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MOLLUSCAN FOSSILS FROM UPPER GLACIAL LAKE AGASSIZ SEDIMENTS IN RED LAKE COUNTY, MINNESOTA[1]

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INTRODUCTION

During the summer of 1963 Mr. C. G. Carlson, Mr. W. P. Eastwood, and Mr. T. F. Freers, geologists of the North Dakota Geological Survey, were assigned by Dr. Wilson M. Laird, State Geologist, to study the lithology of the sediments exposed in a 5 foot deep trench which was dug for the Portal Pipeline. The pipeline extends from Lignite, Burke County, North Dakota, to Clearbrook, Clearwater County, Minnesota, and crosses the Glacial Lake Agassiz Plain in the latitude of Grand Forks, North Dakota. Carlson and Freers discuss the results of their research elsewhere in this volume of the Proceedings.

In examining sediment samples taken during the course of the field investigation, Carlson discovered one sample which contained an abundant molluscan fauna. This report deals with the fossil content of that single sample. The molluscan fauna is listed and figured; and a paleoecologic reconstruction, based on the modern ecology of the various species, is hypothesized.

ACKNOWLEDGMENTS

I wish to express my appreciation to Mr. Carlson for giving me the collection. Dr. Laird encouraged this study and provided financial support for the preparation of the plate. I am grateful to Mr. Merlyn Heimbecker for photographing the specimens.

GLACIAL LAKE AGASSIZ

Glacial Lake Agassiz was a large body of water which flooded parts of Manitoba, Minnesota, and North Dakota at least twice during the Wisconsinan Stage (50,000-70,000 to 5,000 C^{14} years B.P.) of the Pleistocene Epoch (1,000,000 years to present). The ponding of the waters which flowed northeastward before the incursion of continental glaciers in the upper Midwest, was occasioned by a widespread blockage caused by the glaciers as they expanded from a center of accumulation in the area of Hudson Bay and Labrador. As the glaciers expanded into the area of Manitoba, northern Minnesota, and eastern North Dakota, water accumulated; and an outflow of Glacial Lake Agassiz was established in the valley of the present

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Minnesota River. During Woodfordian time (22,000 to 12,500 C^{14} years B.P.) the glaciers overrode the eastern two-thirds of North Dakota and almost all of Minnesota. Thus the Glacial Lake Agassiz basin must have been covered by glacier ice during this period of maximum glaciation.

During the Twocreekan Substage (12,500 to 11,000C^{14} years B.P.) the continental glaciers of North America waned and presumably a later Glacial Lake Agassiz reformed. During the Valderan Substage (11,000 to 5,000 C^{14} years B.P.), ice may have reinvaded the area of northwestern Minnesota and northeastern North Dakota; but the evidence for this period of active glaciation in this portion of the upper Midwest is not conclusive as now known.

The sediments from which the fossils were taken belong to the uppermost sequence formed in Glacial Lake Agassiz. Whether they were of Twocreekan age or of Recent age (5,000 to present) cannot be determined at present. A re-collection of the site could perhaps, provide material for radiocarbon dating.

The vast expanse of the ice front, especially during the recessional stage of Glacial Lake Agassiz, must have contributed huge amounts of cold, turbid meltwater. Because of a lack of vegetative cover, the recently deglaciated areas surrounding the lake must also have contributed large amounts of detritus during the early stages of the recessional lake. Weak thermal stratification can develop in turbid meltwater lakes, due to the effects of solar radiation during the warmer seasons; and this probably occurred in Glacial Lake Agassiz. Thus, it is suggested that the recessional stage of Glacial Lake Agassiz was, according to Hutchinson's classfication (3), a first or second class, atrophic or at most oligotrophic lake. Local areas along the margins may have contained clear water due to inflow from streams which flowed over vegetated terrain, but this would not be expected until the last stages of the lake.

LOCATION AND POSITION OF THE FOSSIL MOLLUSKS

The molluscan fauna was removed, by wet sieving, from a 400 ml. sample of sediments. Carlson collected this sample on August 31, 1962, from a fine sandy to silty lithology 2 feet below the surface in the SW/4 NW/4 Sec. 26, T. 150 N., R. 44 W., Red Lake County, Minnesota. The lithologic unit was traced over a considerable distance and is about 1 mile east of the Upper Norcross beach ridge. The idea that these sediments are the result of deposition in a Recent slough or other similar environment is untenable; because both the species composition of the molluscan fauna and the lateral extent of the lithologic unit in which the fauna occurs precludes this idea.

MOLLUSCAN FAUNA

The following species were identifed from the sediments:

Phylum MOLLUSCA
Class GASTROPODA
Subclass STREPTONEURA
Order MESOGASTROPODA
Superfamily VALVATACEA
Family VALVATIDAE
Genus VALVATA

Valvata lewisi Currier 1868.

Subclass EUTHYNEURA
Order BASSOMMATOPHORA
Family LYMNAEIDAE
Genus LYMNAEA

Lymnaea humilis (Say) 1822.

Superfamily ANCYLACEA
Family PLANORBIDAE
Genus GYRAULUS

Gyraulus parvus (Say) 1817.

Genus ARMIGER

Armiger crista (Linne) 1758.

Family PHYSIDAE
Genus PHYSA

Physa cf. *P. ancillaria* Say 1825.

Order STYLOMMATOPHORA
Suborder HETERURETHRA
Superfamily SUCCINEACEA
Family SUCCINEIDAE
Genus SUCCINEA

Succinea sp.

Suborder SIGMURETHRA
Infraorder AULACOODA
Superfamily ZONITACEA
Family ZONITIDAE
Genus ZONITOIDES

Zonitoides arborea (Say) 1816.

Class PELECYPODA
Order PRIONODESMACEA
Superfamily NAIADEA

fragments of the prismatic layer of naiad shell.

Order TELEODESMACEA
Family SPHAERIDAE
Genus PISIDIUM

Pisidium sp.

The number of specimens representing each species is given below. The number prefixed by the letters UND is the museum number

under which the specimens are curated in the Department of Geology collection at the University of North Dakota.

UND 7043	*Valvata lewisi*	43 specimens
UND 7041	*Lymnaea humilis*	104
UND 7042	*Gyraulus parvus*	96
UND 7047	*Armiger crista*	1
UND 7045	*Physa* cf. *P. ancillaria*	2
UND 7048	*Succinea* sp.	1
UND 7046	*Zonitoides arborea*	2
UND 7044	*Pisidium* sp.	53 valves presumed to represent 27 individuals
UND 7049	Naiads	fragments

PALEOECOLOGY

Valvata lewisi is an operculate, branchiate snail which according to Baker (1) is typical of lakes and shallow water. It is associated with aquatic vegetation and requires clear, seasonally temperate water which does not dry up during periods of low rainfall. It has been found in the northern part of the United States and into Canada to the upper Mackenzie River according to Baker (1).

Lymnaea humilis, Gyraulus parvus, Armiger crista, and *Physa ancillaria* are pulmonate snails and can withstand water conditions which are less stable than can species of *Valvata.* This ability to succeed in adverse conditions of high turbidity, high dissolved solids, and seasonal drying does not preclude their success in water suitable to the species of *Valvata.* All of these pulmonate species have a wide geographic range of occurrence. They are associated with aquatic vegetation and are usually found in shallow water.

The presence of land snails in the fauna, though few in number, is conclusive proof that marginal terrestrial habitats, surfaced with vegetation, existed. *Succinea* and *Zonitoides arborea* are both represented by fragmented shells which lack one diagnostic portion. There is no question that the fragment assigned to *Succinea* is either an immature specimen or the nuclear whorl of a mature specimen of that genus. It is impossible to distinguish specimens of the species *Zonitoides arborea* from members of the species *Nesovitrea binneyana* (Morse) when the last whorl is broken away. This is the condition of both the specimens assigned to *Zonitoides arborea.* The slow expansion of the whorls previous to the last whorl in these broken specimens inclines me to make the tentative assignment in favor of *Z. arborea.*

Pisidium is a genus which is extremely difficult to identify to species. Herrington (2) lists 113 recognized names of species of *Pisidium* for North America alone. He has regrouped these supposed species into 25 species, but has not yet published the characters or life histories of them. For this reason, I have not attempted to assign the *Pisidium* valves found in this fauna to any taxon smaller

than the genus. The reliance upon the literature for the ecologic preferences of the various species is not justified because of the low confidence in the specific assignments of even the most competent workers of the past.

Naiad fragments, mostly prisms from the prismatic layer of the shells of mussels, were found. They are most likely from clams which lived locally at the same time as the gastropods lived. The Cretaceous sediments which once covered western Minnesota were incorporated into the glacial drift. These Cretaceous sediments contained pelecypod fossils which had prisms quite like the more modern freshwater clams, the naiads. Thus it is possible that the prisms, assigned to the superfamily Naiadea here, are actually reworked material from older rocks. The presence of naiads in sediments containing the obviously Pleistocene gastropods is not anomalous. The former frequently form a significant part of the molluscan fauna in modern environments containing the same species of gastropods. Be-

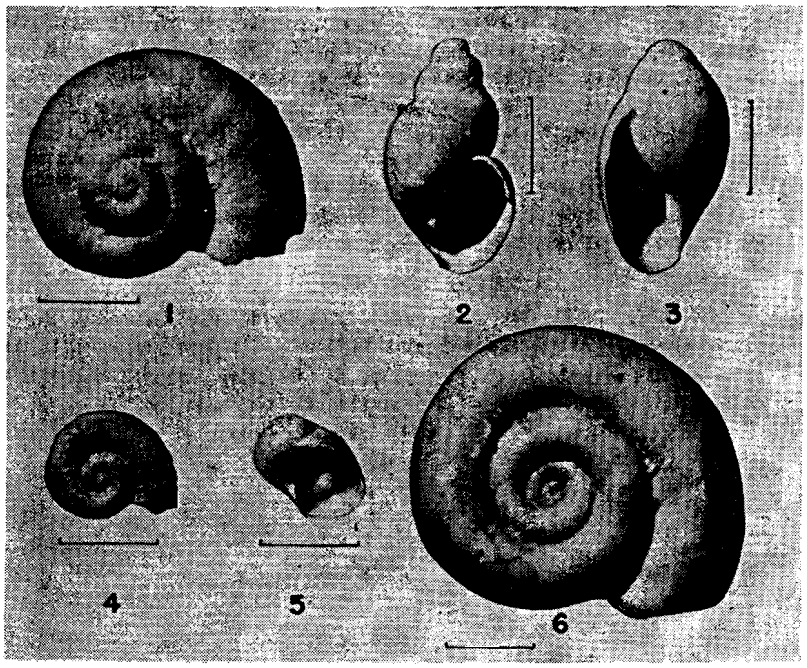

PLATE 1—MOLLUSCAN FOSSILS FROM UPPER GLACIAL LAKE AGASSIZ SEDIMENTS IN RED LAKE COUNTY, MINNESOTA. The line next to the figure equals 1 mm. Fig. 1, *Valvata lewisi* Currier; fig. 2, *Lymnaea humilis* (Say); fig. 3, *Physa* cf. *P. ancillaria* (Say); fig. 4, *Armiger crista* Linne); fig. 5, *Succinea* sp; fig. 6, *Gyraulus parvus* (Say).

cause of the question of their age, naiads have not entered into the paleoecological reconstruction erected here.

The fossils are not representative of a biocoenose. The sediments and the condition of the shells suggests they were transported only a short distance, however. As this sample was taken from sand to silt sized sediments, it is reasonable to assume that the mollusks lived nearby and were transported, after death, only a short distance, either by wave action or by streams which flowed into Glacial Lake Agassiz.

Some of the shells are etched, indicating that they lay in an acid environment after the death of the animal. The unetched surfaces of the vast majority of the shells indicates that the waters in which most of the fauna lived were neutral or basic. Thus it may be assumed that the portion of Glacial Lake Agassiz near where the fossils were deposited had at least two distinct habitats. This is the usual case in lakes today and not at all surprising. The presence of *Valvata lewisi* does indicate a rather surprising condition for Glacial Lake Agassiz, however. At least a portion of the glacially dammed lake was, at one time, clear water. The fossils occur in the uppermost beds of sediments deposited in Glacial Lake Agassiz and indicate that the glaciated margins had become vegetated by this time, thus reducing detritus which *Valvata lewisi* could not have tolerated.

The large number of fossils in so small a sample suggests the presence of a highly successful molluscan fauna, which would not have existed in unvegetated areas.

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