MOLLUSCAN FAUNAS OF THE GUNNISON RESERVOIR DEPOSIT, SANPETE COUNTY, UTAH

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INTRODUCTION

PURPOSE OF INVESTIGATION. This study is an attempt to determine the paleoecology of the Gunnison Reservoir deposit and its possible age through quantitative study of the molluscan faunas which reveal successive changes in the environment. The method of investigation is the same as that used for similar deposits in Ohio.

LOCATION OF DEPOSIT. The Gunnison Reservoir deposit (Fig. 1) is located in Sanpete County, Utah, in the SE 1/4, SE 1/4 of Section 12, Range 1 East, Township 18 South. It is exposed in a west-facing cut, 50 feet east of the Denver and Rio Grande Western Railroad tracks and 1.75 miles N. 7° W. of Sterling, Utah. The deposit is in Sanpete Valley and is between 5400 and 5450 feet above sea level. It is 200 feet east of the southeast edge of the Gunnison Reservoir and some 50 feet above the water level of the reservoir. The deposit described in this paper (A on map, Fig. 2) is labeled Q1, and is the only deposit of lacustrine beds in the area of the map.

ACKNOWLEDGEMENTS. I am very grateful to Dr. Aurèle La Rocque, whose guidance and advice made this investigation possible. Thanks are due to Miss.C. J. Kochis who helped in preparation of the specimens for study.*

STRATIGRAPHIC RELATIONS

The Gunnison Reservoir deposit is associated with other beds of Quaternary age. Overlying the deposit is a thin layer of stream-rounded gravels (Fig. 2, Qtg-1) about one foot thick. These gravels have a nearly flat topography and appear to have been terraced. The materials that make up the gravels are limestone and chert, most likely from nearby exposures of Tertiary Flagstaff and Green River formations.

The base of the deposit is not exposed. It is covered by gravels (Fig. 2, Qtg-2) similar in character and composition to those that overlie the deposit. These gravels, because of their lower position, are assumed to be younger than those above the deposit. Beds underlying the Gunnison Reservoir deposit are not known, but judging by the normal stratigraphic sequence of the area, they are probably those of the Jurassic Arapien shale.

The extent of the Gunnison Reservoir deposit is not known. It is exposed on a west-facing cliff, from 200 feet north of the measured section to 300 feet south of the section. Elsewhere, it is covered by gravel.

Measured Section

The section was measured 200 feet south of

* The cost of printing the illustrations accompanying this paper was borne by the Department of Geology, Ohio State University. The grant of funds is gratefully acknowledged.

the north end of the deposit, which was exposed on the west-facing side of a cut 50 feet east of the Denver and Rio Grande Western Railroad tracks and 1.75 miles N. 7° W. of the town of Sterling, Utah.

The top is overlain by a thin layer of stream-rounded terraced gravels.

Unit		Inches
1	Clay, tan to light gray, weathers gray, thin-bedded, argillaceous	21
2	Sand, grayish brown, fine- to medium-grained, grains composed of subrounded limestone grains, angular clear quartz, and rose quartz crystals, some of which are doubly terminated, fossiliferous.	24
3	Gravel, medium sized, pebbles 1/4 to 1 inch, composed of angular silicious ostracodal limestone, chert, and well-rounded pebbles of sandstone; color varies from light gray to yellow-brown and black.	3
4	Marl, light gray, breaks into angular chunks less than one inch across, chalky to the touch.	18
5	Clay, greenish brown, thin-bedded, breaks into angular chunks less than one-quarter inch across, fossiliferous.	2
6	Marl, light gray, like unit 4.	11
7	Clay, gray to yellowish brown, thin-bedded, breaks into angular chunks one-quarter inch across, fossiliferous.	8
8	Marl, medium gray, blocky, breaks into angular chunks one inch across.	10
9	Clay, greenish brown to yellowish brown, thin-bedded, breaks into angular chunks one-quarter inch across.	28
10	Clay, grayish green to yellowish brown, argillaceous, very loosely compacted, fossiliferous.	12
11	Clay, green to gray-green, weathers gray, thin-bedded, fossiliferous.	9
12	Sand, tan to brown, like unit 2, unfossiliferous.	7
13	Clay, tan to gray-brown, weathers yellow-brown, thin-bedded.	12
	Total deposit exposed	154

The base is covered by stream-rounded gravels.

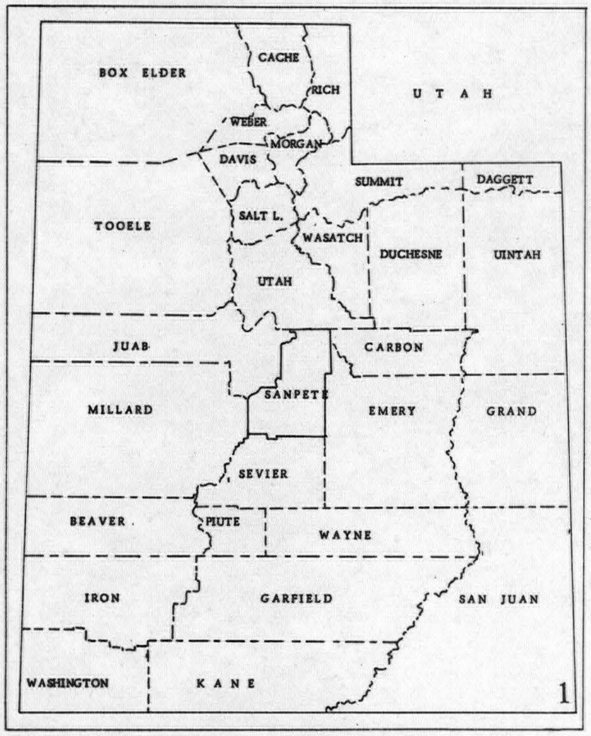
EXPLANATION OF FIGURES, OPPOSITE PAGE

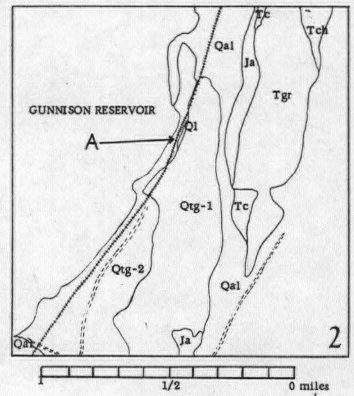
Fig. 1. Index map of Utah, showing the location of the Gunnison Reservoir deposit.

Fig. 2. Geologic map of the Gunnison Reservoir area.

Fig. 3. Cross-section of the Gunnison Reservoir deposit.

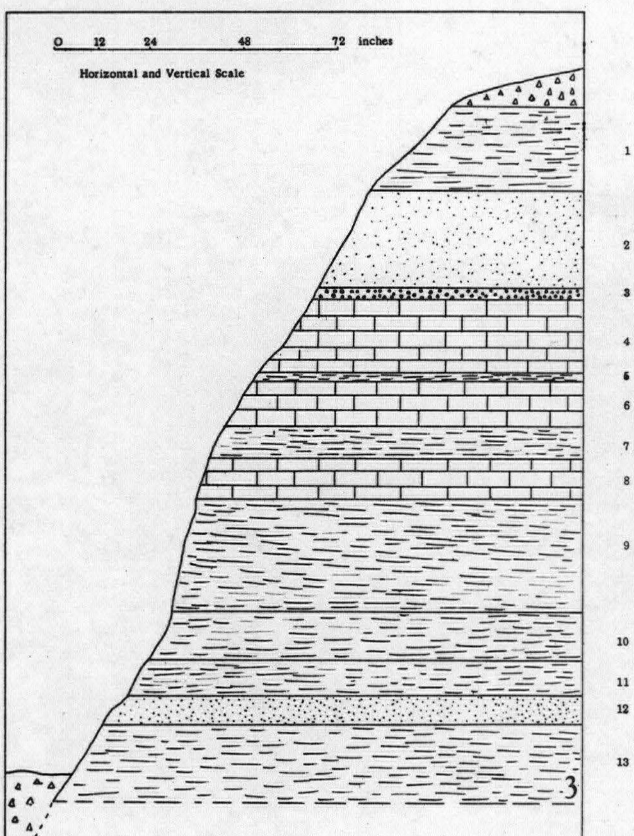
Fig. 4. Quantitative distribution of Pisidium nitidum pauperculum Sterki in the Gunnison Reservoir deposit.





LEGEND

Qtg-2	Lower Terrace Gravels	Tch	Crazy Hollow formation
Qtg-1	Upper Terrace Gravels	Tc	Colton formation
Qal	Quaternary Alluvium	Tgr	Green River formation
Ql	Quaternary lacustrine beds	Ja	Arapien formation



COLLECTION NUMBER	NUMBER OF INDIVIDUALS	PERCENT OF TOTAL INDIVIDUALS	GRAPHIC REPRESENTATION OF PERCENTAGE OF TOTAL INDIVIDUALS 1 2 3 4 5
15	1/2	0.7	
14	1/2	0.3	
13	8/2	4.2	
12	1/2	0.5	
11	3/2	0.7	
10	3/2	0.6	
9	0	0.0	
8	0	0.0	
7	0	0.0	
6	0	0.0	
5	0	0.0	
4	0	0.0	
3	0	0.0	
2	0	0.0	
1	0	0.0	

4

COMPOSITION OF FAUNA

The Mollusca of the Gunnison Reservoir deposit occur at irregular intervals and in unequal distribution throughout the deposit. There is a definite relationship between the lithology and the distribution of Mollusca. The shells occur in the clay units in the lower two-thirds of the deposit and in a sand unit in the upper third (Fig. 3). No shells are found in any of the marl units.

TABLE 1. SPECIES OF MOLLUSCA OCCURRING IN THE GUNNISON RESERVOIR DEPOSIT, SANPETE COUNTY, UTAH.

Pelecypoda

Pisidium nitidum pauperculum Sterki
Sphaerium sp.

Freshwater Gill-breathing Gastropod

Valvata humeralis californica Pilsbry

Freshwater Lung-breathing Gastropods

Gyraulus parvus (Say)
Armiger crista (L.)
Fossaria parva (Lea)
Physa gyrina Say
Promenetus exacuous (Say)
Stagnicola palustris (Müller)
Ferrissia parallela (Haldeman)
Helisoma trivolvis (Say)

Terrestrial Gastropods

Succinea avara Say
Oxyloma retusa (Lea)
Vertigo ovata Say
Discus cronkhitei (Pilsbry)
Retinella binneyana occidentalis H. B. Baker
Vallonia albula Sterki

Of these 17 species identified (Table 1), two are sphaeriid pelecypods, one a gill-breathing freshwater gastropod, eight are lung-breathing freshwater gastropods, and six are terrestrial gastropods. Three species occur in all the fossiliferous units, and one species occurs in all but one of the fossiliferous units. Valvata humeralis californica and Gyraulus parvus are by far the most abundant species in all but one of the fossiliferous units. Fossaria parva occurs in all the units but is significantly abundant in only two units. Armiger crista is more abundant in the lower units than in the upper.

The relationship between the stratigraphic units and the collections is as follows. Collections 15 through 10 were taken from unit 2, collection 9 was taken from unit 5, collections 8 and 7 from unit 7, collections 6 to 4 from unit 10, and collections 3 to 1 were taken from unit 11.

Pelecypods of the species Pisidium nitidum pauperculum and Sphaerium sp. occur only in very small percentages in unit 2. This unit being the only fossiliferous sand in the deposit is considered by the writer to be the only lithologically favorable unit for these species.

Valvata humeralis californica in general shows a gradual increase in the total percentage from collection 1 through 8 (Fig. 6). In collection 9 there is a drastic decline in this species from 52.7 to 1.5 percent, but in the next higher fossiliferous unit, collection 10 shows a recurrence of this species to its greatest total percentage in the deposit, 73.7 (Fig. 6). This species remains fairly constant from collections 10 through 15. Gyraulus parvus varies in total percentage between 28 and 41 in collections 1 through 8. Its decline is not as drastic as that of V. humeralis californica in collection 9 nor is its increase in collection 10 (Fig. 7). Armiger crista is thought by the writer to be the species most significantly controlled by lithologic change. It occurs most abundantly in the clay units varying from 16.3 to 5.6 percent (Fig. 8). It does not occur in collection 9 and it occurs sparingly in collections 10 through 15 where it is probably an intruder in the sand. Fossaria parva occurs in greater abundance in unit 11, collections 1, 2, and 3, and then declines in collections 4 through 8. It reaches its highest percentage in collection 9 after which it declines again in collections 10 through 15 (Fig. 9).

The remaining species of freshwater gastropods, Ferrissia parallela, Stagnicola palustris, Physa gyrina, Helisoma trivolvis, and Promenetus exacuous are scattered throughout the collections in percentages that rarely exceed 1.5. One exception is P. exacuous which is in collection 1 at 3.5 percent. These species for the most part were probably not indigenous to this habitat and were washed in by streams.

Oxyloma retusa, Succinea avara, Retinella binneyana occidentalis, Vallonia albula, Vertigo ovata, and Discus cronkhitei are the six species of terrestrial gastropods. Land snails are in general very scarce in every collection except collection 9. In collection 9, the land gastropods make up 46 percent of the total. V. ovata constitutes 38 percent of that collection. The rapid rise in percentage of land snails in collection 9 seems to indicate an arid year in which the lake was drying up and the land gastropods migrated toward the remaining moisture. Of the land gastropods, O. retusa and S. avara are the most widespread throughout the deposit; one or the other, or both, occur in all collections except 12, 13, and 15. Only one specimen of V. albula occurred and that in collection 6. R. binneyana occidentalis occurs in collections 1, 2, and 3 and in 9 where it reaches 5.2 percent of the total (Fig. 19).

The terrestrial gastropods are obviously intruders in the lake and were probably washed in from land areas along its shore.

PALEOECOLOGY

The Gunnison Reservoir deposit contains a typical freshwater assemblage. Six species of land gastropods occur in small numbers in all fossiliferous units, but this presence is to be expected because of the moist environment.

The ecology for each species has been summarized and condensed from the following authors: Baker, 1928; Clark, 1961; Henderson, 1936; La Rocque, 1952; Leonard, 1950; Mowery, 1961; Reynolds, 1959; and Zimmerman, 1960.

EXPLANATION OF FIGURES, OPPOSITE PAGE

Fig. 5. Quantitative distribution of Sphaerium sp. in the Gunnison Reservoir deposit.

Fig. 6. Quantitative distribution of Valvata humeralis californica Pilsbry in the Gunnison Reservoir deposit.

Fig. 7. Quantitative distribution of Gyraulus parvus (Say) in the Gunnison Reservoir deposit.

Fig. 8. Quantitative distribution of Armiger crista (L.) in the Gunnison Reservoir deposit.

Fig. 9. Quantitative distribution of Fossaria parva (Lea) in the Gunnison Reservoir deposit.

Fig. 10. Quantitative distribution of Physa gyrina Say in the Gunnison Reservoir deposit.

Fig. 11. Quantitative distribution of Promenetus exacuous (Say) in the Gunnison Reservoir deposit.

Fig. 12. Quantitative distribution of Stagnicola palustris (Müller) in the Gunnison Reservoir deposit.

COLLECTION NUMBER	NUMBER OF INDIVIDUALS	PERCENT OF TOTAL INDIVIDUALS	GRAPHIC REPRESENTATION OF PERCENTAGE OF TOTAL INDIVIDUALS 1 2 3 4 5
15	0	0.0	
14	1/2	0.3	
13	0	0.0	
12	0	0.0	
11	1/2	0.2	
10	0	0.0	
9	0	0.0	
8	0	0.0	
7	0	0.0	
6	0	0.0	
5	0	0.0	
4	0	0.0	
3	0	0.0	
2	0	0.0	
1	0	0.0	

5

COLLECTION NUMBER	NUMBER OF INDIVIDUALS	PERCENT OF TOTAL INDIVIDUALS	GRAPHIC REPRESENTATION OF PERCENTAGE OF TOTAL INDIVIDUALS 10 20 30 40 50
15	85	60.7	
14	105	67.7	
13	115	60.7	
12	130	64.2	
11	270	70.8	
10	350	73.7	
9	4	1.5	
8	527	52.7	
7	520	52.0	
6	501	50.1	
5	483	48.3	
4	520	52.0	
3	147	41.7	
2	77	26.6	
1	247	38.6	

6

COLLECTION NUMBER	NUMBER OF INDIVIDUALS	PERCENT OF TOTAL INDIVIDUALS	GRAPHIC REPRESENTATION OF PERCENTAGE OF TOTAL INDIVIDUALS 10 20 30 40 50
15	47	33.5	
14	43	27.7	
13	55	28.9	
12	65	32.0	
11	102	26.5	
10	110	23.1	
9	44	16.4	
8	347	34.7	
7	305	30.5	
6	410	41.0	
5	367	36.7	
4	350	35.0	
3	133	37.7	
2	87	30.1	
1	240	28.0	

7

COLLECTION NUMBER	NUMBER OF INDIVIDUALS	PERCENT OF TOTAL INDIVIDUALS	GRAPHIC REPRESENTATION OF PERCENTAGE OF TOTAL INDIVIDUALS 1 2 3 4 5
15	4	2.9	
14	3	1.9	
13	5	2.6	
12	3	1.4	
11	2	0.5	
10	7	1.4	
9	0	0.0	
8	81	8.1	8.1
7	134	13.4	
6	57	5.7	
5	120	12.0	
4	100	10.0	
3	20	5.6	
2	22	7.6	
1	140	16.3	

8

COLLECTION NUMBER	NUMBER OF INDIVIDUALS	PERCENT OF TOTAL INDIVIDUALS	GRAPHIC REPRESENTATION OF PERCENTAGE OF TOTAL INDIVIDUALS 1 2 3 4 5
15	1	0.7	
14	1	0.6	
13	5	2.6	
12	2	0.9	
11	4	1.0	
10	4	0.8	
9	90	33.5	
8	30	3.0	
7	28	2.8	
6	26	2.6	
5	14	1.4	
4	24	2.4	
3	37	10.5	
2	91	31.8	
1	90	10.5	

9

COLLECTION NUMBER	NUMBER OF INDIVIDUALS	PERCENT OF TOTAL INDIVIDUALS	GRAPHIC REPRESENTATION OF PERCENTAGE OF TOTAL INDIVIDUALS 1 2 3 4 5
15	0	0.0	
14	0	0.0	
13	0	0.0	
12	1	0.5	
11	0	0.0	
10	0	0.0	
9	4	1.5	
8	3	0.3	
7	3	0.3	
6	2	0.2	
5	6	0.6	
4	1	0.1	
3	1	0.3	
2	0	0.0	
1	2	0.2	

10

COLLECTION NUMBER	NUMBER OF INDIVIDUALS	PERCENT OF TOTAL INDIVIDUALS	GRAPHIC REPRESENTATION OF PERCENTAGE OF TOTAL INDIVIDUALS 1 2 3 4 5
15	0	0.0	
14	0	0.0	
13	0	0.0	
12	0	0.0	
11	1	0.2	
10	0	0.0	
9	0	0.0	
8	4	0.4	
7	1	0.1	
6	0	0.0	
5	0	0.0	
4	1	0.1	
3	1	0.3	
2	0	0.0	
1	30	3.5	

11

COLLECTION NUMBER	NUMBER OF INDIVIDUALS	PERCENT OF TOTAL INDIVIDUALS	GRAPHIC REPRESENTATION OF PERCENTAGE OF TOTAL INDIVIDUALS 1 2 3 4 5
15	0	0.0	
14	0	0.0	
13	0	0.0	
12	0	0.0	
11	0	0.0	
10	0	0.0	
9	3	1.1	
8	4	0.4	
7	3	0.3	
6	2	0.2	
5	0	0.0	
4	0	0.0	
3	0	0.0	
2	3	1.0	
1	2	0.2	

12

Pelecypods

Pisidium nitidum pauperculum Sterki. This species lives in ponds, small and large lakes, in generally shallow water from 1 to 6 m. deep on sand, mud, or clay bottoms, in water with a pH of 7.0 to 8.0 and fixed carbon dioxide of 9.3 to 24.73 ppm.

Sphaerium sp. The one valve of a Sphaerium that occurred in the collection cannot as yet be identified to species. Sphaeriids live in all kinds of habitats. They occur in all depths of water; and in a great variety of bottom conditions. A firm bottom in which to burrow, such as sand, mud, or clay, is preferred.

Fresh-water Gastropods

Valvata humeralis californica Pilsbry. Very little ecological information on this species was found in the literature. Henderson (1929, p. 120) reports finding fossil V. humeralis californica high above water, at what now are small saline lakes, in the Grand Coulee district of Washington. Living members of the species occur in surrounding freshwater lakes. He considers the lacustrine deposits Pleistocene. Other occurrences are reported as lakes, ponds, and streams. The ecology of this species is inferred from that of V. tricarinata. This species lives in weedy places on either sand or muddy bottoms. None of the Valvatidae are found at a pH lower than 7.1 nor in water softer than that containing 8 ppm of fixed carbon dioxide.

Gyraulus paruvs (Say) usually occurs in quiet bodies of water often of small size, in depths between 0.5 and 2.2 m., with various bottoms supporting plant growth. It exhibits a partiality to vegetation, for it is rarely found in other situations. It is also found on debris near the top of the water. It lives in water of pH 7.0 to 8.16; and a fixed carbon dioxide of 8.16 to 30.56 ppm.

Armiger crista (L.). Very few ecological data are recorded for this species. It has been found in Barren Brook, Maine in three or four inches of water under logs and bark, and in a marl pond in Barren Brook, with some vegetation. It has also been reported to occur sparingly on dead leaves in stagnant water in small lakes in the company of G. deflectus obliquus but in much smaller amounts than that species. The only other reported occurrence of this species in Utah is by Eardley and Gvosdetsky (1960, p. 1337). It was located, by a core taken in Great Salt Lake, at a depth of 271 feet. Associated with A. crista were Valvata humeralis, Stagnicola caperata, Gyraulus sp., and Promenetus cf. P. exacuous.

No pH or fixed carbon dioxide data are available.

Fossaria parva (Lea) inhabits wet marshy places, generally out of water, on sticks, stones, or muddy flats. The animal is more prone to leave the water than any species of the family. The pH for the variety F. obrussa decampi is 7.42 to 7.7 and the fixed carbon dioxide 10.6 to 18.8 ppm.

Physa gyrina Say can exist in a variety of habitats, but it appears to be characteristic of slow-moving, and stagnant bodies of water, usually a mud bottom in small ponds. It flourishes best in newly isolated ponds. Its pH is 7.1 to 8.37 and fixed carbon dioxide 9.5 to 25.75 ppm.

Promenetus exacuous (Say) lives generally in quiet places that are more or less marshy; and on mud flats on the edge of small mountain streams of cold, clear water. It is generally found on the underside of lily-pads, sticks, or stones. The most important factors in its habitat seem to be its preference for cold water and the presence of vegetation. Its pH is 7.0 to 7.64 and fixed carbon dioxide 9.3 to 22.5 ppm.

Stagnicola palustris (Müller) occurs plentifully in bodies of water of all sizes, on floating sticks and submerged vegetation, on stones and on muddy bottoms. It inhabits both clear and stagnant water, but prefers a habitat in which the water is not in motion. The pH of the variety S. palustris elodes is 7.4 and fixed carbon dioxide 21.0 ppm.

Ferrissia parallela (Haldeman) is an inhabitant of quiet water, on plants and on the shells of Naiades, in shallow water, from 0.3 to 2 m. deep. It is commonly found near the water's edge. The presence of vegetation seems to be an important factor in the distribution. F. parallela seems to be a lake or pond species, at least in Wisconsin. Its pH is 6.05 to 8.37 and fixed carbon dioxide 2.75 to 25.7 ppm.

Helisoma trivolvis (Say) is always an inhabitant of quiet, more or less stagnant water. It occurs along swampy shores, in marshes, or in stagnant pools, with mud or with fine sandy-silt bottoms, up to 2 m. in depth although generally in water less than 0.6 m. Its pH is 6.6 to 8.37 and fixed carbon dioxide from 7.5 to 30.56 ppm.

Terrestrial Gastropods

Succinea avara Say has a wide range of habitat preferences. It lives in low, swampy areas crawling on the muddy banks of ditches. This species has been observed climbing to a height of three feet on tall fronds in the water.

Oxyloma retusa (Lea) occurs in marshes and other wet places. It can be found upon partly submerged sticks and on rotting water weeds. It commonly occurs on mud flats above the high water level along swampy shores caused by the raising of water in a lake or pond.

Vertigo ovata Say prefers a moist environment afforded by shaded slopes near streams and the shores of ponds. It is found in swampy areas, along stream banks and other bodies of water, and under sticks and flat stones. The limiting factor for this species is a relatively high moisture requirement.

Discus cronkhitei (Pilsbry) in the east, lives in humid forests, under dead wood, and among rotting leaves and grass in rather wet situations. In northern Nebraska it occurs

EXPLANATION OF FIGURES, OPPOSITE PAGE

Fig. 13. Quantitative distribution of Ferrissia parallela (Haldeman) in the Gunnison Reservoir deposit.

Fig. 14. Quantitative distribution of Helisoma trivolvis (Say) in the Gunnison Reservoir deposit.

Fig. 15. Quantitative distribution of Succinea avara Say in the Gunnison Reservoir deposit.

Fig. 16. Quantitative distribution of Oxyloma retusa (Lea) in the Gunnison Reservoir deposit.

Fig. 17. Quantitative distribution of Vertigo ovata in the Gunnison Reservoir deposit.

Fig. 18. Quantitative distribution of Discus cronkhitei (Pilsbry) in the Gunnison Reservoir deposit.

Fig. 19. Quantitative distribution of Retinella binneyana occidentalis H. B. Baker in the Gunnison Reservoir deposit.

Fig. 20. Quantitative distribution of Vallonia albula Sterki in the Gunnison Reservoir deposit.

COLLECTION NUMBER	NUMBER OF INDIVIDUALS	PERCENT OF TOTAL INDIVIDUALS	GRAPHIC REPRESENTATION OF PERCENTAGE OF TOTAL INDIVIDUALS 1 2 3 4 5
15	0	0.0	
14	1	0.6	
13	2	1.0	
12	0	0.0	
11	0	0.0	
10	0	0.0	
9	0	0.0	
8	0	0.0	
7	0	0.0	
6	0	0.0	
5	1	0.1	
4	0	0.0	
3	0	0.0	
2	0	0.0	
1	0	0.0	

13

COLLECTION NUMBER	NUMBER OF INDIVIDUALS	PERCENT OF TOTAL INDIVIDUALS	GRAPHIC REPRESENTATION OF PERCENTAGE OF TOTAL INDIVIDUALS 1 2 3 4 5
15	0	0.0	
14	0	0.0	
13	0	0.0	
12	0	0.0	
11	0	0.0	
10	0	0.0	
9	0	0.0	
8	3	0.3	
7	0	0.0	
6	0	0.0	
5	1	0.1	
4	0	0.0	
3	0	0.0	
2	0	0.0	
1	0	0.0	

14

COLLECTION NUMBER	NUMBER OF INDIVIDUALS	PERCENT OF TOTAL INDIVIDUALS	GRAPHIC REPRESENTATION OF PERCENTAGE OF TOTAL INDIVIDUALS 1 2 3 4 5
15	0	0.00	
14	1	0.65	
13	0	0.00	
12	0	0.00	
11	3	0.40	
10	2	0.45	
9	0	0.00	
8	1	0.10	
7	5	0.50	
6	0	0.00	
5	8	0.80	
4	0	0.00	
3	0	0.00	
2	1	0.30	
1	4	0.46	

15

COLLECTION NUMBER	NUMBER OF INDIVIDUALS	PERCENT OF TOTAL INDIVIDUALS	GRAPHIC REPRESENTATION OF PERCENTAGE OF TOTAL INDIVIDUALS 1 2 3 4 5
15	0	0.0	
14	0	0.0	
13	0	0.0	
12	0	0.0	
11	0	0.0	
10	0	0.0	
9	6	2.2	
8	1	0.1	
7	0	0.0	
6	1	0.1	
5	0	0.0	
4	4	0.4	
3	5	1.5	
2	3	1.0	
1	2	0.2	

16

COLLECTION NUMBER	NUMBER OF INDIVIDUALS	PERCENT OF TOTAL INDIVIDUALS	GRAPHIC REPRESENTATION OF PERCENTAGE OF TOTAL INDIVIDUALS 1 2 3 4 5
15	0	0.0	
14	0	0.0	
13	0	0.0	
12	1	0.5	
11	0	0.0	
10	0	0.0	
9	102	38.6	
8	0	0.0	
7	0	0.0	
6	0	0.0	
5	0	0.0	
4	0	0.0	
3	0	0.0	
2	1	0.3	
1	0	0.0	

17

COLLECTION NUMBER	NUMBER OF INDIVIDUALS	PERCENT OF TOTAL INDIVIDUALS	GRAPHIC REPRESENTATION OF PERCENTAGE OF TOTAL INDIVIDUALS 1 2 3 4 5
15	2	1.5	
14	0	0.0	
13	0	0.0	
12	0	0.0	
11	0	0.0	
10	0	0.0	
9	0	0.0	
8	0	0.0	
7	0	0.0	
6	0	0.0	
5	0	0.0	
4	0	0.0	
3	2	0.6	
2	0	0.0	
1	0	0.0	

18

COLLECTION NUMBER	NUMBER OF INDIVIDUALS	PERCENT OF TOTAL INDIVIDUALS	GRAPHIC REPRESENTATION OF PERCENTAGE OF TOTAL INDIVIDUALS 1 2 3 4 5
15	0	0.0	
14	0	0.0	
13	0	0.0	
12	0	0.0	
11	0	0.0	
10	0	0.0	
9	14	5.2	
8	0	0.0	
7	0	0.0	
6	0	0.0	
5	0	0.0	
4	0	0.0	
3	5	1.5	
2	4	1.3	
1	1	0.1	

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COLLECTION NUMBER	NUMBER OF INDIVIDUALS	PERCENT OF TOTAL INDIVIDUALS	GRAPHIC REPRESENTATION OF PERCENTAGE OF TOTAL INDIVIDUALS 1 2 3 4 5
15	0	0.0	
14	0	0.0	
13	0	0.0	
12	0	0.0	
11	0	0.0	
10	0	0.0	
9	0	0.0	
8	0	0.0	
7	0	0.0	
6	1	0.1	
5	0	0.0	
4	0	0.0	
3	0	0.0	
2	0	0.0	
1	0	0.0	

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under sticks and logs on moist leaf mold, always close to running water.

Retinella binneyana occidentalis H. B. Baker is found mostly in forests under forest debris, at the base of stumps, under logs, and under loose bark of fallen trees. This species is also found on lowlands which border lakes.

Vallonia albula Sterki. These small snails live in moss and among dead leaves, under decaying wood and stones and are very sensitive to light. During rains they may be washed along streams.

ENVIRONMENTAL HISTORY

The Gunnison Reservoir deposit reveals an unusual distribution of Mollusca. In similar lacustrine deposits, particularly in Ohio, mollusks are found in the marl units; in this deposit there was no evidence of any shells in the marl units.

The measured section (page 6) and the cross-section (Fig. 3) of the deposit show the order of deposition and lithologic variation from which the sequence of events can be established.

The lowest exposed unit of the deposit is an unfossiliferous clay. Above this unit is a sand unit, unit 12, which is also unfossiliferous. The first fossiliferous unit is unit 11, which consists of clay. Four significant species occur in this unit, Valvata humeralis californica, Gyraulus parvus, Fossaria parva, and Armiger crista. The occurrence of F. parva and A. crista indicates that this was probably a near-shore environment, in which the depth of water was not over 3 feet. G. parvus seems to substantiate this conclusion and its presence with A. crista indicates abundant vegetation. Valvata humeralis californica is not out of place here for it has a variable depth range.

Unit 10, the next higher unit, is also a clay and is also fossiliferous. It contains the same species as the lower units. A change in the percentages of F. parva, which decreases, seems to indicate that the depth of water increased at this point. G. parvus and A. crista remain unchanged, indicating the presence of vegetation.

Unit 9 is unfossiliferous clay. The disappearance of the gastropods from this unit may be explained by a rapid increase in water level under very muddy conditions which led to the destruction of the fauna. Unit 8 is marl and is unfossiliferous. A possible explanation for the lack of fossils is that the marl was deposited at a depth greater than the living conditions of the lake inhabitants.

Unit 7 is a highly fossiliferous clay. The significant species are the same as those in units 10 and 11 and this indicates a return to the former depth of 3 to 4 feet and fairly close to shore with abundant vegetation. The conditions must have been highly favorable for the gastropods because their abundance here far exceeds that in any other unit.

Unit 6 is an unfossiliferous marl, probably indicating an increase in depth at this point, similar to unit 8.

Unit 5 shows the greatest change in species in the entire deposit. The fresh-water species decline and the land gastropods increase. The great abundance of Vertigo ovata, a species that requires a certain amount of moisture, seems to indicate that the lake was drying up at this point. Fossaria parva attains its greatest total percentage here which can be considered normal because of the ability of this species to live on mud flats. Significant decrease in the percentage of G. parvus and V. humeralis californica and the complete absence of A. crista indicates an environment unsuitable for these species. The greater percentage of land snails permits us to assume that the lake was drying up in an arid period and that the land snails were migrating toward the last remaining moisture.

Unit 4 is the uppermost marl unit and is also unfossiliferous. This unit probably indicates a return to the deeper water conditions similar to units 6 and 8.

Unit 3 is a 3-inch layer of coarse stream gravels. This unit indicates a new source of sediments carried at higher energy than any before. Its position here may be due to the shifting of a stream channel during an unusually wet period, carrying coarse sediments into the lake.

Unit 2 is a sand unit and is the uppermost fossiliferous unit in the deposit. The species V. humeralis californica and G. parvus make up approximately 90 percent of the shells. This shows that the change in lithology has greatly affected the occurrence of other species, namely A. crista and F. parva, which should probably be called intruders in this environment. Pisidium nitidum pauperculum and Sphaerium sp. occur in small percentages here. The water was probably between 4 and 6 feet deep with some vegetation.

Unit 1 is an unfossiliferous clay unit which probably indicates increased depth at this point.

AGE AND CORRELATION

Lack of data on Pleistocene molluscan assemblages in Utah makes it difficult to determine the age of the Gunnison Reservoir deposit. Taylor (1960, pp. 22-42) describes 9 Pliocene and Pleistocene faunas from the High Plains but none is similar to this assemblage. The two most abundant species in this deposit are recorded for the Pliocene. Taylor (1960, p. 58) reports the occurrence of Gyraulus parvus in the Pliocene. Chamberlin and Berry (1933, p. 29) report the occurrence of Valvata humeralis californica for the Pliocene. La Rocque (manuscript records) shows both of these species still living in Utah, as well as the other species that occur in the deposit with the exception of Armiger crista. Due to the fact that all the species except one are still living in Utah, the writer assumes that the deposit is of Wisconsin age and probably of latest Wisconsin age.

In a core taken in Great Salt Lake a number of layers containing fresh-water mollusks were located (Eardley and Gvosdetsky, 1960, pp. 1336-1338). The species Armiger crista occurred only at a depth of 271 feet along with other species that also occur in this assemblage. Eardley and Gvosdetsky (1960, p. 1340) estimate a rate of sedimentation of 1 foot in 825 years down to a depth of 330 feet. Assuming this rate of sedimentation, the age of the sediments at the 271 foot level would be 223,-575 years. Because of the similarity of the Gunnison Reservoir assemblage to that collected at a depth of 271 feet in the Great Salt Lake core, it may be possible to consider these two assemblages as of the same age.

REFERENCES CITED

BAKER, F. C. (1928) Fresh-water Mollusca of Wisconsin. -- Wis. Geol. and Nat. Hist. Survey, Bull. 70, pt. 1, Gastropoda, 507 pp., 28 pls., 202 figs.

CHAMBERLIN, R. V. and BERRY, Elmer (1933) Mollusks of the Pliocene Deposits at Collinston, Utah. -- Nautilus, vol. 47, pp. 25-29, pl. 1.

CLARK, A. L. (1961) Pleistocene Molluscan Faunas of the Castalia Deposit, Erie County, Ohio. -- Sterkiana, No. 3, pp. 19-39, 10 figs.

EARDLEY, A. J. and GVOSDETSKY, V. (1960) Analysis of Pleistocene Core from Great Salt Lake, Utah. -- Geol. Soc. Am., Bull., vol. 71, no. 9, pp. 1323-1344, 2 figs., 1 pl.

La ROCQUE, A. (1952) Molluscan faunas of the Orleton Mastodon Site, Madison County, Ohio. -- Ohio Jour. Sci., vol. 52, pp. 10-27.

LEONARD, A. B. (1950) A Yarmouthian Molluscan Fauna in the Midcontinent of the United States. -- Univ. Kansas, Paleont. Contrib., Mollusca, Art. 3, 48 pp., 6 pls.

MOWERY, D. H. (1961) Pleistocene Molluscan Fauna of the Jewell Hill Deposit, Logan County, Ohio. -- Sterkiana, No. 4, pp. 1-21, 17 figs.

REYNOLDS, M. B. (1959) Pleistocene Molluscan Faunas of the Humboldt Deposit, Ross County, Ohio. -- Ohio Jour. Sci., vol. 59, pp. 153-166, 2 figs.

TAYLOR, D. W. (1960) Late Cenozoic Molluscan Faunas from the High Plains. -- U. S. Geol. Survey, Prof. Paper 337, 94 pp., 4 pls.

ZIMMERMAN, J. A. (1960) Pleistocene Molluscan Faunas of the Newell Lake Deposit, Logan County, Ohio. -- Ohio Jour. Sci., vol. 60, pp. 13-39, 19 figs.

ECOLOGICAL DATA -- 3. MOQUIN-TANDON'S OBSERVATIONS ON ANCYLUS FLUVIATILIS MÜLL.

Tucked away on the last two pages of a paper on "anatomico-physiological" investigations on A. fluviatilis (Jour. Conchyl. 3: 7-21, 1852) are some observations on this fresh-water limpet which may be useful to some of our readers. They are given here verbatim.

2° Fonctions. Les Ancyles sont herbivores; elles se nourrissent de fibrilles radicales, d'algues d'eau douce, surtout de conferves, de matière verte et de substances végétales en décomposition.

Dans la mastication, la membrane linguale, mise en mouvement par la plaque cartilagineuse qui se trouve au-dessous de son extrémité antérieure, presse la matière alimentaire contre la mâchoire supérieure; puis les mâchoires latérales se portent horizontalement l'une contre l'autre, s'écartent bientôt, et la langue recommence son mouvement de bas en haut.

Les papilles linguales, dirigées d'avant en arrière, doivent contribuer puissamment à la déglutition.

Les Ancyles avalent, avec leurs aliments, une certaine quantité de parcelles minérales, dures, sans doute pour faciliter la digestion. Plusieurs fois j'ai trouvé leur estomac rempli de graviers extrêmement fins (37); c'étaient de petits fragments de quartz et de calcaire, mêlés à une matière roussâtre ou verdâtre de nature végétale.

Un individu qui avait vécu trois jours dans une solution de cochenille, m'a présenté l'estomac et la cavité buccale colorés en rougeâtre. Les matières contenues dans la poche digestive étaient d'un rouge assez intense.

La digestion paraît lente. Des Ancyles, conservées pendant huit jours dans de l'eau très pure, offraient encore une partie de l'intestin remplie de matières fécales.

Les excréments de l'Ancyle sont filiformes, un peu contournés et de couleur brunâtre.

L'animal peut vivre assez longtemps sans manger.

(37) Gray a remarqué aussi des fragments de matière inorganique.