, Hendersonia occulta is closely associated with some stream. All of the localities in southwestern Pennsylvania fall within the drainage systems of the Allegheny, Monongahela, and Ohio Rivers, and occur along these rivers or some tributaries of them.

HELICOID SNAILS OF THE DESERT REGIONS OF CALIFORNIA. -- BY WENDELL O. GREGG. -- (Reprinted from American Malacological Union News Bulletin and Annual Report, 1947, p. 4)

The speaker described the distribution and some of the peculiar habits of these snails which belong to four genera, Helminthoglypta, Micrarionta, Sonorelix, and Sonorella and include 41 species and subspecies. The detailed discussions of generic and specific characters as well as the account of the distribution of these interesting snails will be published shortly in the Minutes of the Conchological Club of Southern California.

THE TERRESTRIAL GASTROPOD FAUNA OF LOS ANGELES COUNTY, CALIFORNIA (EXCLUSIVE OF SANTA CATALINA AND SAN CLEMENTE ISLANDS). -- BY WENDELL O. GREGG. (Reprinted from American Malacological Union News Bulletin and Annual Report, 1949, p. 24).

Although Los Angeles and vicinity has long been the home of many conchologists, interest has generally been in marine mollusca rather than in the nonmarine groups. The aquatic species are unattractive and many of the land forms are small and inconspicuous. Most of our land snails are hard to find. During the time generally required to collect a few land snails of a single species, one can readily go to the sea-shore and collect a score or more of the larger conspicuous forms. Notwithstanding, considerable work has been done on our local land snail fauna.

From the area under consideration has come type material for the following eight species and subspecies: Helminthoglypta traski (Newcomb), 1861; Punctum conspectum pasadenae Pilsbry, 1896; Helminthoglypta petricola sangabrielis (Berry), 1920; Helminthoglypta fontiphila Gregg, 1931; Helminthoglypta traski pacoimensis Gregg, 1931; Helminthoglypta tudiculata imperforata Pilsbry, 1939; Glyptostoma gabrielense Pilsbry, 1939; and Sonorelix (Herpeteros) angelus Gregg, 1949.

From the mainland portion of Los Angeles County 44 species and subspecies of land gastropods are known. Of these 33 are endemic and 11 are introduced. We have 35 species and subspecies of land snails, 29 endemic and 6 introduced. There are 9 species of slugs, 4 endemic and 5 introduced. Of the endemic forms, 9 families and 20 genera are represented.

In Dr. Pilsbry's monograph, Land Mollusca of North America, Los Angeles County records are listed for 27 species and subspecies. In addition, the following 17 forms have been found: Sonorelix angelus Gregg, Euconulus fulvus alaskensis (Pilsbry), Oxychilus cellarius (Müller), Oxychilus draparnaldi (Beck), Oxychilus alliarius (Miller), Pristiloma chersinella (Dall), Hawaiia minuscula neomexicana (Ckll. & Pls.), Deroceras laeve (Müller), Discus cronkhitei (Newcomb), Oxyloma sillimani (Bland), Succinea avara Say, Quickella rehderi Pilsbry, Vertigo californica (Rowell), Vertigo californica trinotata (Sterki), Vertigo rowelli (Newcomb), and Sterkia hemphilli (Sterki).

COLLECTING LAND SNAILS IN SOUTHEASTERN ARIZONA. -- BY W. O. GREGG. (Reprinted from American Malacological Union News Bulletin and Annual Report, 1950, pp. 24-25).

The topography of southern Arizona is particularly marked by parallel mountain ranges separated by intervening arid mesas. These ranges lie in a general north and south trend. The intervening arid mesas serve as absolute barriers to the large land snails. This isolation is said to have been initiated during the Pliocene. Thus isolated, each mountain range usually has its own particular molluscan fauna.

The mountains of the southeastern portion of Arizona, particularly the Huachucas and the Chiricahuas, are especially rich in species. In many cases a species is confined to a single canyon and its tributaries. In one instance each slope of a canyon has its own fauna with three distinct forms not found elsewhere. Outstanding genera are Sonorella, Oreohelix, Ashmunella, and Holospira. While Sonorella extends as far north as the Grand Canyon and westward nearly to the Colorado River, it has its greatest concentration of species in the southeastern part of the state. Oreohelix s. s. extends south to the Huachucas and Chiricahuas and a short distance below the Mexican boundary. Radiocentrum, a subgenus of Oreohelix which is also found in southern New Mexico and northern Mexico, extends to the northwest as far as the Chiricahua Mts. where two species and two subspecies are found. Ashmunella, with the same general distribution, extends further west and is found in the Huachucas while Holospira is found as far west as the Santa Cruz River. In addition to these larger land snails there is a large number of minute forms of the genera Thysanophora, Microphysula, Euconulus, Retinella, Zonitoides, Striatura, Vitrina, Discus, Helicodiscus, Radiodiscus, Gastrocopta, Chaenaxis, Vertigo, and others.

Before the researches of Ferriss, Pilsbry, Daniels and others which began in 1902, this snail fauna was practically unknown. At that time there were no topographic maps of this area. Travel was often slow and difficult.

During the past two years three trips to this area have been made by Mr. M. L. Walton and myself. Excellent topographic maps are now available. We found good roads where once collectors had been forced to travel on foot. In locating type localities, we were frequently annoyed by finding earlier roads and even town sites which had been long abandoned. This is particularly true* in the mining districts. We have found the latter part of March and early October the best times of the year for trips to this part of Arizona. New roads are being built and most of the older ones are being constantly improved. In addition to the numerous published collecting localities, there is still plenty of new territory left to be explored.

* End of page 24 and beginning of page 25.

CALIFORNIA LAND SNAILS AND HOW SOME OF THEM LIVE. -- BY E. P. CHACE. (Reprinted from American Malacological Union News Bulletin and Annual Report, 1951, pp. 7-8).

The speaker started at the southern end of a large map of California and enumerated the species found in various localities, together with some remarks on their habits and peculiarities. Around San Diego are found the following: Micrarionta stearnsiana (Gabb), near Point Loma, under rocks and also in sand; M. kelletti (Forbes) on the Channel Islands and one colony on the mainland, possibly introduced from the islands. Glyptostoma newberryanum (W. G. Binney) occurs under rocks in San Diego County and also buried in the ground under decaying cacti. It is also found in the mountains back of Pasadena. Helminthoglypta traski (Newcomb) and its varieties are found in the southern half of California. It lives in cactus patches but also one colony was found at high tide line and another in sand dunes. Helminthoglypta tudiculata (Binney) is found in the southern part of the State and north to Santa Barbara County. It occurs almost anywhere, under logs and in rock piles, in lumber and trash piles, and even in wood rats' nests. The sand dunes near Surf and Morro Bay harbor Helminthoglypta walkeriana (Hemphill), a very papillose species. A smooth form is found at San Luis Obispo. Helminthoglypta umbilicata (Pilsbry) is also found near San Luis Obispo, in a trickle of water with sycamores; it is abundant under aster bushes at Cayucos. In the Monterey Peninsula are found Helminthoglypta dupetithouarsi (Deshayes) in pine woods around Pacific Grove. It requires (page 8) moist conditions. With it are found Vertigo cupressicola (Sterki) under twigs and pine needles at Cypress Point, which is the type locality for both species. Helminthoglypta umbilicata is also found 8 miles up Carmel Valley; H. dupetithouarsi consors (Berry) in the San Juan Valley, in stream beds at Felton Grove; H. exarata (Pfeiffer) and H. nickliniana (Lea) have been recorded for the same place.

Near San Francisco the first Monadenias appear on the coast; they are also found in the country back of Fresno. M. infumata (Gould) is found from here northward to Scotia. At Cape Mendocino, M. infumata gives way to M. fidelis subcarinata (Hemphill) which ranges north to Trinidad. From Trinidad northward are found true hybrids between M. subcarinata and M. fidelis. M. fidelis (Gray) makes its first appearance near Crescent City and has a somewhat different cycle of life. In winter no live shells are found or else they are very scarce. In spring they are active but in summer they go up into trees 10 or 11 feet or even 20 feet up, or as far up in the brush as they can go. They are partial to wild cucumber and often aestivate in these or in the brush which the wild cucumber covers. During the fall rains they are active again, but after these they dig into the soil again for the winter. Ground aestivation permits them to escape brush fires. The habit of aerial aestivation is confined to northern California and a small section of Oregon adjoining. At Point St. George, in the rocky, moist habitats with Mesembryanthemum and other seashore plants, there is a stunted form of M. fidelis which has been called variety pronotis (Berry); it digs under plantains. It may be only a depauperate form. Other species of Monadenia also have depauperate forms which develop under unfavorable conditions. Lack of time did not permit discussion of the land snails of the interior of California, much to the regret of all present.

GENETIC ANALYSIS OF WILD POPULATIONS OF THE LAND SNAIL, *CERION*. COLONIAL INHERITANCE OF THE MULTIPLE FACTOR FOR SHELL LENGTH. -- BY R. TUCKER ABBOTT. (Reprinted from American Malacological Union News Bulletin and Annual Report, 1951, pp. 10-11).

A preliminary biometric study was made of over 500 colonial samples of the land snail, *Cerion*, housed in the Museum of Comparative Zoölogy, Harvard College. 50 colonies were measured in detail. Of these, 20 were used in histogram form and shown on lantern slides. From the material presented, there appears to be a multiple factor for shell length which appears at random in colonies and sets a mean for the size of individuals of a colony. The variation in size of the mean length of a colony is inherited without change unless hybridization with another colony takes place or unless there is a genetic drift within the colony.

In hybridization between two colonies the mean may be unchanged because of the dominance of the multiple factors of one or the other of the orig- (page 11) inal colonies; or an intermediate mean may be expressed in some cases.

Possible "genetic drift" in which the mean length of a colony changes over a period of several or many generations occurs exclusive of hybridization, and is probably brought about by intra-colonial segregation during migration or by partial elimination of individuals by adverse ecological conditions.

Mr. Abbott's paper was illustrated with numerous charts. Discussion: Dr. Morrison: "Was this drift in size by units?" Abbott: "Yes, by genetic colonies." Dr. Bartsch: "This ties in with the intensive studies I have made of the *Cerionidae*. I discovered that my experimental plantings took three years to mature. Where colonies were isolated, environment such as grass, coral, etc., brought about no material change. But in one batch, *Cerion incanum* had mixed in, bringing about extreme and sometimes grotesque hybridization. I was able to make intensive anatomical studies. And again the birds played their part when the sparrow hawks at Dry Tortugas mixed up my plantings!"

COLLECTING IN CAPE BRETON. -- BY GORDON K. MacMILLAN. (Reprinted from American Malacological Union News Bulletin and Annual Report, 1951, p. 13).

It had been my ambition for quite a number of years to conduct a collecting trip to Cape Breton, the northernmost section of the Province of Nova Scotia, Canada. The purpose of this expedition was to study the effects of isolation upon the speciation of the land and freshwater snails, and also to tie up the results of this study with those obtained by Dr. S. T. Brooks, former Curator of Invertebrates at the Carnegie Museum, with a similar project in Newfoundland. Cape Breton Island had been separated from the mainland by the flooding of the St. Lawrence Valley some 25,000 years ago. The Strait of Canso, parting Cape Breton from the remainder of Nova Scotia, is one-quarter to one mile in width, thus creating a formidable barrier to the migration and distribution of animal life.

Last summer this aspiration of mine was fulfilled when I was able to spend the month of August in Cape Breton collecting land and freshwater mollusca and other natural history objects in and around Sydney, Baddeck, Baddeck Bay, and Whycocomagh. However, before reaching my destination I stopped at the Royal Ontario Museum, Toronto, the Canadian National Museum, Ottawa, the Peter Redpath Museum, Montreal, and the Provincial Museum of Quebec, Quebec City. Locality lists of the land and freshwater snails from the collections of these institutions were made not only from Cape Breton, but also from Prince Edward Island, Magdalen and Anticosti Islands.

This informal talk was illustrated with numerous Kodachrome transparencies showing the Museums visited in eastern Canada and the varied ecological situations from which the natural history specimens had been obtained.

SOME NEW RECORDS OF NAIADES FROM EASTERN NORTH AMERICA. -- BY HERBERT D. ATHEARN. (Reprinted from American Malacological Union News Bulletin and Annual Report, 1952, pp. 8-9).

Much work is still to be done in the collecting and study of the distribution of naiades in our extensive river drainages. I wish to include here, a few of the most interesting discoveries that I have come across during recent years.

The Petitcodiac River system of Westmoreland County, New Brunswick, has yielded two outstanding species, uncommon throughout the extent of their range. Alasmidonta marginata varicosa Lamarck is fairly common just above Salisbury. Length of specimens run up to 79 mm. The North River, a branch of the Petitcodiac, contains the species Alasmidonta heterodon Lea. This should be an important record to add to the few existing records of the species. Additional records for this species which I believe to be new were found in the Scantic River in Hartford County, Connecticut and Hampden County, Massachusetts.

Very few stations for Margaritana margaritifera Linne have been reported from Massachusetts and Connecticut. To this short list I can add Salmon Brook, Hartford County, Connecticut and Scantic River, Hampden County, Massachusetts.

In pursuit of the species Anodonta implicata Say, I have found that it is very common near the mouth of the Aroostook River, Victoria County, New Brunswick. This station is fully 150 miles from the sea. Other stations taken in the St. John River system, New Brunswick are St. John River, York County; Canaan River, Queens County; and Kennebecasis River, Kings County. Northern records which may be new are McIntyre Lake and Grand Mira River, Cape Breton Island, Nova Scotia.

A survey of the St. Lawrence River drainage for east coast species and eastern records of Great Lakes species has brought about several interesting results. Very definite records of Lampsilis cariosa Say have been taken from the Grass River, St. Lawrence County, New York; Madawaska River, Renfrew County, Ontario (a tributary of the Ottawa River); St. Francis River, Yamaska County, Quebec and the Nicolet River, Nicolet and Yamaska Counties, Quebec.

Some extreme eastern records for Great Lakes fauna were taken from the Nicolet and St. Francis Rivers, Yamaska County, Quebec. From the South (page 9) Branch of the Nicolet River were taken Lasmigona costata Rafinesque, Ligumia recta latissima Rafinesque and Alasmidonta marginata Say; while from the St. Francis a very brief survey under difficult collecting conditions brought in Lasmigona compressa Lea and Obovaria olivaria Rafinesque.

Some recent work done in Adams County, Pennsylvania has established some new records not recorded by Dr. Ortmann in his work of 1919. From Marsh Creek were taken Elliptio productus Conrad, Elliptio fisherianus Lea and Lasmigona subviridis Conrad. In the same county, large specimens of Elliptio fisherianus Lea and Lampsilis ovata Say were taken in Rock Creek.

Following Mr. Athearn's paper, observation was made from the floor that Margaritana margaritifera Linne is known to have a long life, sometimes as long as 80 or 90 years. Also, that where extensive mussel surveys have been made, the water in which this species occurs is predominately soft, quite the contrary to that of the Connecticut River, listed as a record by this paper. A single Michigan locality is known for Alasmidonta marginata varicosa Lamarck, that of the Ocqueoc River in the lower peninsula.

A VARIATION OF ELLIPTIO COMPLANATUS SOLANDER. -- BY HERBERT D. ATHEARN.
(Reprinted from American Malacological Union News Bulletin and Annual Report, 1954, pp. 13-14).

During the last century, Isaac Lea gave specific recognition to a large number of variations of Elliptio complanatus. Among these were Elliptio roanokensis and Elliptio northamptonensis. These titles are synonymous. This variant differs from the typical complanatus in that it is larger, more elongated, subrhomboid rather than rhomboid, more compressed and usually exhibits a shallow radial depression in front of the posterior ridge.

The form is sometimes found in the generally shallow sections of streams where the water is flowing fairly rapidly over a packed sand and gravel bottom. Records range from the Michipicoten River near Lake Superior in Ontario to Lime Kiln Creek in Coweta County, Georgia, where the waters flow into the Gulf of Mexico by way of the Apalachicola River system.

A. E. Ortmann, in his A MONOGRAPH OF THE NAIADES OF PENNSYLVANIA, using the title violaceus in place of the now recognized title of complanatus states, "The ability of Elliptio violaceus to live everywhere under a great variety of environmental conditions undoubtedly accounts for its great variability, as well as its tendency to develop many different phases, which may turn up anywhere under proper conditions, but which do not lead to the development of geographical races, at least in our territory." In large streams where habitats such as long sandbars form an abrupt line of demarcation between them and an adjacent, perhaps somewhat deeper mud or clay bottom, the variants within the species are usually quite distinct. In smaller streams where there is an equal contrast in habitat, although on a smaller scale, the variants within the species will merge with one another. Where a stream is found containing a consistent environment, one will find Elliptio complanatus to be quite unvarying in shape, excepting of course, where mechanical obstructions have distorted the shell. (page 14)

When such individual environments become permanently separated by topographic or climatologic changes, the species seems particularly adaptable to transform itself into various constant forms which must be identified as subspecies and in more advanced cases, as species. This is the case with our Floridian Elliptios.

Such permanent changes of environmental conditions have not taken place where the variant roanokensis or northamptonensis exists in the St. Lawrence River and the Atlantic Coastal Plain systems. In this instance therefore, there appears to be no scientific purpose in giving this variant specific or sub-specific rank.

A SURVEY OF LAND AND FRESHWATER SNAILS IN JEFFERSON COUNTY, WEST VIRGINIA

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West Virginia lies near two of the areas of migration for the northern dispersal of the southern snail fauna, viz., the Coastal Plain and the Mississippi Valley (Ortmann, 1913). The boundaries between the southern and northern faunal groups lie within this State (Ortmann, op. cit.). Since no detailed studies on snails have been undertaken in Jefferson County, this survey was made to determine their distribution.

General Physical Features

Jefferson County is the easternmost county of West Virginia. It lies within latitudes of 37° 7' and 39° 43' and longitudes 79° 45' and 78° 30', and comprises an area of 212 square miles. The topography is marked with ridges, valleys, and mountains. The eastern border of the area extending from Harpers Ferry towards the south is formed by the Blue Ridge. The height of the ridge ranges from 1000 to 1100 feet at the north and 1600 to 1700 feet at the south line of the county. From the south mountain in Pennsylvania the Blue Ridge extends south into Virginia. (Price, et al., 1938).

The eastern side of the county is drained by the Shenandoah River. This river enters the Potomac, of which it is the principal tributary, at Harpers Ferry. It has a North Fork and a South Fork which unite at Riverton. The source of the North Fork is 7 miles north of Harrisonburg, Virginia. The South Fork rises southeast of Greenville in Augusta County, Virginia. The total length of the river is 170 miles. From its source in Augusta County it flows northeast, on the west side of, and parallel to the Blue Ridge.

The chief drainage stream of Jefferson County, however, is the Potomac River. It is formed by the junction of two rivers. The river called the North Branch rises in the western Alleghenies and the South Branch in the central Alleghenies. These branches unite about 15 miles southeast of Cumberland, Maryland. From the junction of these two head streams the river reaches the Chesapeake Bay after a course of 400 miles. Most of the drainage of Jefferson County is through the Potomac River into the Chesapeake Bay and the Atlantic Ocean (Price, et al., op. cit.).

The drainage system is arranged like a trellis (Fig. 1). Except in the mountain areas, which have no well-defined stream courses, branches of the smaller streams extend to all parts of the upland. The rivers and their tributaries are admirably suited as accessible routes of migration. Land snails when migrating tend to follow water courses.

Discussion

In this survey 77 species of snails were collected from 34 collecting stations (Table 1 and Fig. 1). Those found in the largest number of localities were: Gastrocopta armifera (Say), 31; Mesodon thyroidus (Say), 29; Helicodiscus parallelus (Say), 22; G. contracta (Say), 21; Pupoides albilabris (C. B. Adams) and Triodopsis juxtidens (Pils.), 20; T. albolabris (Say), 18; Hawaiia minuscula (Binney), 17; Ventridens ligerus (Say), 16; and G. pentodon (Say), 15. Localities with the largest number of species were Bloomery with 31; Leetown, 30; Harpers Ferry, 29; and Bolivar, 21. Areas with the smallest number of species were Blair and Mt.Pleasant with five. Species found in a single locality are listed in Table 2.

Some of the mollusks found during this survey have been previously reported from other parts of West Virginia (Pilsbry, 1894; Brooks, 1935; Brooks and Kutchka, 1937; Brooks and Kutchka, 1938). Dr. J. P. E. Morrison of the United States National Museum implied (personal conversation) that the following species he collected in nearby Loudon County, Virginia may also be found living in Jefferson County, West Virginia: Gastrocopta holzingeri (Sterki); Guppya sterkii (Dall); Retinella virginica Morrison; Strobilops aenea (Pils.); and Vertigo clappi Brooks and Hunt.

Favorable climatic conditions, diversified habitats, available limestone soils, and an abundance of plant foods have made Jefferson County a favorable region for many species of snails.

Summary

Gastropods were collected from 34 localities in Jefferson County, West Virginia. Seventy-seven species were found and their distributions noted. Localities with the largest number of species were Bloomery with 31; Leetown, 30; Harpers Ferry, 29; and Bolivar, 21.

Acknowledgments

I wish to thank Dr. J. P. E. Morrison, Associate Curator of Mollusks, United States National Museum, for identifying many of the specimens and for indicating changes of nomenclature. I am also grateful to him for including 12 additional Jefferson County records. Acknowledgment is also due Mr. Lewis Goens and Mr. Charles Napper for helping me collect this material.

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NOTE. Tables referred to in the text will be found after page 43. Editor.

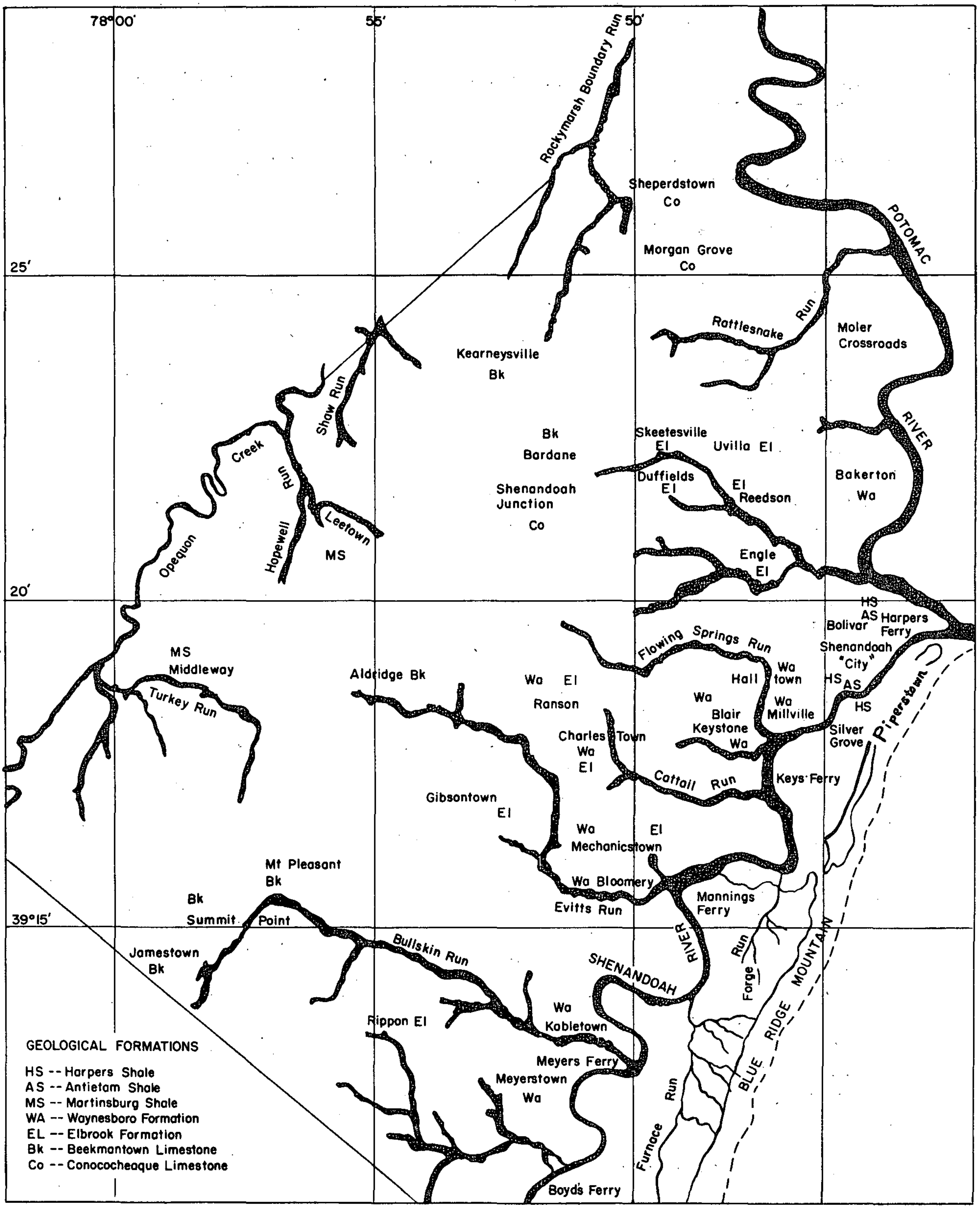

FIG. I

A MAP DIAGRAM OF JEFFERSON CO. W. VA. TO SHOW LOCATION OF COLLECTING STATIONS

Table 1. Snails of Jefferson County, West Virginia. °Collected by Dr. J. P. E. Morrison (USNM)

Species Localities:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17 [*]
Amnicola limosa Say	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.
Anguispira alternata mordax (Shut.)	.	x	.	.	x	x	.	.	.	.	.	.	.	.	.	.	x
Carychium exiguum (Say)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Carychium exile Lea	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.
Cionella lubrica (Müll.)	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.
°Cionella morseana Doherty	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
°Clappia pennsylvanica (Walker)	.	.	.	.	x	.	.	.	.	.	.	x	.	.	.	.	.
Columella edentula (Drap.)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Discus cronkhitei anthonyi Pils.	.	x	.	.	.	.	x	x	.	.	.	.	.	.	.	.	.
Euconulus dentatus (Sterki)	.	.	.	.	x	x	.	.	.	.	.	.	.	.	.	.	.
Euconulus polygyratus (Pils.)	.	.	.	.	x	x	.	.	.	.	.	.	.	.	.	.	.
Fossaria dalli (F. C. Baker)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Fossaria modicella (Say)	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Fossaria obrussa (Say)	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	x
Fossaria parva (Lea)	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.
Fossaria rustica (Lea)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Gastrocopta armifera (Say)	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Gastrocopta contracta (Say)	x	.	x	.	x	x	.	x	.	.	x	x	x	x	.	x	x
Gastrocopta corticaria (Say)	x	.	.	.	.	.	.	.	x	.	x	.	.	.	.	.	.
Gastrocopta pentodon (Say)	x	.	x	.	x	x	x	.	.	x	.	x	.	.	x	x	x
Gastrocopta pentodon gracilis (Say)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Gastrocopta tappaniana (C. B. Adams)	.	.	.	.	x	.	x	.	.	x	.	.	.	x	.	.	x
Gastrocopta procera (Gould)	x	.	x	.	x	x	.	.	.	.	.	.	.	x	x	x	x
Gillia altilis (Lea)	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.
Gyraulus circumstriatus (Tryon)	.	.	.	.	.	.	x	x	.	.	.	.	.	.	.	.	x
Gyraulus parvus (Say)	.	.	.	.	.	.	.	.	.	.	x	x	.	.	.	.	.
Haplotrema concavum (Say)	.	.	x	.	.	x	.	.	.	.	.	x	.	.	.	.	.
Hawaiia minuscula (Binney)	.	x	.	.	x	x	x	.	x	x	x	x	x	.	.	.	x
Helicodiscus parallelus (Say)	x	x	x	x	x	x	.	x	x	x	x	x	x	x	x	.	x
Helisoma trivolvis (Say)	.	.	.	.	.	.	x	.	.	.	.	x	.	.	.	.	.
°Hendersonia occulta (Say)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lioplax subcarinata (Say)	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.
Menetus dilatatus (Gould)	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.
°Menetus dilatatus buchanensis (Lea)	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.
Mesodon thyroidus (Say)	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Mesodon thyroidus bucculenta (Gould)	.	.	x	.	x	.	.	x	.	.	x	.	.	x	x	.	x
Mudalia carinata (Brug.)	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.
Oxychilus lucidum (Drap.)	.	.	.	.	.	x	x	.	.	.	.	.	x	.	.	.	.

[*] For list of locality numbers, see page 48.

Table 1. Snails of Jefferson County, West Virginia. •Collected by Dr. J. P. E. Morrison (USNM)

Species Localities	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34 *
Amnicola limosa Say	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Anguispira alternata mordax (Shut.)	.	.	x	x	.	.	.	.	.	.	x	.	.	x	.	.	.
Carychium exiguum (Say)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carychium exile Lea	.	.	.	x	.	.	.	.	.	x	.	.	.	.	.	.	.
Cionella lubrica (Müll.)	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.
•Cionella morseana Doherty	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.
•Clappia pennsylvanica (Walker)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Columella edentula (Drap.)	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.
Discus cronkhitei anthonyi Pils.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.
Euconulus dentatus (Sterki)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Euconulus polygyratus (Pils.)	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.
Fossaria dalli (F. C. Baker)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Fossaria modicella (Say)	.	x	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Fossaria obrussa (Say)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Fossaria parva (Lea)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Fossaria rustica (Lea)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Gastrocopta armifera (Say)	x	x	x	x	x	x	x	x	.	x	.	x	x	x	x	x	.
Gastrocopta contracta (Say)	.	x	x	x	x	.	.	.	x	.	x	.	x	.	x	x	x
Gastrocopta corticaria (Say)	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.
Gastrocopta pentodon (Say)	.	x	.	.	.	.	.	x	x	.	.	.	x	.	.	.	.
Gastrocopta pentodon gracilis (Say)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Gastrocopta tappaniana (C. B. Adams)	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.
Gastrocopta procera (Gould)	x	x	x	x	x	.	.	.	.	x	.	.	.	.	.	x	.
Gillia altilis (Lea)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Gyraulus circumstriatus (Tryon)	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Gyraulus parvus (Say)	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Haplotrema concavum (Say)	.	.	.	.	.	.	.	.	x	.	x	.	.	.	.	.	.
Hawaiia minuscula (Binney)	x	.	.	.	.	.	.	x	.	x	.	.	x	.	.	.	x
Helicodiscus parallelus (Say)	x	.	x	.	.	.	.	.	.	.	x	x	x	.	x	.	x
Helisoma trivolvis (Say)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
•Hendersonia occulta (Say)	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.
Lioplax subcarinata (Say)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Menetus dilatatus (Gould)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
•Menetus dilatatus buchanensis (Lea)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Mesodon thyroidus (Say)	.	.	x	x	x	x	.	x	x	x	x	x	x	x	x	.	x
Mesodon thyroidus bucculenta (Gould)	.	.	x	.	.	.	.	x	.	.	.	.	.	.	x	.	x
Mudalia carinata (Brug.)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Oxychilus lucidum (Drap.)	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.

* For list of locality numbers, see page 48.

Table 1. Snails of Jefferson County, West Virginia. •Collected by Dr. J. P. E. Morrison (USNM)

Species Localities	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17[1]
Oxytrema virginica (Gmelin)	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.
•Paravitrea multidentata (Binney)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Physa gyrina Say	.	x	.	.	.	.	x	.	.	.	.	x	.	.	.	.	.
Physa heterostropha (Say)	.	x	.	.	.	.	.	x	.	.	.	.	.	.	.	.	x
Physa integra Haldeman	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.
Pomatiopsis lapidaria (Say)	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.
Punctum minutissimum (Lea)	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.
•Punctum vitreum H. B. Baker	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.
Pupoides albilabris (C. B. Adams)	x	x	x	.	x	.	x	.	x	x	x	x	x	x	x	x	x
•Retinella burringtoni (Pils.)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Retinella indentata (Say)	.	x	.	.	.	x	x	.	.	.	.	.	.	x	.	.	.
•Retinella lewisiana nr raderi (Dall)	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.
•Retinella rhoadsi (Pils.)	.	.	.	.	x	.	.	.	.	.	.	x	.	.	.	.	.
Stagnicola palustris elodes (Say)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Stenotrema hirsutum (Say)	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.
•Striatura meridionalis (Pils. & Ferriss)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Striatura milium (Morse)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Strobilops labyrinthica (Say)	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.
Succinea avara Say	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	x
Succinea ovalis Say	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Triodopsis albolabris (Say)	x	.	x	x	.	x	.	.	x	.	x	x	x	.	x	.	.
Triodopsis fallax (Say)	.	.	.	.	x	.	.	.	.	.	.	.	x	.	.	.	.
Triodopsis fraudulenta Pils.	.	x	.	.	x	.	.	.	.	.	.	x	x	.	.	.	.
Triodopsis juxtidens (Pils.)	x	.	.	x	x	x	x	x	.	x	.	x	x	.	.	x	.
Triodopsis tridentata (Say)	.	x	.	.	.	.	.	.	.	.	x	.	.	x	.	.	.
Vallonia costata (Müll.)	.	x	.	.	.	.	.	.	x	x	x	x	.	.	.	.	x
Vallonia excentrica (Sterki)	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.
Vallonia pulchella (Müll.)	.	x	.	.	.	x	x	.	x	x	.	x	.	.	.	.	x
Ventridens ligerus (Say)	.	.	.	.	x	.	x	.	x	x	x	x	.	x	.	x	x
Ventridens suppressus (Say)	.	.	.	.	x	x	.	.	x	.	.	x	x	.	.	.	.
•Ventridens virginica (Vanatta)	x	.	.	.	x	.	.	.	.	x	.	.	x	.	.	.	.
Vertigo elatior Sterki	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Vertigo gouldii (Binney)	.	.	.	.	x	.	.	.	.	.	.	x	.	.	.	.	x
Vertigo milium (Gould)	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.
Vertigo morsei Sterki	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	x
Vertigo ovata Say	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
•Vertigo pygmaea (Drap.)	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.
Vertigo tridentata Wolf	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.
Zonitoides arboreus (Say)	.	x	.	.	.	.	.	.	.	.	.	.	.	.	x	x	.

[1] For list of locality numbers, see page 48.

Table 1. Snails of Jefferson County, West Virginia. *Collected by Dr. J. P. E. Morrison (USNM)

Species Localities	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34 [1]
Oxytrema virginica (Gmelin)	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.
*Paravitrea multidentata (Binney)	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.
Physa gyrina Say	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Physa heterostropha (Say)	.	x	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.
Physa integra Haldeman	.	.	x	.	.	.	.	.	.	.	x	.	.	.	.	.	.
Pomatiopsis lapidaria (Say)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Punctum minutissimum (Lea)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
*Punctum vitreum H. B. Baker	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.
Pupoides albilabris (C. B. Adams)	x	.	x	.	x	.	.	.	.	x	.	.	x	.	.	x	.
*Retinella burringtoni (Pils.)	.	.	.	.	.	.	x	.	x	.	.	.	.	x	.	.	.
Retinella indentata (Say)	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.
*Retinella lewisiana nr raderi (Dall)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
*Retinella rhoadsi (Pils.)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Stagnicola palustris elodes (Say)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Stenotrema hirsutum (Say)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
*Striatura meridionalis (Pils. & Ferriss)	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.
Striatura milium (Morse)	.	.	.	.	.	.	x	.	x	.	.	.	.	.	.	.	.
Strobilops labyrinthica (Say)	.	.	.	x	.	.	.	.	.	.	.	.	x	.	.	.	.
Succinea avara Say	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Succinea ovalis Say	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Triodopsis albolabris (Say)	.	.	.	x	x	x	.	.	x	x	.	x	.	x	.	x	x
Triodopsis fallax (Say)	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	x	.
Triodopsis fraudulenta Pils.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Triodopsis juxtidens (Pils.)	x	.	.	x	x	x	.	.	.	x	x	x	x	.	x	.	x
Triodopsis tridentata (Say)	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Vallonia costata (Müll.)	.	x	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Vallonia excentrica (Sterki)	.	.	.	.	.	.	.	.	.	x	.	.	.	x	.	.	.
Vallonia pulchella (Müll.)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ventridens ligerus (Say)	.	.	x	.	x	.	.	x	x	.	x	.	x	.	.	x	.
Ventridens suppressus (Say)	x	.	.	x	.	.	.	.	x	.	.	.	x	.	.	.	.
*Ventridens virginica (Vanatta)	.	.	.	.	.	.	x	.	.	.	.	.	.	x	.	.	.
Vertigo elatior Sterki	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.
Vertigo gouldii (Binney)	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.
Vertigo milium (Gould)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Vertigo morsei Sterki	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Vertigo ovata Say	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
*Vertigo pygmaea (Drap.)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Vertigo tridentata Wolf	.	.	.	.	.	.	.	.	x	.	.	.	x	.	x	.	.
Zonitoides arboreus (Say)	.	x	.	.	x	.	.	.	x	.	.	x	.	.	.	.	.

[1] For list of locality numbers, see page 48.

Table 1. Snails of Jefferson County, West Virginia. Explanation of locality numbers, pp. 44-47)

1. Aldridge	12. Harpers Ferry	23. Mt. Pleasant
2. Bakerton	13. Jamestown	24. Piperstown
3. Bardane	14. Kabletown	25. Ranson
4. Blair	15. Kearneysville	26. Reedson
5. Bloomery	16. Keystone	27. Rippon
6. Bolivar	17. Leetown	28. Shenandoah "City"
7. Charles Town	18. Mechanicstown	29. Shenandoah Junction
8. Duffields	19. Meyerstown	30. Sheperdstown
9. Engle	20. Middleway	31. Silver Grove
10. Gibsontown	21. Millville	32. Skeetersville
11. Halltown	22. Morgan Grove	33. Summit Point
		34. Uvilla

Table 2. -- Species found in a single locality

BLOOMERY

Menetus dilatatus buchanensis
Pomatiopsis lapidaria
Retinella lewisiana
Vertigo pygmaea

BOLIVAR

Menetus dilatatus
Punctum minutissimum

CHARLES TOWN

Fossaria parva

HARPERS FERRY

Amnicola limosa
Gillia altilis
Lioplax subcarinata
Mudalia carinata
Stenotrema hirsutum

LEETOWN

Carychium exiguum
Fossaria dalli
Gastrocopta pentodon gracilis
Stagnicola palustris elodes
Succinea ovalis
Vertigo ovata

PIPERSTOWN

Cionella morseana
Paravitrea multidentata

REEDSON

Columella edentula

SILVER GROVE

Striatura meridionalis

REPRINTS OF RARE ARTICLES ON MOLLUSCA. -- Timothy A. Conrad, 1834, "Description of some New Species of Fresh Water Shells from Alabama, Tennessee, &c." --- American Journal of Science, vol. 25, No. 2, pp. 338-343, 1 pl. (Reprinted with permission of the Editor of the American Journal of Science, Dr. John Rodgers).

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ART. IX. -- Description of some New Species of Fresh Water Shells from Alabama, Tennessee, &c.; by Timothy A. Conrad, Member of the Academy of Natural Sciences of Philadelphia.

UNIO COELATUS. Pl. 1. fig. 2.

Shell sub-triangular; much compressed, surface waved and with small irregular undulations becoming profound towards the posterior margin; anterior side and umbo destitute of undulations; umbones flattened; beaks prominent.

Inhabits Tennessee, Elk and Flint rivers, and is rare. Length 1.8 inches. Cabinet of the Academy of Natural Sciences of Philadelphia.

Shell sub-triangular; very inequilateral, and much compressed, with a broad furrow extending from the beaks to the base; anterior sides and umbo entire, and the remaining parts furnished with small irregular interrupted undulations, which are profound behind the umbonial slope; surface rough, with distant slight concentric grooves; umbones much flattened; beaks prominent, compressed; epidermis dark olive, and obscurely rayed; cardinal and lateral teeth very robust; anterior and posterior muscular impressions profound; nacre pearly white and iridescent.

Observations. This is a remarkable and very distinct species; very similar in outline to the U. securis of Lea; but differing from all its congeners in the singular manner in which its undulations or incipient tubercles are disposed; it is nearly as much compressed as the U. securis. The epidermis in some specimens is almost black.

UNIO PEROVATUS. Pl. 1. fig. 3.

Shell ovate, ventricose, valves moderately thick; beaks rather prominent, cardinal teeth erect; lateral teeth rectilinear, compressed; nacre white.

Inhabits Prairie creek, Marengo Co. Al. rare; Length 1.9 inches. Cabinet of the Academy of Natural Sciences of Philadelphia.

Shell ovate, rather ventricose, valves thick on the anterior side, but becoming much thinner on the posterior; anterior margin regularly rounded; basal margin rounded; posterior extremity subangulated; beaks a little elevated; approximate and undulated at tip; epidermis olive, and wrinkled towards the margin; cardinal teeth erect and prominent, not very thick; lateral teeth rectilinear, com-

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pressed; anterior muscular impression profound: posterior one slightly impressed; nacre white.

Observations. The regular ovate form of this shell will distinguish it from most other species. The young shell, however is broader behind, approaching to an oval figure, and is prettily ornamented with green rays on an olive yellow ground.

UNIO LIENOSUS. Pl. 1. fig. 4.

Shell narrow-elliptical, ventricose; beaks approximate, little elevated and corrugated; posterior basal margin abruptly rounded; posterior end sub-angulated; cardinal teeth rather compressed and oblique, and double in both valves.

Inhabits small streams in South Alabama. Length 2.8 inches. Cabinet of the Academy of Natural Sciences of Philadelphia.

Shell narrow-elliptical, ventricose or inflated in old shells; substance of the valves thick before and thinner behind; posterior dorsal and basal margin rounded, and the end subangulated; beaks approximate, not very prominent, and with interrupted undulations; concentric lines coarse and prominent; epidermis very dark olive, and obscurely rayed; wrinkled on the margin; cardinal teeth double in both valves, a little compressed and oblique, and coarsely striated; cavity most capacious under the umbonial slope; nacre varying from bluish white to deep salmon color, or purple.

Observations. This species is remarkable for preferring the smaller streams to the rivers, and is not an uncommon shell in such waters, I found them in company with the U. rubiginosus, Lea, which though not very rare in the small creeks of South Alabama, I never found in either the Black Warrior or Alabama rivers.

UNIO STRAMINEUS. Pl. 1. fig. 6.

Shell sub-oval, posterior side wider than the anterior and rounded; beaks slightly prominent, with irregular undulations; umbones convex; concentric lines remarkably coarse and prominent; cardinal teeth double in both valves, and sub-compressed: nacre pearly white and iridescent.

Inhabits with the preceding species. Length 2.5 inches. Cabinet of the Academy of Natural Sciences of Philadelphia.

Shell sub-oval, convex, inflated behind the middle; posterior side wide and rounded at the end; posterior dorsal and basal margins abruptly rounded; umbonial slope disposed to be subangulated; surface

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with strong prominent concentric lines and undulations; beaks slightly prominent and with undulations disposed in angular lines; epidermis straw colored, rayed only behind the umbonial slope; wrinkled only at the two ends; cavity most capacious behind the middle of the valve; nacre pearly white and iridescent.

Observations. Approaches the U. abruptus of Say, and is a very rare species; a specimen very much resembles the U. cariosus of the Delaware and Schuylkill rivers.

UNIO ARCUS. Pl. 1. fig. 8.

Shell narrow-elliptical, thick and ponderous; dorsal margin regularly curved, or arched; beaks scarcely above the dorsal line; basal margin straight, posterior side somewhat cuneate.

Inhabits Alabama river. Length 2 inches. Cabinet of the Academy of Natural Sciences of Philadelphia.

Shell narrow-elliptical, thick and ponderous; dorsal margin forming an arched curve, which is scarcely interrupted by the beaks, umbonial slope abruptly rounded posteriorly, basal margin straight; epidermis olive and wrinkled; cardinal teeth thick, pyramidal; distant from the lateral teeth; anterior muscular impression profound; posterior rather deeply impressed; cavity not capacious; nacre pearly white.

Observations. This is a rare shell, and distantly related to the U. phaseolus of Hildreth; it is not however so compressed, is more pointed behind, &c. and differs altogether in the epidermal markings or color. It is never rayed.

UNIO ARCTATUS. Pl. 1. fig. 9.

Shell narrow-elliptical, elongated, much compressed; and slightly contracted over the umbo to the base; beaks not prominent; basal margin slightly arcuated, cardinal and lateral teeth distinct.

Inhabits Black Warrior and Alabama rivers. Length 2 inches. Cabinet of the Academy of Natural Sciences of Philadelphia.

Shell elongated, much compressed, slightly contracted from the beaks to the base; posterior side much produced and sub-angulated at the end; beaks depressed; epidermis very dark olive;

cardinal teeth disposed to be single in both valves; lateral teeth compressed and a little prominent, nacre bluish white.

Observations. This shell has somewhat the form of the U. monodonta, Say, but it is more nearly allied to U. purpureus of Say

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than to any other species. Beside its other characters, the uniform bluish white color of the interior will distinguish it from the latter.

ALASMODONTA RADIATA. Pl. 1. fig. 10.

Shell ovate-acute, ventricose; posterior end produced and pointed at the end; cardinal tooth in the right valve elongated and anterior to, and distant from the beak; cardinal tooth in the left valve elongated, and situated immediately under the beak.

Inhabits small streams in South Alabama. Length 2 1/2 inches. Cabinet of the Academy of Natural Sciences of Philadelphia.

Shell ovate-acute, ventricose, with the posterior side produced and pointed at the end; beaks prominent and pointed at the apex, which has two or three profound undulations; epidermis light olive, beautifully rayed with dark green; cavity capacious; nacre waxen yellowish.

ANODONTA SUBVEXA. Pl. 1. fig. 12.

Shell sub-oval, inflated; thin; anterior end rounded; posterior end subtruncated; posterior dorsal margin elevated and abruptly rounded at the extremity; callus resembling an incipient tooth.

Inhabits Black Warrior river. Length about 2 inches. Cabinet of the Academy of Natural Sciences of Philadelphia. Very rare.

Shell sub-oval, inflated, thin, with prominent beaks, undulated at the apex, and not distant from the middle of the valve; umbo inflated; umbonial slope angulated, and the space behind with radiating lines; epidermis olive and rather obscurely rayed; cavity very capacious, most so behind the middle; nacre bluish, stained with a light waxen yellow.

ANODONTA DECLIVIS. Pl. 1. fig. 11.

Shell sub-ovate, thin, slightly ventricose; posterior end produced and cuneiform; margin of the dorsal slope nearly rectilinear, and the extremity truncated; beaks slightly prominent and tuberculated at the apex.

Inhabits Flint river, Morgan Co. Alabama, extremely rare. Length 3 1/3 inches. Cabinet of the Academy of Natural Sciences of Philadelphia.

Shell sub-ovate, thin, slightly ventricose; umbonial slope angulated; posterior dorsal margin rectilinear; epidermis green olive, with dark concentric wrinkled lines; and on the posterior slope are numerous interrupted irregular lines; space behind the umbonial slope flattened;

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nacre waxen yellow, except on the margin, which is pearly white and highly iridescent.

CYCLAS STAMINEA. Pl. 1. fig. 5.

Shell oval, ventricose, inequilateral; with numerous regular prominent concentric lines; beaks slightly prominent; anterior and posterior ends nearly equally rounded; cardinal teeth none; lateral teeth distinct.

Inhabits small streams in South Alabama. Figure of the natural size. Cabinet of the Academy of Natural Sciences of Philadelphia.

Shell oval, regularly convex; inequilateral; anterior and posterior ends similarly rounded; umbo inflated; beaks a little prominent, apex obtusely rounded; epidermis yellowish, with darker stains; lateral teeth rather prominent; nacre bluish white; cavity capacious.

MELANIA OLIVULA. Pl. 1. Fig. 13.

Shell oblong or narrow-elliptical, smooth and entire; spine conical; volutions five; suture impressed; aperture somewhat elliptical, longitudinal; about half the length of the shell, color green olive; with strongly marked brown revolving bands; about 4 on the body whorl.

V a r. A. Much more elevated, with a truncated or eroded apex; the whorl flattened, and the spine less conical.

O b s e r v a t i o n s. Inhabits the Alabama river, adhering to the soft calcareous banks, which it perforates in such a manner that they resemble honey comb, or wood pierced by T e r e d o n a v a l i s.

MELANIA PRASINATA. Pl. 1. Fig. 14.

Shell subulate, slightly turrited; whorls 7 or 8, flattened; aperture elliptical, a little oblique; about one third of the length of the shell; body whorl sub-angulated at base; epidermis green olive.

V a r. A. with broad revolving costae, those on the body whorl crenulated.

Inhabits Alabama river, adhering to limestone rocks. Cabinet of the Academy of Natural Sciences of Philadelphia.

ANCULOSA PICTA. Fig. 15.

Shell sub-oval, shoulder obtusely rounded; aperture obovate, large; columella callous above; epidermis olive, with numerous quadrangular small spots disposed in revolving lines, strongly marked in the aperture.

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Inhabits Alabama river, adhering to pebbles on the bars. Cabinet of the Academy of Natural Sciences of Philadelphia.

UNIO SUBTENTUS. S a y. var. Pl. 1, fig. 3.

This beautiful variety of the U. s u b t e n t u s was found by me in the Tennessee and Elk rivers. The annexed delineation of the species is probably better than any hitherto given.

UNIO MYTILLOIDES. R a f. var. Pl. 1, fig. 7.

I obtained this shell in the Alabama river. Its characters appear to be intermediate between U. e l l i p s i s, Lea, and U. m y t i l l o i d e s, Raf., yet is doubtless identical with the latter species.

SUPPLEMENT

PLANORBIS ANTROSUS.

Shell dextral, not depressed; whorls three; spire profoundly indented, or concave, with the summit of the body whorl angular; inner volutions angulated; umbilicus profound, with the margin and inner volutions angulated : body whorl abruptly dilated near the aperture; aperture longitudinally subovate, dilated.

MELANIA CONGESTA.

Shell subulate, with about nine volutions, the lower ones obscurely angulated, those of the spire becoming acutely carinated towards the apex; suture well defined; body whorl obscurely sub-angulated; aperture longitudinal, elliptical.

PHYSA POMILIA

Shell with four volutions, horn colored and polished; spire short conical; body whorl ventricose; aperture patulous. --- REMARK. It resembles P. h e t e r o s t r o p h a, Say, but is much smaller and thinner.

These three univalves inhabit Randon's creek near Claiborne, Alabama, adhering to Limestone rocks.

(To be continued.)