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Paleoenvironmental analysis of a late Holocene deposit : Stanton site, west-central North Dakota

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PALEOENVIRONMENTAL ANALYSIS OF A LATE HOLOCENE DEPOSIT:

STANTON SITE, WEST-CENTRAL NORTH DAKOTA

by

David W. Fischer

Bachelor of Science, North Dakota State University, 1977

A Thesis

Submitted to the Graduate Faculty

of the

University of North Dakota

in partial fulfillment of the requirements

for the degree of

Master of Science

Grand Forks, North Dakota

August
1980

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This thesis submitted by David W. Fischer in partial fulfillment of the requirements for the Degree of Master of Science from the University of North Dakota is hereby approved by the Faculty Advisory Committee under whom the work has been done.

Alan W. Brunner
(Chairman)

Alan Brunner

David B. Johnson

This thesis meets the standards for appearance and conforms to the style and format requirements of the Graduate School of the University of North Dakota, and is hereby approved.

Dean of the Graduate School

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PALEOENVIRONMENTAL ANALYSIS OF A LATE HOLOCENE DEPOSIT:
Title STANTON SITE, WEST-CENTRAL NORTH DAKOTA

Department Geology

Degree Master of Science

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ABSTRACT

The Stanton Site (~~W₂NE₂~~ sec. 16, T. 144 N., R. 85W.), eastern Mercer County, North Dakota, contains a late Holocene organic deposit in the cutbank of an ephemeral stream on the Missouri Plateau. Stratigraphic units of the 104-cm section are, in ascending order: (1) gravel; (2) silty, organic, sandy clay; (3) organic silt; (4) silty, sandy, organic clay; (5) organic silt; (6) sandy, silt, organic clay; and (7) sand. A radiocarbon date of wood from the base of unit 2 indicates initiation of deposition at 325±115 radiocarbon years B.P.

Abundant well-preserved fossils are present in the organic sediments of the Stanton Site. A molluscan assemblage from a measured section consists of 2 species of sphaeriid bivalves, 6 species of aquatic snails, and 8 species of terrestrial snails, including Stagnicola caperata (Say), Aplexa hypnorum Haldeman, Gyraulus parvus (Say), Armiger crista (Linnaeus), Euconulus fulvus (Müller), and Hawaiiia miniscula (Binney). A coleopteran assemblage of 43 taxa includes 22 identified species, primarily ground beetles, including Dyschirius setosus LeConte, Elaphrus olivaceus LeConte, Pasimachus elongatus LeConte, Pterostichus leconteianus Lutshnik, and Patrobus stygicus Chaudoir. Interpretation of the fossil assemblages indicates a thickly vegetated, ephemeral, prairie stream. The similarity of faunal components throughout the section, suggests environmental stability, including the climatic parameters.

INTRODUCTION

A small organic deposit, hereafter referred to as the Stanton Site, was discovered by Jon Reiten, University of North Dakota, while mapping Quaternary landforms near Stanton, North Dakota. Preliminary examination of the site showed that it was fossiliferous. This, and consideration of its stratigraphic position and location, suggested that information gained from an investigation of this deposit might increase our present understanding of post-glacial climatic conditions in west-central North Dakota.

Location

The Stanton Site is approximately 6 km southwest of Stanton in eastern Mercer County, west-central North Dakota (Figures 1 and 2). The deposit is in the cutbank of an ephemeral stream in the W₁NE₄ sec. 16, T. 144 N., R. 85 W. The source of the stream is approximately 3.3 km south of the site; 1.6 km north of the site, the stream enters an area of stabilized sand dunes where it disappears. At the Stanton Site, the stream runs adjacent to the current western limit of the Glenharold mine of the Consolidated Coal Company.

Regional Setting

The site is on the Pleistocene McKenzie Terrace near the southern edge of the Knife River Trench (Reiten 1979). The Knife River Trench is superimposed on the glaciated portion of the Missouri Plateau

Fig. 1. Location of the Stanton Site in west-central North Dakota.

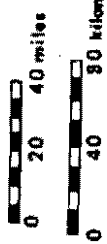
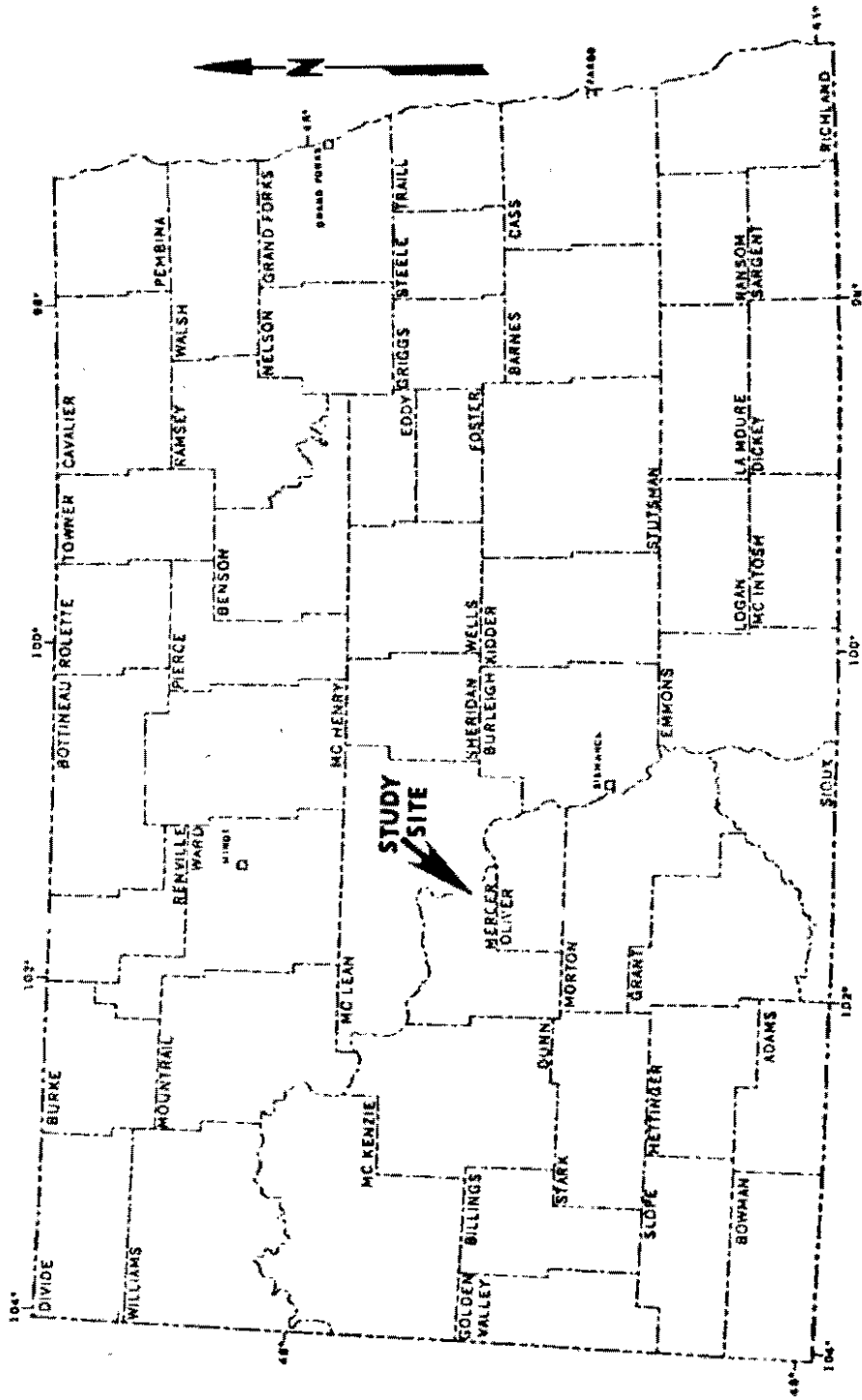
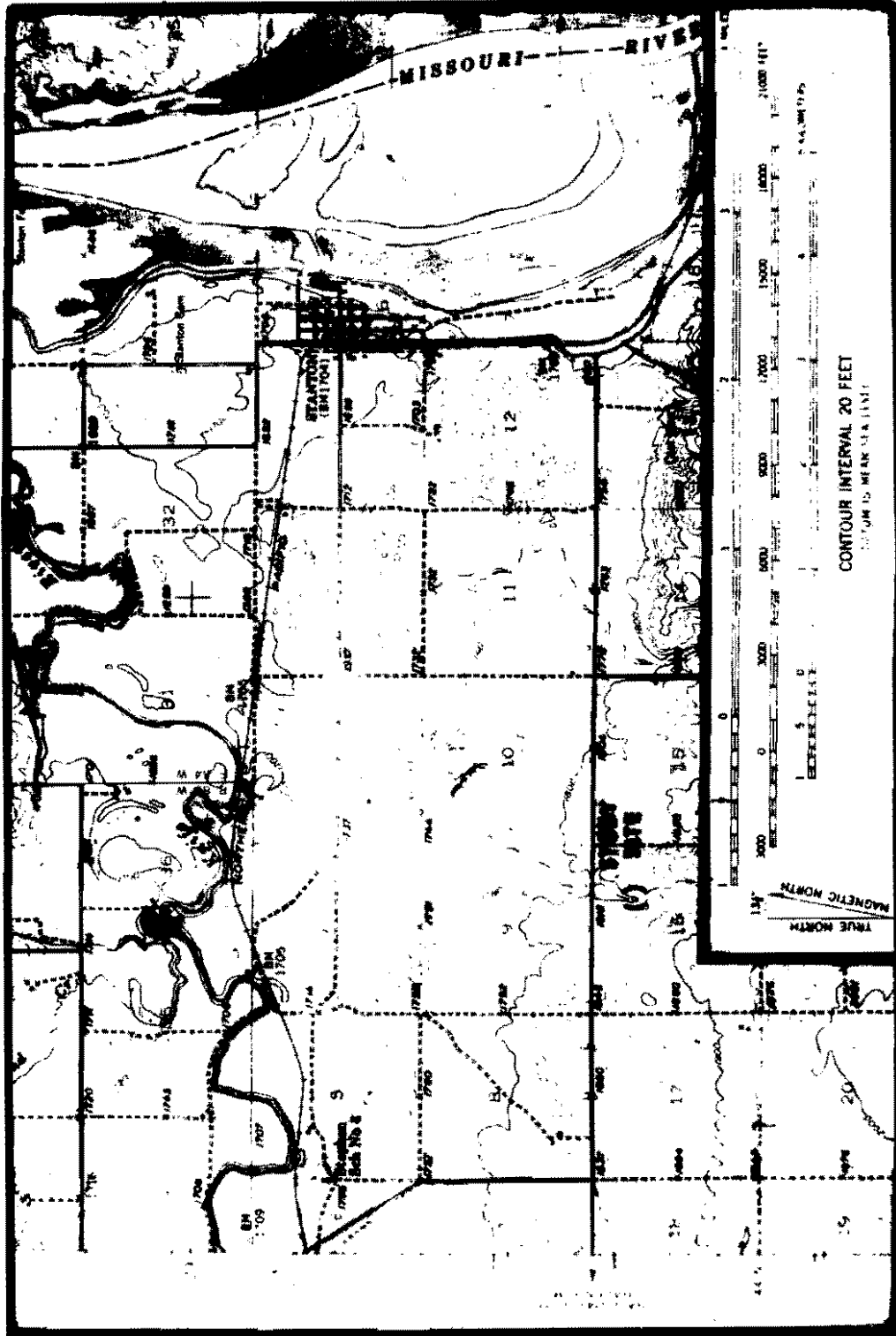


Fig. 2. Specific location of the Stanton Site, eastern Mercer County, North Dakota. Stanton Quadrangle, North Dakota. 15 minute series, United States Geological Survey 1948.



Region (Moran et al. 1978). The Missouri Plateau Region is of gently undulating topography formed on bedrock (Bluemle 1977). The surface of the McKenzie Terrace slopes gently northward towards the Knife River, but, unlike many terraces, it is not bounded by a prominent scarp. The terrace may be erosional, having been cut into bedrock and glacial till, or may be depositional, composed of fill sands and gravels (Reiten 1979). The surface is overlain by eolian silt and sand. Scattered, stabilized sand dunes, some with active blowouts, are common.

The climate of this area is semi-arid, with an average precipitation of approximately 45.7 cm per year. Half of the precipitation received occurs during the short summer, falling in brief, but intense thunderstorms. The winters are long and harsh (Jensen 1972).

The vegetation of the area is mixed grass prairie. Woodlands occur on floodplains, with the primary constituent being cottonwood, and along steep valley and gully sides (Stevens 1963).

Objectives

The primary objective of this study was to evaluate the environmental conditions present in this area during late Holocene time, by isolation and identification of the molluscan and coleopteran assemblages from within the organic deposit. In this study, late Holocene is considered to be less than 4,500 years before present (Cvancara et al. 1971). Known modern ranges and habitats of the identified assemblages were employed to reconstruct the ecological and climatological conditions present during the time the organisms lived.

Secondary objectives included:

1. The construction of a topographical map of the site.
2. The construction of an isopach map of the deposit.
3. The determination of the percentage of the organic content of the deposit.
4. The analysis of the grain-size distribution of sediments within the deposit.

Because of the occurrence of substantial numbers of molluscs and Coleoptera, these groups were used as paleoenvironmental indicators. Ostracods, charophytes, and seeds were also noted continuously throughout the deposit, but were not studied.

Previous Work

There are no paleoecological studies from North Dakota primarily concerned with late Holocene climatic conditions. Other North Dakota paleoecological investigations have sediments of this age included within the scope of their studies, but treat the late Holocene in only the most general of terms. McAndrews et al. (1967) generated a pollen diagram and evaluated a molluscan assemblage for a Missouri Coteau deposit, the Woodworth Pond in southeastern North Dakota, that included late Holocene sediments. They concluded that conditions at the site during the late Holocene, before the water level was disturbed by man, were those characteristic of a temporary prairie water body. They noted a decreasing frequency in desiccation of the Woodworth Pond during the late Holocene, different from the more arid conditions present prior to that time.

Late Holocene sediments were analyzed as part of a stratigraphic sequence from the Seibold Site in southeastern North Dakota. Comprehensive studies of this lacustrine deposit (Ashworth and Brophy 1972;

Bickley 1970; Bickley and Clayton 1972; Bickley et al. 1971; Cvancara et al. 1971), which included evaluation of molluscan and coleopteran assemblages, have revealed a relative cooling trend during the late Holocene, with more moist conditions present than during the middle Holocene (Cvancara et al. 1971).

Okland (1978), investigating the McClusky Canal Site on the Missouri Coteau in central North Dakota, suggested, on the basis of molluscan and seed assemblages, the possibility of fluctuating or constantly decreasing water levels for this lacustrine site during the late Holocene. The shallowing of the lake probably resulted in increased concentrations of dissolved ions in the water body during the late Holocene.

Other North Dakota studies of relevance in this region include an evaluation of the Quaternary geology in the study area by Reiten (1979). Along with generation of a geological map of the area, he suggested a regional late Holocene history of minor climatic fluctuations. Bickley (1972) investigated the stratigraphy of this region and suggested a regional geological history during the Quaternary. Although he recognized the relative cooling trend during the late Holocene that had been noted in other studies, he further hypothesized episodic climatic events during this time. Basing his interpretations primarily upon sedimentological evidence, he suggested that cool, moist "stable episodes" would be contemporaneous with soil formation. Clayton et al. (1976) discussed the origin and climatic implications of late Quaternary silts in North Dakota. Their study summarized Bickley's (1972) results, emphasizing the climatic implications of upland silt, and they drew similar conclusions.

METHODS

Field

Preliminary examination of the site and sample collection was completed in August, 1978. Approximately 30 cm of sediment was cleaned horizontally from the face of the exposure, an amount probably sufficient to eliminate the possibility of contamination of the fossil assemblage by living forms. The thickest exposure at the site was described, measured, divided into 10-cm increments from the top of the exposure, and sampled. Samples were stored in sealed plastic bags for transportation to the laboratory.

Although not considered to be sedimentologically similar or contemporaneous with the study section, the 0-15-cm interval (UND Accession Number A2422a) was sampled and bagged for possible examination. The 15-20-cm interval (UND Accession Number A2422b) was bagged separately, thus allowing the remainder of the 119-cm section to be sampled in 10-cm units (UND Accession Numbers A2422c-A2422i). A sample of the unit underlying the organic section was also taken for possible examination (UND Accession Number A2422m). At a depth of 100 cm, a log was encountered that extended to the base of the deposit; a portion of that log was collected for identification and C14 dating.

During August of 1979, the site was revisited, at which time 33 cores were taken with a hydraulic soil probe. The vertical position and thickness of the organic sediments within each core was noted. The

location and elevation of the cores were surveyed with plane table and alidade, and the surveyed data were used to construct an isopach map of the deposit and a topographical map of the site.

Laboratory

Samples were split into 3 subsamples:

1. a 1-liter subsample for isolation of the molluscs;
2. a 200-g subsample from grain-size analysis and for determination of the organic content; and
3. the remainder of the sediment for isolation of the Coleoptera.

Each subsample was treated separately, as discussed below.

Molluscs

The 1-liter subsamples were disaggregated by soaking in a 5% Calgon solution for up to two months. Coleopteran fragments were isolated before the subsamples were soaked in household bleach (5.5% sodium hypochlorite) for up to 48 hrs. The bleach oxidized most of the organic portion of the sediment, facilitating the isolation of the mollusc shells during sieving. The bleach had no apparent adverse effect on the microsculpture of the shells.

Each subsample was then washed through a series of 4-mm, 2-mm, 1-mm, and 0.5-mm screens: U. S. standard sieve sizes 5, 10, 18 and 35. The material remaining on the screens was dried and sorted under a binocular microscope for identifiable mollusc shell fragments. Due to the large amount of sample remaining on the 0.5-mm screen, that material was quartered. Upon sorting of the quartered size fraction, it was found that identifiable mollusc fragments consisted of juveniles. Due to the size of these shells, and the lack of observable

microsculpture, it was possible to identify only a limited number of the juveniles to the specific level.

Coleoptera

The largest of the subsamples, each weighing on the average of 2.0 kg, was first disaggregated by boiling in sodium carbonate for a period of less than 1 hr. Insect fragments were then isolated using a kerosene floatation technique (Ashworth 1979), and mounted on micropaleontological slides with water soluble glue.

Sediment

The percentage of gravel and sand within the sediments of a given interval was determined by wet sieving. Silt and clay percentages were determined through pipette analysis (Folk 1974). The sediment was first treated with 30% hydrogen peroxide in an attempt to remove the organic material present (Gross 1971). This procedure effectively removed all but the lignin content, which was separated from the oxidized residue by decantation. Decantation was chosen, rather than some chemical means for lignin removal, so as to not alter the soluble sedimentary carbonate content.

Organic Content

Sediment was oven-dried at 110°C for 24 hrs, and 10 g of the dried sediment was ignited in a furnace for 15 mins. at 600 C°. Weight loss was measured and calculated as the percentage of organic material present within the sample (Gross 1971).

Identification

Molluscs were identified by direct comparison with reference materials at the Geology Department, University of North Dakota. Mounted coleopteran fragments were identified after careful comparison with pinned museum specimens at the Canadian Department of Agriculture in Ottawa and at the North Dakota State Insect Collection, North Dakota State University. Many of the mounted coleopteran specimens were referred to qualified taxonomists for identification or confirmation of identifications.

Wood sampled from the site was identified at the USDA, Center for Wood Anatomy Research, U.S. Forest Products Laboratory, Madison, Wisconsin. Carbon 14 dating of the wood was completed at Geochron Laboratories Division, Krueger Enterprises, Cambridge, Massachusetts.

Faunal Parameters

Faunal succession is based upon an orderly and predictable developmental sequence (Schaak and Franz 1978). This sequence is dependent on a variety of environmental factors present within a given habitat. Many of the factors--biomass, total dissolved solids, salinity, and entropy--that control faunal development are lost in the fossil record, and are impossible to analyze quantitatively. The number of taxa present within a deposit, diversity, and equitability are factors that may be quantified and used in paleoecological investigations (Schaak and Franz 1978).

Due to relatively large numbers of molluscs in the Stanton sediments, three approaches have been used in an attempt to evaluate trends

within the snail fauna; number of taxa present, Simpson index, and equitability. Only consideration of the number of taxa present within the beetle assemblage was considered valid in this study, due to the small numbers within a given taxon.

The number of taxa present in a faunal assemblage is one measure of the diversity of that assemblage. Taxa, in this study, refers to the lowest level of taxonomic identification possible. One spire, one body whorl, or any combination was considered as an individual mollusc. Any combination of one head, one thorax, one right elytron, and one left elytron was considered as one coleopteran individual.

Another approach in determining the diversity of a faunal assemblage is the Simpson index, which adjusts for population frequencies within a taxon (Figure 7). The Simpson index is calculated from the following (N = number of taxa per sample, and n = number of individuals per taxon):

$$\Sigma \frac{n(n-1)}{N(N-1)}$$

A maximum value is attained if each individual is representative of a separate taxon, or maximum diversity. A minimum value is achieved if all individuals belong to a single taxon, or total dominance (Schaak and Franz 1978).

Equitability compares the evenness of distribution of frequencies for various taxa. Unity is indicative of total equalness; lower values indicate increased dominance (Schaak 1975). It is calculated as:

$$\frac{\text{Simpsons Index}}{\text{number of taxa}}$$

RESULTS

Stratigraphy

Areally, the Stanton Site consists of two organic lenses (Figure 3). The smaller lens is approximately 4 m by 40 m, and was not investigated in this study. The larger lens measures 12 m by 90 m, reaching a maximum thickness of 104 cm at the measured section.

Populus sp. (Christensen 1978) from the basal contact has been dated at 325 ± 125 C14 radiocarbon years B.P. A localized scarp, variable in relief but less than 0.33 m high, outlines the horizontal extent of the deposit. The scarp is believed to be the result of settling of the organic sediments. No units were determined in the field because of similar sedimentological content.

Upon laboratory analysis, seven sedimentological units are distinguishable, from oldest to youngest: unit 1, gravel; unit 2, silty, organic, sandy clay; unit 3, organic silt; unit 4, silty, sandy, organic clay; unit 5, organic silt; unit 6, sandy, silt, organic clay; and unit 7, sand. Units 1 and 7 are not continuous with the organic section.

Units 2, 4, and 6 are essentially the same. They are black (10YR 2/1 to 10YR 3/2), with only minor variations in organic content and grain size (Figure 4). All three units are fossiliferous. Units 3 and 5 are similar sedimentologically and paleontologically. Both units are black (10YR 3/2), with the percentage of silt relatively high, reaching near 70% in the 80-90-cm interval of unit 3. Clay percentages within both units are near zero.

Fig. 3. Topographical map of the Stanton Site, North Dakota and isopach map of the organic section of the site. Topographical contours in feet.

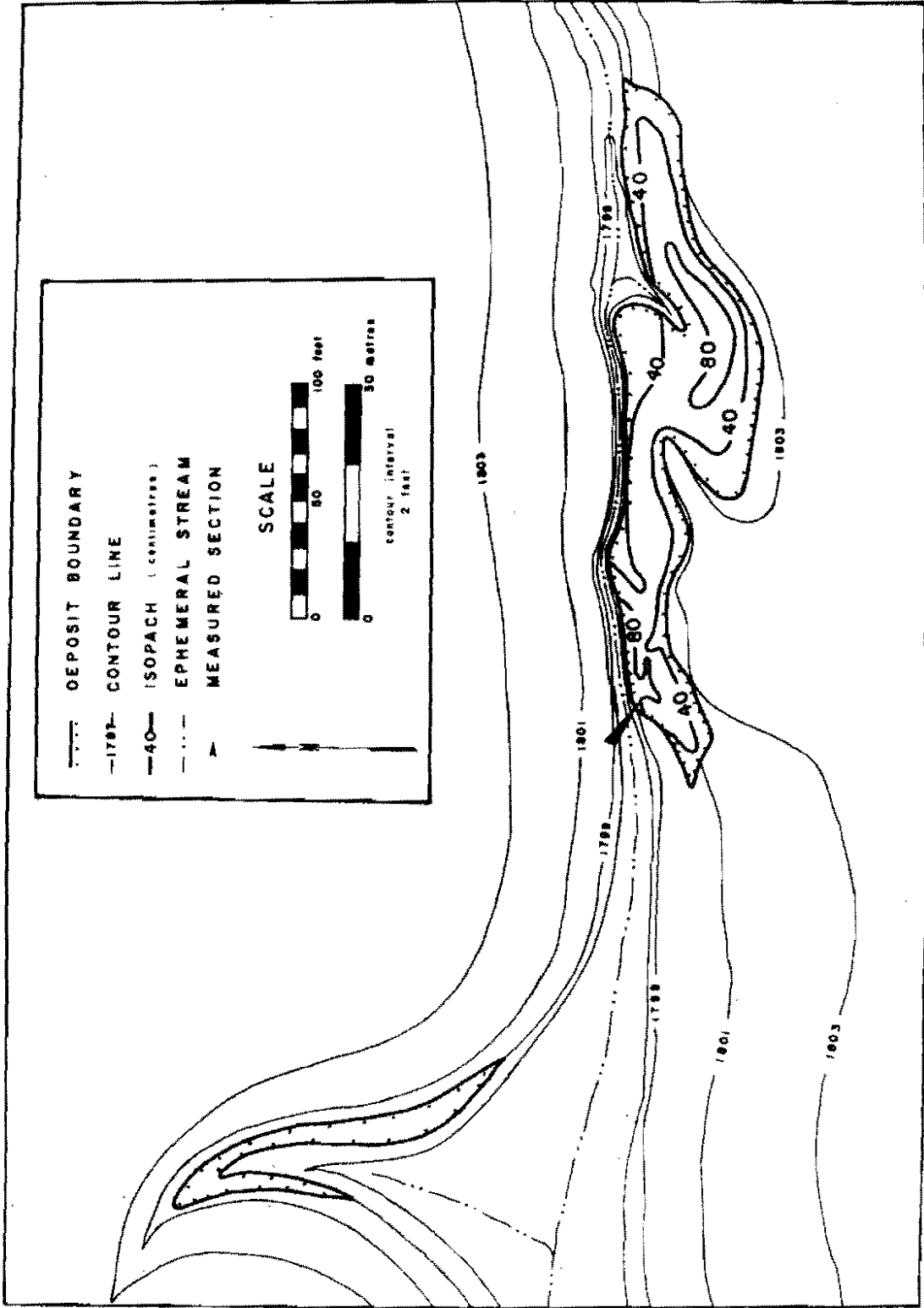
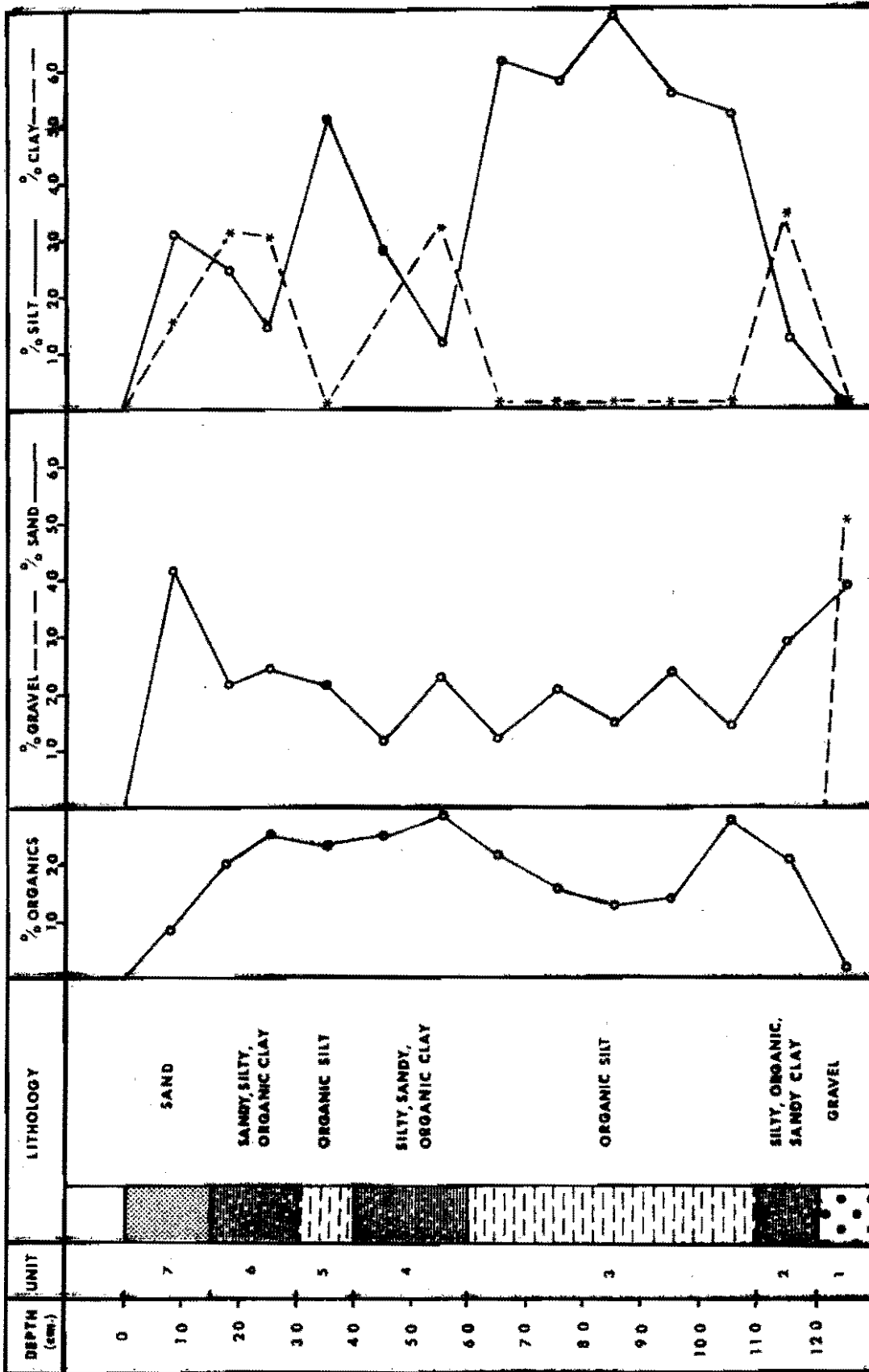


Fig. 4. Stratigraphic section and sediment composition,
Stanton Site, North Dakota.



Paleontology

A wide variety of fossils were found in the sediments of the Stanton Site, including: Trichoptera (caddisflies); Hemiptera (bugs); Acari (mites); Hymenoptera (ants and wasps); Coleoptera (beetles); molluscs (snails); ostracods; charophytes; plant seeds; and plant macrofossils. Only the molluscan and coleopteran faunas are described in this study.

Molluscs

Both aquatic and terrestrial molluscs are present within the studied section. A molluscan assemblage of low diversity, consisting of only 16 species--6 aquatic snails, 8 terrestrial snails, and 2 pill clams--has been identified. The stratigraphic occurrence of the molluscan fauna identified from the Stanton Site is listed in table 1, appendix A, and Figures 5 and 6. All identified species are extant, and their present ranges include North Dakota (Cvancara 1975). Although no mollusc fossils were found in the 100-110-cm interval in unit 3 at the sampled section, an assemblage of molluscs from this interval, consisting primarily of Stagnicola caperata and Gyraulus parvus, was noted elsewhere within the deposit. These species are dominant components of the molluscan assemblage throughout the site.

The maximum number of molluscan taxa isolated from the site is 15, in unit 5. A minimum of six taxa is present in the upper 10 cm of unit 3 (Figure 7). A general trend towards increased numbers within represented species, with the exception of Pisidium casertanum, is noted with younger stratigraphic position. P. casertanum reaches a

maximum number of individuals in the 80-90-cm interval in unit 3, where a minor peak for S. caperata, G. parvus, and C. avara is also noted (Figures 5 and 6).

Stagnicola caperata and Gyraulus parvus are present, and represented by relatively large numbers, in every unit. Aplexa hypnorum is first noted in the 90-100-cm interval in unit 3, then continuously from the base of unit 4 to the top of unit 6. The maximum number of individuals for this species is recorded in the 20-30-cm interval in unit 6. Numbers and trends of the remaining aquatic species, Stagnicola elodes, Armiger crista, Physa integra, and Pisidium ventricosum are variable.

Catinella avara is the most commonly represented terrestrial snail. This species is first noted in the 80-90-cm interval of unit 3, and continuously through unit 6, with the maximum number of individuals occurring in the 20-30-cm interval in unit 6. Occurrences of the remaining species of terrestrial snails, Oxyloma retusa, Gastrocopta pentodon, Vertigo ovata, Hawaila minuscula, Euconulus fulvus, Carychium exiguum, and Zonitoides arboreus, are variable (Figures 5 and 6).

Graphic presentation (Figure 7) of the diversity and equitability parameters as applied to the snail fauna from the Stanton Site depicts minimal trends. The constancy of the data is the result of an assemblage of low diversity, and complete dominance of the snail biota by S. caperata and G. parvus throughout the organic section.

The diversity index is at its minimum in unit 2. The total number of molluscan taxa present at the measured section is at a minimum in the 60-70-cm interval in unit 3, with the equitability curve at its maximum (decreased dominance).

Fig. 5. Stratigraphic occurrence of aquatic molluscs,
Stanton Site, North Dakota.

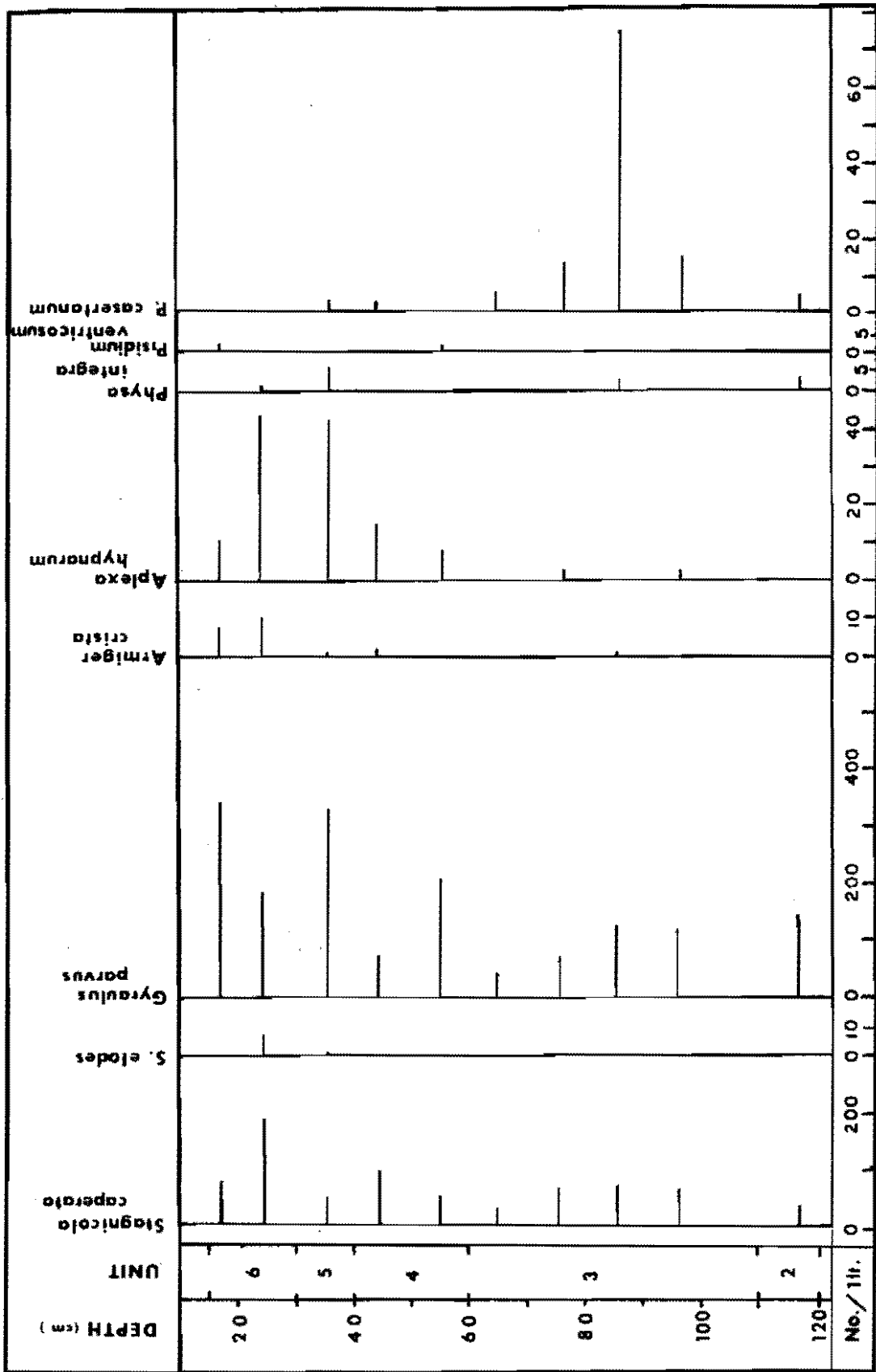


Fig. 6. Stratigraphic occurrence of terrestrial gastropods,
Stanton Site, North Dakota.

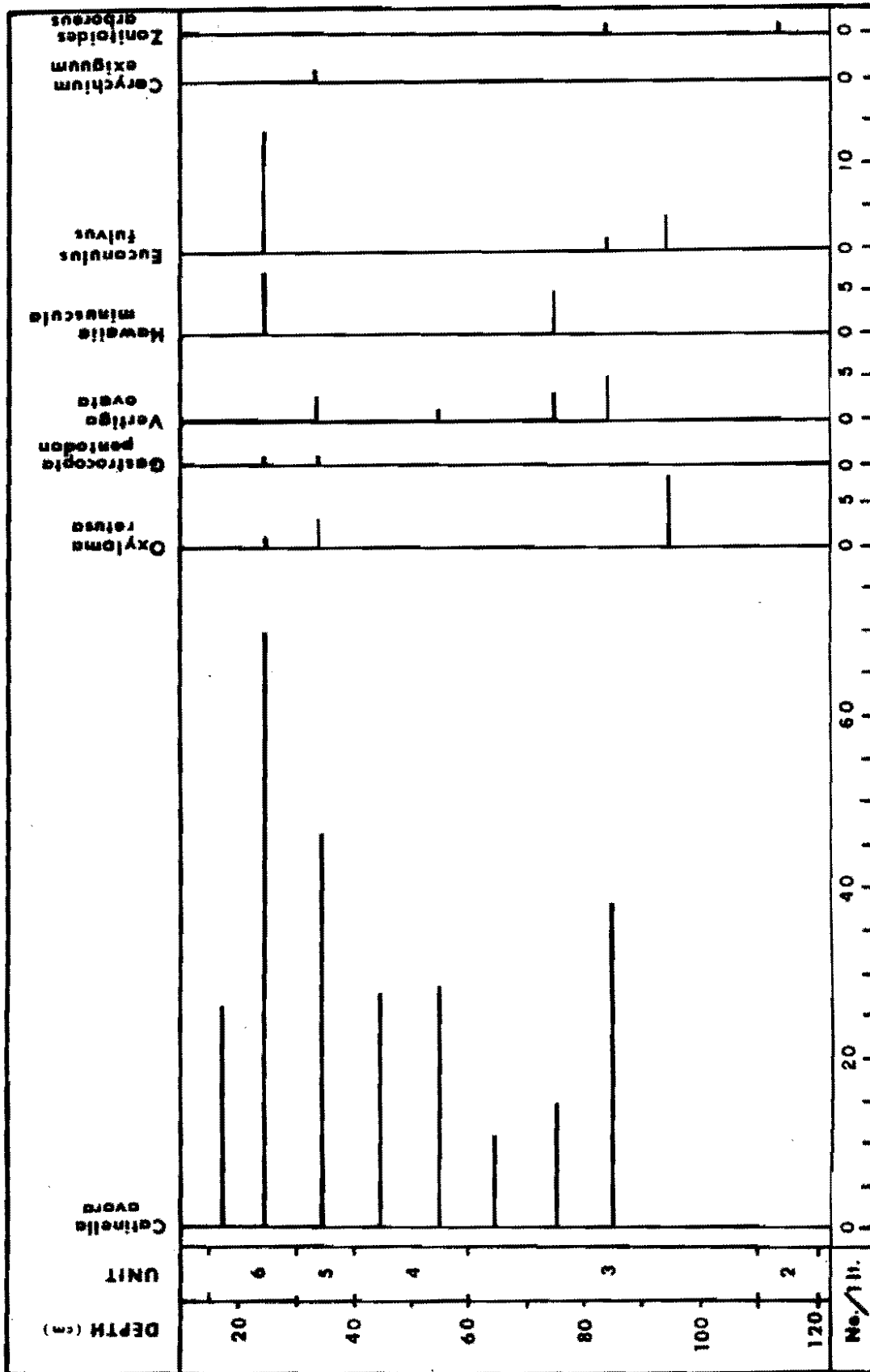
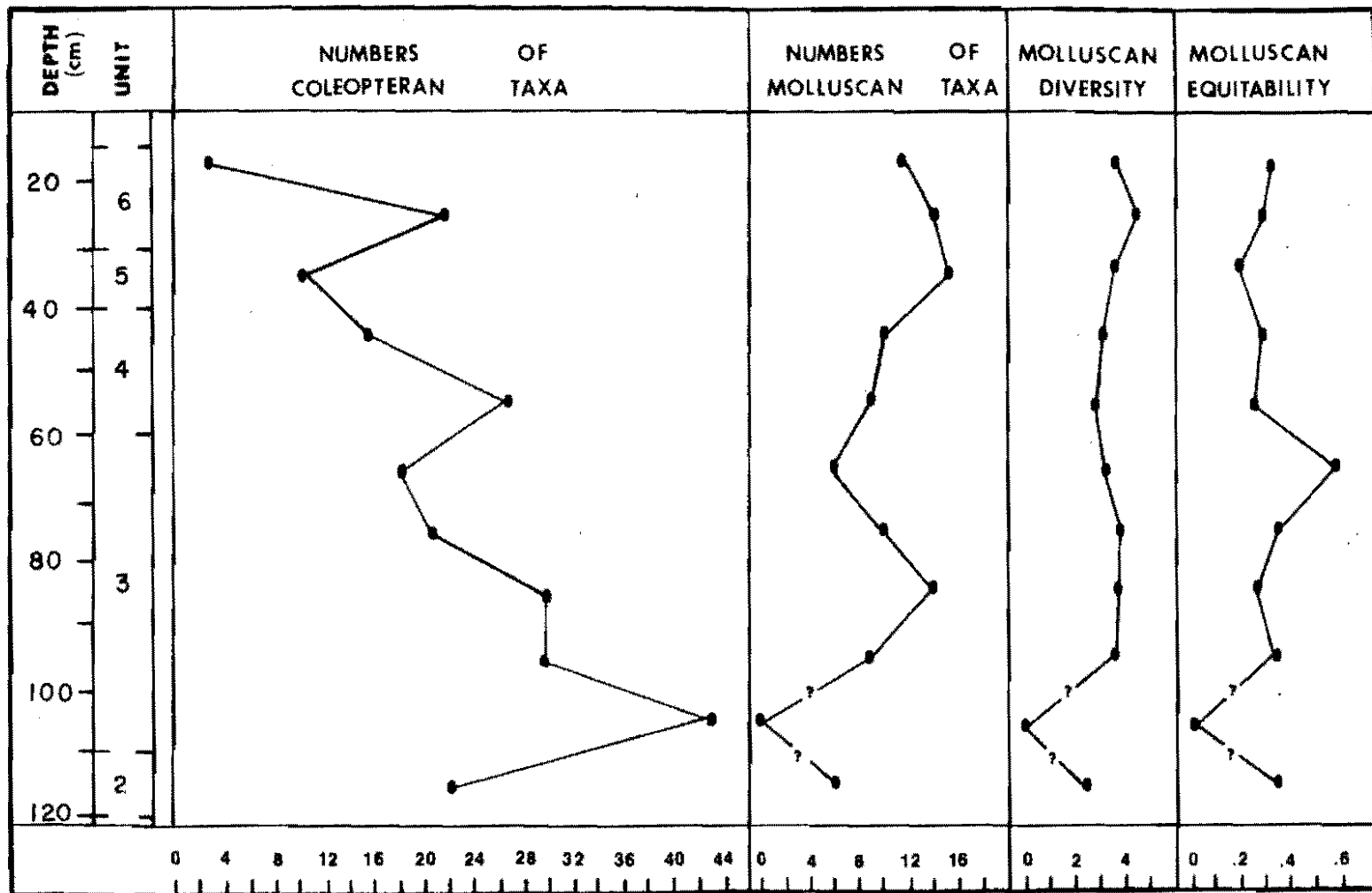


Fig. 7. Graphic presentation of faunal parameters, Stanton Site, North Dakota. Molluscs are present in the lower interval of unit 3 elsewhere in the deposit.



Coleoptera

Representatives of both aquatic and terrestrial families of Coleoptera have been isolated from the sediments of the Stanton Site. Of the 22 species identified from the 43 taxa represented in the fauna, all are terrestrial. The stratigraphic occurrence of the beetle fauna identified from the Stanton Site is listed in table 2, appendix A. All species reported are extant, and the present range for most includes North Dakota. Considering the habitat requirements of those species not reported from North Dakota, it is probable that their ranges actually do include this area, but were not recorded in the literature or were not present in the insect collections investigated for this study.

The maximum number of coleopteran taxa present in the organic deposit of the Stanton Site is 43 in the 100-110-cm interval in unit 3, nearly twice the taxa recorded elsewhere at the section. A minimum of 3 taxa is recorded in unit 6 (Figure 7).

Representation within any given taxon is low, often only one or two individuals. For this reason any trends suggested in a graphical presentation of faunal parameters would have no meaning, but for two exceptions. The Donaciinae are present in relatively large numbers in unit 2 and in the basal 30 cm of unit 3. Scattered occurrence and representation of this subfamily by a single individual is characteristic in sediments less than 80 cm in depth. Barilepton sp. is present in numbers in all but the 15-20-cm interval in unit 5.

DISCUSSION

Stratigraphy and Sedimentation

The organic section of the Stanton Site is overlain by eolian silt and sand, and underlain by fluvial sand and gravel. Populus sp. from the basal contact of the organic section has been radiocarbon dated at 325 ± 125 radiocarbon years before present. This date is similar as that suggested for the "Jules Stable Episode" by Bickley (1972), and the organic deposit at the Stanton Site and the paleosol with which it is laterally continuous is considered of that "episode." According to Bickley (1972), development of a soil during this "episode" began after deposition of the gray loess of the Riverdale Member of the Oahe Formation, continuing until about 1928 A.D., the beginning of the "Dirty Thirties Unstable Episode."

Clayton et al. (1976) suggested that the climate during "stable episodes" is relatively cool and moist, resulting in increased vegetation of hillslopes and uplands. An increase in vegetation results in increased stability of hillslopes, thus reducing eolian deflation of those surfaces. This is reflected in a time of soil formation, and a subsequent decrease of silt deposition in the small valleys and ponds of the upland. The converse is true in the warmer, more arid climates of "unstable episodes."

The sedimentary record of the Stanton Site indicates two periods of high silt deposition, units 3 and 5. The higher percentage of silt

of these units may be in response to a shift in the orientation of the depositing media, a change in the depositional regime, a change in the deposited sediments, or a time of increased aridity. During times of increased aridity, silt could be introduced into a depositional basin by increased slopewash, due to a reduction of upland vegetation, or by increased eolian deposition of hillslope silts in upland valleys.

In order to determine a sedimentological explanation for the high silt percentage in these units, investigation of grain size distribution patterns from other late Holocene deposits, or from a series of cores from the Stanton Site are needed.

General Paleoecological Considerations

Interpretation of paleoecological conditions based on fossil assemblages is a well-established practice. Such interpretations are based upon the premise that species recognized from fossils possess ecological tolerances that have not changed from those of extant species, in the time span involved. Paleoecological interpretations of any assemblages is therefore necessarily limited to our present knowledge of the occurrences and environmental tolerances of components of that assemblage. Interpretations cannot be biased by the preferential occurrence of an assemblage member to a specific habitat, if that member is reported from a variety of habitats. Incomplete collecting records and our lack of understanding of the role of species zonation and microhabitats within a given range greatly limit our interpretations.

Molluscan Paleoecology

The depositional environment of the Stanton Site, based on interpretation of the molluscan assemblage, is that of an intermittent stream. Although all aquatic snail species isolated from the sediments of the Stanton Site have been reported from such habitats (Clarke 1973; Baker 1928), the dominance of the snail assemblage by Stagnicola caperata (see remarks, p. 42), and the occurrence of Aplexa hypnorum seem to be most characteristic of such an environment. The continual presence of these species throughout the section is suggestive of environmental consistency during deposition.

The occurrence of Pisidium casertanum may be indicative of periods of increased aridity at the site. It is not only restricted to units of high silt content, but the population maximum of this species is coincident with intervals of maximum silt influx. Herrington and Taylor (1958) suggested that this pill clam is one of the few species of Pisidium able to tolerate seasonal desiccation. They further stated that it is often the only mollusc present in a temporary stream or seepage. This species is not restricted to such habitats (Clarke 1973; La Rocque 1967), thus limiting any interpretation based upon its occurrence.

The presence of Gyraulus parvus may seem anomalous to the suggested environmental interpretation for this deposit. Moyle and Bacon (1969) reported this species as a dominant member of a snail assemblage in a Minnesota lake at a depth of 9 m. They further suggested a preference of this species to cold water conditions. Bickley (1970) suggested that this species can be interpreted as capable of living in temporary

water bodies, but not able to withstand extended periods of drying. In contrast, Clarke (1973) reported that G. parvus is most often collected from large, permanent water bodies, and recorded a limited occurrence in smaller water bodies. Cvancara (1975) reported the occurrence of this species from all aquatic environments in North Dakota, but noted a preferential habitation in intermittent streams. The variability of recorded occurrences of this species suggests an adaptability to a variety of habitats, limiting its usefulness in paleoenvironmental interpretation.

The terrestrial molluscs of the Stanton Site are interpreted as having lived in a moist area or on a floodplain adjacent to a stream. The presence of Carychium exiguum, Hawailia miniscula, and Euconulus fulvus seem to be especially indicative of such a habitat. These species often occur in organic litter or debris along streams and rivers (La Rocque 1970). Cvancara (1973) also reported that H. miniscula, and E. fulvus occur in open habitats with grass, forbs and possibly wolfberry, adjacent to ephemeral drainage. Other terrestrial species reported in this study are capable of adapting to a variety of conditions, including the habitat described.

The trend noted in the upper 10-cm of unit 3, a reduction in the assemblage present but an overall equality in representative numbers within taxa, may be characteristic of a "relict" community. The occurrence of this "relict" community is coincident with the end of a period of major silt deposition. This trend may be in response to climatic change or variation of depositional parameters.

Coleopteran Paleoecology

The coleopteran fauna of the Stanton Site lived in or near a prairie stream. For convenience of presentation, the fauna is discussed in terms of three assemblages, based on general ecological requirements:

1. aquatic assemblage
2. semi-aquatic assemblage
3. upland assemblage

The aquatic assemblage is not well represented in the deposit. Members of the Elmidae are most often found in streams, and have tarsi adapted for clinging onto vegetation, debris, and rocks in running water. The Hydrophilidae are phytophagous and inhabit mostly shallow water with abundant vegetation. The absence of the Gyrinidae is interpreted as indicating an absence of open, calm, water, a requirement for this family. A lack of open water may indicate very shallow water conditions, or a water body choked with vegetation, but not necessarily temporary.

The water marginal assemblage is best represented by members of the Chrysomelidae. The Donaciinae are very hygrophilous. Their larvae are aquatic, and the adults feed on emergent aquatic vegetation (Marx 1957). The abundance of members of this subfamily in the basal 30 cm may indicate that the stream was clotted with vegetation at this time.

The carabid Elaphrus olivaceus occurs in moist, water marginal situations, on fine organic muds or in thin mosses (Lindroth 1961). Other members of the Carabidae in this assemblage, Patrobus stygicus and Chlaenius alternatus, are found on the borders of slowly moving rivers, often with high, dense vegetation. Chlaenius sericeus,

Bembidion frontale, and B. nigripes occur at the edge of standing or slowly running water, often in the presence of carices (Lindroth 1963). Dyschirius setosus and Tachys incurvus are found at the margins of streams and rivers in patches of sparse vegetation (Lindroth 1961, 1969).

The Curculionidae are well represented by large numbers. Representatives of the genus Barilepton were reported by Blatchley (1910) to be semi-aquatic plant feeders. Their continual presence in the studied section may indicate the continual presence of vegetation along the stream margin. Members of the Heteroceridae live in burrows along muddy or sandy banks of rivers and streams (Borrer et al. 1976).

The upland beetle assemblage, primarily carabid, is diagnostic of prairie conditions. Pasimachus elongatus, Agonum cupripenne, and Metabletus americanus occur on open, dry, sandy prairie, with sparse vegetation (Lindroth 1961, 1966, 1969). Stenolophus conjunctus is found in a similar habitat, often on sage-brush prairie (Lindroth 1968).

Aphodius and Rhyssemus are beetles that burrow and feed on dung. Aphodius concavus feeds on the fecal pellets of burrowing mammals. Rhyssemus sonatus is found in fecal pellets of prairie dogs or in buffalo feces. Distribution of Aphodius distinctus is restricted to the dung of larger mammals, such as sheep, cattle, and deer in North Dakota (Helgesen and Post 1967). The occurrence of beetles that burrow must be viewed with caution, as their burrows may extend to a depth of 15 cm, thus representing a possible contaminant. Their occurrence in the fossil assemblage of the Stanton Site is not

believed to be the result of contamination, as the preservation of these fragments does not differ from those of other beetle fossils.

The constancy of the habitat suggested by the upland assemblage is probably the best evidence available from this study that intervals of high silt accumulation and the restricted occurrence of P. casertanum to these intervals are not the result of minor climatic fluctuations. Were this the case, the upland assemblage would be expected to show a change. As an example, increased representation of members of Tenebrionidae could quickly replace the ground beetles, in response to a more sparsely vegetated prairie.

Regional Comparisons of Molluscan and Coleopteran Assemblages

The appearance of Aplexa hypnorum in the studied sediments of the Stanton Site is at the same depth as the appearance of these species in the sediments of the Woodworth Pond (McAndrews et al. 1967). Its appearance in the 90-100-cm interval of those sediments, combined with the occurrence of a planorbid (not recorded from the Stanton Site) and increased numbers of individuals of three lymnaeids (including S. caperata) in the 15-125-cm unit of the Woodworth Pond, is interpreted by McAndrews et al. (1967) to be evidence of unstable water conditions. My interpretation of ephemeral water conditions at the Stanton Site, based on the presence of A. hypnorum and S. caperata is in agreement with that interpretation. A. hypnorum was not reported from the Seibold (Bickley 1972) or McCluskey Canal (Okland 1978) Sites, probably due to the permanency of those water bodies. If the appearance of this species is documented from future studies of smaller, temporary water bodies, at a similar stratigraphic level, and those

stratigraphic levels are time correlative, then the appearance of this species may indicate increasing desiccation of temporary water bodies in this region. Within the sediments of the Stanton Site, A. hypnorum is not restricted to units 3 and 5, nor is its occurrence coincident with maximum numbers of P. casertanum. Therefore, the occurrence of A. hypnorum is not supportive of increasingly arid conditions within these units, as might be suggested by the presence of P. casertanum.

Few terrestrial snails have been reported from previous paleo-environmental studies of the Quaternary in North Dakota. Tuthill (1969) referred to this phenomenon as being a "profound anomaly," indicating that there is "no apparent associative biological reason for their absence." Okland (1978) reported a specimen of Vallonia from the sediments of the McCluskey Canal Site. McAndrews et al. (1967) reported Gastrocopta holzingeri, Hawaiiia miniscula, Vertigo ovata, unidentified pupillids, and specimens of close affinity to Succinea from the sediments of Woodworth Pond. McAndrews et al. (1967) concluded that the occurrences of terrestrial molluscs in these sediments indicated that the shores of the water body was closer to the position of sampling than in units where no terrestrials were reported.

The identification of eight species of terrestrial snails (50% of the total mollusc species identified from the assemblage of the Stanton Site) would seem to reinforce the observation of McAndrews et al. (1967) that abundance of terrestrial molluscs present as components of fossil assemblages is dependent upon distance of the living organism from a basin, where it can be deposited upon death. It would seem, taking this into consideration, that the practice of

sampling maximum exposures of sedimentary columns, theoretically coincident with the deepest portion of a basin, is biased against terrestrial molluscs in sampled sediments.

Ashworth and Brophy (1972) noted that the beetle fauna from the fish bed of the 10,000-year-old lacustrine deposit at the Seibold Site is striking, in so far as no one area in North America contains a similar assemblage today. In direct contrast with this observation, the beetle assemblage described from the Stanton Site is distinctly that of prairie, with ranges of the assemblage members consistently including central North America. There is no evidence of mixing of fauna from other geographical provinces, as noted in the investigated unit of the Seibold Site.

Paleoenvironmental Analysis

Formation of the organic deposit of the Stanton Site may be associated with either spring seepage or accumulation of fluvial sediments. Initiation of spring activity, coincident with the beginning of a "stable climatic episode," could establish moist, thickly vegetated pockets along a pre-existing valley. Continuation of this activity could result in a vertical accumulation of organic sediments, such as those at the Stanton Site. A similar process is presently occurring at the site. Areas that are very moist, and thickly vegetated are associated with springs occurring along the western bank of the streams, providing a habitat similar to the one believed present during the deposition of the studied sequence. This process is not happening on the eastern bank of the stream as continual pumping of an enormous quantity of water seeping into the

open pit of the Glenharold Mine, east of the site, has probably lowered the ground water table, preventing such activity.

Another explanation for the origin of the organic section of the Stanton Site could be the accumulation of fluvial sediments, and associated vegetation in shallow pools of the stream bottom.

Investigation of a snail and beetle assemblage from the organic deposit of the Stanton Site indicates that no climatological or depositional changes occurred during formation of the deposit, which began between 1520 A.D. and 1750 A.D., after deposition of the fluvial gravels of unit 1, and ended about 1928 A.D., with deposition of the eolian silt and sand of unit 7. The depositional environment indicated by the paleofauna is that of a small, ephemeral, prairie stream. The water conditions would have been slow moving to stagnant, with a substrate of mud, and lush aquatic vegetation and possibly flooded grasses were present. The banks of the stream had clayish, moist, soil with scattered patches of sand, and were thickly vegetated, although scattered, thinly vegetated, sandy patches were also present. The upland was open and dry, with sandy soil. The presence of burrowing mammals is indicated in the uplands. Grazing or foraging mammals, such as buffalo, deer, sheep, and cattle, were also present.

The paleoecological interpretation of the fossil assemblage of the Stanton Site is significant in as much as it seemingly addresses the validity of such interpretations. The age of this deposit was initially estimated by visual examination, from a current understanding of occurrences of organic deposits within the region, to be early Holocene. A nearly completed analysis of the fossil assemblage from the deposit, nearly completed, independent of a C14 date, indicated

that deposition of this deposit occurred after transgression of the prairie, 9000-4000 years before present, following McAndrews et al. (1967). A middle or late Holocene age inferred from the paleobiological data was later supported by a date of 325 ± 125 radiocarbon years before present. This suggests that the procedures used in paleoecological investigations are sound.

CONCLUSIONS

Stratigraphic units of a 104-cm thick organic section of the Stanton Site are, in ascending order: (1) gravel; (2) silty, organic, sandy clay; (3) organic silt; (4) silty, sandy, organic clay; (5) organic silt; (6) sandy, silty, organic clay; and (7) sand. The organic section of the Stanton Site, units 2 through 6, is overlain by eolian silt and sand, and underlain by fluvial sand and gravel. The organic section laterally grades into and is contemporaneous with a regional paleosol, that of the "Jules Stable Episode" of Bickley (1972). A radiocarbon date of a species of Populus from the basal contact of the organic section indicates initiation of deposition between 1520 A.D. and 1750 A.D. Deposition ended about 1928 A.D., the beginning of the "Dirty Thirties Unstable Episode" of Bickley (1972).

A mollusc assemblage from the measured section consists of 2 species of sphaeriid bivalves, 6 species of aquatic snails, and 8 species of terrestrial snails, and a coleopteran assemblage of 43 taxa includes 22 identified species, primarily ground beetles. The maximum number of molluscan taxa is 15 in unit 5, reaching a minimum of 6 taxa in the upper 10 cm of unit 3. A molluscan relict community of 5 species may occur in the upper 10 cm of unit 3. A maximum of 43 coleopteran taxa occurs in the 100-110-cm interval in unit 3, and a minimum of 3 taxa in unit 6.

The higher silt percentage in units 3 and 5 may be the result of a shift in the orientation of the depositing media, a change in the depositional regime, a change in deposited sediments, or a response to increased aridity when the units were deposited.

Interpretation of the fossil assemblages indicates a depositional environment of a thickly vegetated, ephemeral, prairie stream. The similarity of faunal elements throughout the section suggests constancy of the depositional environment and climatic parameters.

SYSTEMATIC PALEONTOLOGY

All specimens in this study were identified by direct comparison with museum specimens.

Nomenclature and synonymies of the aquatic snails follows Clarke (1973), except for the Lymnaeidae, which can be found in LaRocque (1968). Nomenclature and synonymies of the terrestrial molluscs follows Pilsbry (1946, 1948).

Family level nomenclature and synonymies of the beetles can be found in Arnett (1971). Generic and specific level nomenclature and synonymies of the Carabidae follows Lindroth (1963, 1966, 1968, 1969). Nomenclature and synonymies of the remaining genera and species of Coleoptera is based upon current literature and is individually referenced herein.

Phylum Mollusca

Class Gastropoda

Subclass Pulmonata

Order Basommatophora

Superfamily Lymnaea

Family Lymnaeidae

Diagnosis.--Shell size variable; dextral; conispiral; normally elongate; thickened and normally twisted columnellar axis; umbilical "chink" is "partially" opened; sculpture variable, possibly consisting

of spiral ridges, malleations or any combination (modified from Clarke 1973, p. 266).

Genus Stagnicola (Leach)

Diagnosis.--Shell moderate to large; elongate to ovate; outer lip thickened from within; whorls gradually increasing in size; perforation of axis only slight, if present (modified from La Rocque 1968, p. 437).

Stagnicola caperata (Say)

Plate I, Figure 2

Diagnosis.--Shell length up to 17 mm; approximately 6 convexly inflated whorls; body whorl at least two-thirds of shell length; columnellar axis not twisted; aperture ovate; regularly spaced spiral striae, corresponding to the position of periostracal ridges (modified from La Rocque 1968, p. 266).

Material.--818 specimens, UND Acc. Nos. A2422b, A2422c, A2422d, A2422e, A2422f, A2422g, A2422h, A2422i, A2422j, A2422k.

Hypotype.--UND Cat. No. 140304.

Geographic range.--Yukon Territory to James Bay, south to Massachusetts; west to California (La Rocque 1968, p. 437).

Remarks.--Most lymnaeids from this study are probably immatures of this species. S. caperata is primarily restricted to seasonal water bodies, or shallows of perennial water bodies. It is associated with aquatic vegetation or flooded grasses. The bottom sediment is most often muddy, and water movement moderate to stagnant. La Rocque (1968, p. 437) suggested that this species can survive in habitats that completely dry in late spring and summer.

I have collected shells of S. caperata in an alfalfa field in southeastern North Dakota. The field had been flooded by heavy summer rains for about 6 weeks the previous year.

Stagnicola elodes (Say)

Diagnosis.--Shell up to 35 mm long; about 7 inflated whorls; body whorl may be up to two-thirds of shell length; aperture broadly ovate; sculpture variable, consisting of coarse collabral lines, irregularly-spaced spiral striae, with or without microscopic crescents between the striae, and with or without malleations (modified from La Rocque 1968, p. 445).

Material.--11 specimens, UND Acc. Nos. A2422c, A2422d.

Hypotype.--UND Cat. No. 140305.

Geographic range.--Circumboreal (La Rocque 1968, p. 445).

Remarks.--S. elodes occurs in most aquatic habitats. The species is most numerous where vegetation is thick, but may also occur where no vegetation exists. La Rocque (1968, p. 444) found this species to be extremely tolerant, able to survive in marginal water bodies, even those with little aeration.

Superfamily Planorbacea

Family Planorbidae

Diagnosis.--Shell small to moderately large; planispral or depressed; aperture oblique (modified from Clarke 1973, p. 388).

Genus Gyraulus Charpentier

Diagnosis.--Shell small; whorls convex to carinate, fully exposed, and ultradextral; body whorl may be deflected in certain species; aperture ovate (modified from Clarke 1973, p. 391).

Gyraulus parvus (Say)

Diagnosis.--Shell up to 5 mm long; abruptly enlarging whorls; convex; ovate in cross-section; umbilical concavity and apical depression shallow, and proportionally dissimilar (modified from Clarke 1973, p. 401).

Material.--2159 specimens, UND Acc. Nos. A2422b, A2422c, A2422d, A2422e, A2422f, A2422g, A2422h, A2422i, A2422j, A2422k.

Hypotype.--UND Cat. No. 140306.

Geographic range.--Alaska and northern Canada to Cuba, Atlantic to Pacific Coasts in the northernmost United States (Clarke 1973, pp. 402-403).

Remarks.--Consistently collected on aquatic vegetation, G. parvus is found in both permanent and temporary aquatic habitats with a variety of bottom sediments, notable those with mud (Clarke 1973, p. 400). La Rocque (1968, p. 491) has found this species most often in protected, vegetated habitats.

Genus Armiger Hartmann

Diagnosis.--Shell minute; similar to Gyraulus, with abruptly enlarging whorls, but with costae projecting as periostrical lamellae in most species (modified from Clarke 1973, p. 406).

Armiger crista (Linnaeus)

Plate I, Figure 4, 4b

Diagnosis.--Shell up to 3 mm wide; planispiral; whorls planar on apical side and well rounded on umbilical side; aperture subovate (modified from Clarke 1973, p. 406).

Material.--21 specimens, UND Acc. Nos. A2422b, A2422c, A2422d, A2422e, A2422i.

Hypotype.--UND Cat. No. 140307.

Geographic range.--Holarctic (Clarke 1973, p. 407).

Remarks.--Clarke (1973, p. 407) found A. crista living in small, eutrophic ponds and slow-moving vegetated creeks, both with muddy bottoms. La Rocque (1968, p. 496) reported this species from seasonal bodies of water and small lakes with quiet water and muddy bottoms.

Superfamily Physacea

Family Physidae

Diagnosis.--Shell size variable; conispiral; nonumbilicate; sinistral; spire short to moderately depressed; aperture large, angulated above and rounded below (modified from Clarke 1973, p. 361).

Genus Physa Draparnaud

Diagnosis.--Shell small; oblong or elongate; spire acute or depressed, usually shorter than aperture; outer lip sharp; inconspicuous chink or perforation; fine spiral sculpture may be present (modified from Baker 1928, p. 408; Clarke 1973, p. 362).

Physa integra Haldeman

Diagnosis.--Shell medium to large; about 5 rounded whorls; body whorl tends to be shouldered; aperture about seven-tenths of shell length, ear-shaped (modified from La Rocque 1968, p. 545).

Material.--11 specimens, UND Acc. Nos. A2422c, A2422d, A2422i, A2422l.

Hypotype.--UND Cat. No. 140308.

Geographic range.--Midwestern states, north of Ohio river; Ontario in Canada (La Rocque 1968, p. 548).

Remarks.--P. integra seems to be a species adaptable to a variety of environments. Primarily observed in permanent water bodies, it is also known to inhabit small streams (La Rocque 1968, p. 548).

Genus Aplexa Fleming

Diagnosis.--Shell medium-sized; spire elongate; shell shiny; and without sculpture (modified from Clarke 1973, p. 383).

Aplexa hypnorum (Linnaeus)

Plate I, Figure 1

Diagnosis.--Shell up to 25 mm long; about 7 whorls; rounded body whorl, and flatly-rounded spire whorls; columnar axis twisted; spire and aperture of same length (modified from Clarke 1973, p. 383).

Material.--120 specimens, UND Acc. Nos. A2422b, A2422c, A2422d, A2422e, A2422f, A2422h, A2422j.

Hypotype.--UND Cat. No. 140309.

Geographic range.--Hudson Bay Lowlands, New England to James Bay, northwest to Victoria Islands, Bank Island, and Arctic Alaska (Clarke 1973, p. 385).

Remarks.--La Rocque (1968, p. 551) found A. hypnorum preferentially in seasonal woodland ponds. Clarke (1973, p. 385) also suggested this species association primarily with seasonal water bodies. Bottom sediments are substantially of mud, with water movements of moderate currents to stagnant.

Baker (1928, p. 474) frequently found A. hypnorum to inhabit swales and intermittent streams, or stagnant pools. He also reports the occurrence of this species in woodland pools that dry in the summer, commonly associated with S. caperata and G. gyrina.

I have collected A. hypnorum from a woodland alfalfa field in east-central Minnesota. This field was flooded by heavy spring rains for a period of at least three months at the time of collection. The water depth was about 15-cm, and the substrate was muddy.

Family Carychiidae

Diagnosis.--Shell minute; elongate-ovate to cylindrical; closed axis; expanded lip; aperture oblong or ovate (modified from Pilsbry 1948, p. 1051).

Genus Carychium Müller

Diagnosis.--Shell pupilliform; perforate or rimate; prominent lamella expanding within the last whorl (modified from Pilsbry 1948, p. 1051).

Carychium exiguum (Say)

Diagnosis.--Shell about 1.7 mm long; about 4.5 whorls; rimate; nearly smooth, with spire having the last 2 whorls striated; aperture greater than one-third the total length; undulating lamella within the last whorl (modified from Pilsbry 1948, p. 1052).

Material.--1 specimen, UND Acc. No. A2422c.

Hypotype.--UND Cat. No. 140310.

Geographic range.--Holarctic (La Rocque 1970, p. 558).

Remarks.--C. exiguum is found in moist, shady, protected areas along floodplains of rivers and creeks, and along the edges of marshes (La Rocque 1970, p. 558).

Order Eulamellibranchia

Superfamily Sphaeriacea

Family Sphaeridae

Diagnosis.--Shell small to minute; subovate, subrhomboid, or subtriangular; ligament feeble; pallial line simple; cardinal teeth generally single in right valve, double in left; 4 laterals in the right valve, 2 anterior, 2 posterior; 2 laterals in left valve, 1 anterior, 1 posterior (modified from Clarke 1973, p. 130; La Rocque 1967, p. 286).

Genus Pisidium Pfeiffer

Diagnosis.--Shell 2.0-12.0 mm long; ovate; slightly inflated to globose; usually asymmetrical; beak located poster-dorsally; cardinals double in left valve, single in right valve, sometimes united, located directly under beaks; laterals elongate, lamelliform, double in right valve, single in left valve (modified from Clarke 1973, p. 163; La Rocque 1967, p. 315).

Pisidium casertanum (Poli)

Diagnosis.--Shell up to 8.0 mm long; triangular-ovate; beaks posterior of center; length of hinge moderate; cardinals near anterior cusp; C3 slightly curved, enlarging posteriorly; C2 usually an inverted D; C4 somewhat curved, thin, directed towards interior (modified from Clarke 1973, p. 172; Herrington 1962, pp. 33-34).

Material.--111 specimens, UND Acc. Nos. A2422d, A2422e, A2422g, A2422h, A2422i, A2422j, A2422k.

Hypotype.--UND Cat. No. 140311.

Geographic range.--Nearly cosmopolitan; all of North America, north to southern tier of Arctic Islands (Clarke 1973, p. 174).

Remarks.--Burch (1975, p. 37) stated that P. casertanum is adaptable to a wide range of aquatic habitats. Clarke (1973, p. 174) found this species preferentially in habitats with mud substrates, and slow water movement.

Pisidium ventricosum Prime

Diagnosis.--Shell up to about 3.0 mm long; more or less ovate; inflated; very finely to moderately striated; prominent beak, posterior; very short hinge; C3 curved; C2 short, usually straight or just a peg, almost parallel with hinge plate; C4 straight or slightly curved, usually directed slightly downward, parallel downward, parallel with C2 (modified from Clarke 1973, p. 200).

Material.--2 specimens, UND Acc. Nos. A2422b, A2422f.

Hypotype.--UND Cat. No. 140312.

Geographic range.--East to Newfoundland, west to Alberta, north and northwest to Ungava, south to Maine and Washington (Clarke 1973, p. 203).

Remarks.--Clarke (1973, p. 203) collected P. ventricosum from all permanent aquatic environments. The substrate most often mud, and vegetation was always present.

Order Stylommatophera

Suborder Heterurehra

Family Succineidae

Diagnosis.--Shell size variable; up to 4 whorls; thin shelled; imperforate; short spire; large ovate aperture (modified from Pilsbry 1948, pp. 771-772).

Genus Catinella Pease

Diagnosis.--Shell up to about 11.0 mm long; dull; spire and aperture of nearly same length (modified from Burch 1962, p. 6).

Catinella avara (Say)

Diagnosis.--Shell about 15 mm long; strongly impressed sutures; irregularly, coarsely wrinkled surface (modified from Pilsbry 1948, p. 837).

Material.--246 specimens, UND Acc. Nos. A2422b, A2422c, A2422d, A2422e, A2422f, A2422g, A2422h, A2422i.

Hypotype.--UND Cat. No. 140313.

Geographic range.--Newfoundland, James and Hudson Bays; British Columbia, south to Florida and Mexico (Pilsbry 1948, p. 837).

Remarks.--C. avara has been reported from most terrestrial environments. Pilsbry (1948, p. 839) stated that this species is most commonly found on muddy shores, exposed to the sunlight, or on organic litter.

Genus Oxyloma Westerlund

Diagnosis.--Very thin shelled; somewhat flattened whorls; depressed spire; large ovate aperture (modified from Pilsbry 1948, p. 775).

Oxyloma retusa (Lea)

Diagnosis.--Shell about 8.0 mm long; oblong; aperture dilated and drawn back (Pilsbry 1948, p. 786).

Material.--14 specimens; UND Acc. Nos. A2422c, A2422d, A2422i, A2422j.

Hypotype.--UND Cat. No. 140314.

Geographic range.--Midwestern states, south to Iowa, west to Montana (Pilsbry 1948, p. 786).

Remarks.--O. retusa is found on partially submerged grass. This species is found in lakes, rivers, and swampy environments (Pilsbry 1948, p. 788).

Suborder Orthurethra

Family Pupillidae

Diagnosis.--Shell small to minute; elongate; rimate or umbilicate; typically with 5 lamellae (modified from Pilsbry 1948, p. 868).

Genus Gastrocopta Wollaston

Diagnosis.--Shell small; ovate-conic; lip well expanded; angular and parietal lamella bifid (modified from Pilsbry 1948, p. 871).

Gastrocopta pentodon (Say)

Diagnosis.--Shell up to 1.8 mm long; about 5 convex whorls; apex obtuse; lamellae typically 5; angulo-parietal lamella simple (Pilsbry 1948, pp. 886-888).

Material.--2 specimens, UND Acc. Nos. A2422b, A2422c.

Hypotype.--UND Cat. No. 140315.

Geographic range.--Canada, eastern and southern United States (Pilsbry 1948, p. 888).

Remarks.--La Rocque (1970, p. 723) found G. pentodon to inhabit both open and forested regions, living under damp organic debris.

Genus Vertigo Müller

Diagnosis.--Shell small; ovate to ovate-conic; blunt apex; typically 6 lamellae; angular lamella not reaching outer lip (modified from Pilsbry 1948, p. 943).

Vertigo ovata Say

Diagnosis.--Shell up to 2.3 mm long; 5 abruptly expanding whorls; last whorl noticeable larger in diameter; aperture with distinct lip; parietal lamella relatively long; columnellar lamella especially prominent (modified from Pilsbry 1948, p. 953).

Material.--12 specimens, UND Acc. Nos. A2422c, A2422d, A2422f, A2422h, A2422i.

Hypotype.--UND Cat. No. 140316.

Geographic range.--Central and southern Canada, Alaska, all but southwestern United States (La Rocque 1970, p. 738).

Remarks.--V. ovata is adaptable to a wide variety of climatic and environmental conditions. This species is most often found near the margins of aquatic habitats, among organic litter, mosses, grasses, or under logs or bark (La Rocque 1970, p. 738).

Family Zonitidae

Diagnosis.--Shell usually helicoid, but may be discoidal, or conic; umbilicate, rarely imperforate; aperture thin; lip unexpanded (modified from Pilsbry 1946, p. 233).

Genus Zonitoides Lehmann

Diagnosis.--Shell small; depressed; umbilicate; whorls convex, regularly increasing; last whorl rounded; shell slightly to distinctly rounded viewed from apex; aperture rounded to lunate; thin lip; lamellae absent (modified from Pilsbry 1946, p. 474).

Zonitoides arboreus (Say)

Diagnosis.--Shell about 3.0 mm high, about 5 mm in diameter, about 4.5 convex, regularly increasing whorls; umbilicus about one-fourth or one-fifth the diameter; whorls weakly sculptured; irregularly spaced growth lines (modified from Pilsbry 1946, pp. 480-481).

Material.--1 specimens, UND Acc. No. A2422i.

Hypotype.--UND Cat. No. 140317.

Geographic range.--Eastern and southern Canada; all but western United States (Pilsbry 1946, p. 481).

Remarks.--Z. arboreus occurs under trees or shelter of any kind (Pilsbry 1946, p. 482). La Rocque (1970, pp. 652-653) stated that; "this species is able to occupy almost any environment; it is equally at home in dense woods and open plains."

Genus Hawaiia Gude

Diagnosis.--Shell small to minute; openly umbilicate; depressed convex spire; aperture broadly lunate (modified from Pilsbry 1946, p. 418).

Hawaiiia minuscula (Binney)

Plate I, Figure 5, 5b

Diagnosis.--Shell about 1.2 mm high; umbilicus up to two-thirds of diameter; 4 strongly convex, gradually enlarging whorls (modified from Pilsbry 1946, p. 421).

Material.--12 specimens, UND Acc. Nos. A2422b, A2422h.

Hypotype.--UND Cat. No. 140318.

Geographic range.--Eastern and midwestern United States (Pilsbry 1946, p. 421).

Remarks.--H. minuscula often occurs in the floodplains of creeks and rivers (La Rocque 1970, p. 693).

Genus Euconulus Reinhardt

Diagnosis.--Shell very small; conic; closely coiled whorls; aperture crescentic; lip thin; microsculpture of close, regularly, spaced vertical striae (modified from Pilsbry 1946, p. 234).

Euconulus fulvus (Miller)

Plate I, Figure 3

Diagnosis.--Shell about 2.4 mm high; about 5.5 whorls; periphery rounded; apex obtuse; surface glossy; faint spiral microsculpture (modified from Pilsbry 1946, p. 235).

Material.--23 specimens, UND Acc. Nos. A2422b, A2422d, A2422i, A2422j.

Hypotype.--UND Cat. No. 140319.

Geographic range.--Holarctic realm except southern and eastern United States and Gulf region (Pilsbry 1946, p. 236).

Remarks.--E. fulvus is found in damp organic litter, and is common in debris along creeks and rivers (Pilsbry 1946, p. 236).

Suborder Sigmurethra

Family Limacidae

Diagnosis.--Shell reduced to flat plate (modified from Pilsbry 1948, p. 521).

Genus Deroceras Rafinesque

Diagnosis.--Shell ovate; concentrically striated; nucleus offset to the left of middle of posterior margin (modified from La Rocque 1970, p. 664).

Material.--2 specimens, UND Acc. Nos. A24221, A24221.

Hypotype.--UND Cat. No. 140320.

Remarks.--La Rocque (1970, p. 664) stated that as a fossil, Deroceras is indistinguishable from other genera of Limacidae except by size.

Phylum Arthropoda

Subphylum Mandibulata

Class Insecta

Order Coleoptera

Family Carabidae

Diagnosis.--Size variable, up to about 45.0 mm long in North America; elongate to ovate; usually black; pronotum usually rounded, often margined, separated from episterna by suture; 1st sternite divided by 3rd coxae; elytra usually margined, sides curved, surface usually striated, often punctate (modified from Arnett 1971, p. 56).

Genus Elaphrus Fabricius

Diagnosis.--Up to about 11.0 mm long; convex, protruding eyes; head as wide as prothorax; elytral striae absent, elytral sculpture of 3 rows of ocellate fovea, each with setigerous puncture in center, smooth, more or less elevated area between foveae (modified from Lindroth 1961, p. 108).

Elaphrus olivaceus LeConte

Plate II, Figure 2

Diagnosis.--Upper surface greenish, often with bluish or purplish reflection; punctuation finer, denser and more regular than in E. clairvillei; elevation between foveae little pronounced (modified from Lindroth 1961, p. 113).

Material.--5 specimens, UND Acc. Nos. A2422e, A2422f, A2422k, A2422l.

Hypotype.--UND Cat. No. 140321.

Geographic range.--In Canada, east of Rocky Mountains, north to Saskatoon in Saskatchewan, north to Victoria Beach in Manitoba, east to Nova Scotia, southern Northwest Territories; in United States south to New England with remainder of southern limit unknown (Lindroth 1961, p. 113).

Remarks.--E. olivaceus occurs on fine organic muds, or in thin mosses, in exposed sunlight (Lindroth 1961, p. 113).

Genus Loricera Latreille

Diagnosis.--Medium sized; very long, erect seta on segments 2-6 of antennae; prothorax small, narrowed basally; elytra distinctively

with 12 regular striae; few impressed foveae on 4 interval, possibly 7 (modified from Lindroth 1961, p. 121).

Material.--1 specimen, UND Acc. No. A2422c.

Hypotype.--UND Cat. No. 140322.

Remarks.--Only one left elytron of this genus was isolated in this study and identification to species level was impossible as the apex was not present.

Genus Pasimachus Bonelli

Diagnosis.--Large; flat; black; head immense; with large, robust mandibles; prothorax broad, base completely margined; elytra more or less smooth; striae, if present, consist of rows of shallow punctures; no apical or dorsal punctures (modified from Lindroth 1961, p. 130).

Pasimachus elongatus LeConte

Plate II, Figure 4

Diagnosis.--Up to 28.0 mm long; mandibles clearly rugose; side of head in front of eyes regularly rounded; humeral carina of elytra long and sharp (modified from Lindroth 1961, p. 131).

Material.--1 specimen, UND Acc. No. A2422k.

Hypotype: UND Cat. No. 140323.

Geographic range.--On prairie from Canadian border south to Texas (Lindroth 1961, p. 131). This species has been collected alive at the study site.

Remarks.--P. elongatus has been collected consistently in open, dry, sandy prairie with low vegetation (Lindroth 1961, p. 131).

Genus Dyschirius Bonelli

Diagnosis.--Usually less than 7.0 mm long; often metallic; prothorax convex, with rounded side, narrowly constricted base, 2 marginal setae; elytra with 8 striae; usually 1 to 3 dorsal punctures on 3 interval (modified from Lindroth 1961, p. 131).

Dyschirius setosus LeConte

Plate II, Figure 1

Diagnosis.--Up to 3.2 mm long; prothorax usually with several lateral dorsal punctures, lateral margin complete; elytral striae poorly developed, consisting of rows of punctures (modified from Lindroth 1961, p. 157).

Material.--1 specimen, UND Acc. No. A2422k.

Hypotype.--UND Cat. No. 140324.

Geographic range.--Transamerican; south at least to Massachusetts, New York, and Michigan; Washington and Idaho in the West; southern Canadian provinces (Lindroth 1961, p. 157).

Remarks.--D. setosus is often collected on the banks of rivers and brooks, on sandy or clayish, moist soil that is often sparsely vegetated or barren (Lindroth 1961, p. 157).

Genus Bembidion Latreille

Diagnosis.--Up to about 8.5 mm long; slender; more or less well-defined sulcus along inside of each eye; two supra-orbital punctures inside each eye; rudimentary maxillary palpi; shape and micro-sculpture of prothorax highly variable within genus, yet distinctive for species; elytra variable, often spotted; preapical setigerous puncture near apex of elytra (modified from Lindroth 1963, pp. 206-207).

Bembidion canadianum Casey

Diagnosis.--Length to 3.6 mm, black or dark brownish black; prothorax much broader than head, constricted at base, greatest width before middle; elytra oviform; striae of coarse punctures; microsculpture absent on head and prothorax, if present on elytra restricted to apical $\frac{1}{4}$ (modified from Lindroth 1963, p. 399).

Material.--1 specimen, UND Acc. No. A2422c.

Hypotype.--UND Cat. No. 140325.

Geographic range.--Canadian interior; distribution in United States unknown. Lindroth (1963, p. 399) did not report this species from the United States.

Remarks.--Habitat virtually unknown.

Bembidion frontale LeConte

Diagnosis.--Length 2.2-2.6 mm; color brownish black to near black; frontal furrows doubled, reaching far behind eyes; prothorax only slightly wider than head, strongly constricted at base; anterior transverse impression with large, stretched foveate punctures; upper surface without microsculpture (modified from Lindroth 1963, p. 402).

Material.--1 specimen, UND Acc. No. A2422c.

Hypotype.--UND Cat. No. 140326.

Geographic range.--Southern Canada, south to Virginia, west to Iowa and Missouri (Lindroth 1963, p. 402).

Remarks.--B. frontale occurs at the margins of small, standing water bodies. It is most often found on clayish, organic soils, often shaded by dense vegetation (Lindroth 1963, p. 402).

Bembidion nigripes Kirby

Diagnosis.--Length 3.0-4.2; black; similar to B. graphicum but with narrower prothorax and more coarsely punctate elytra; microsculpture strong, isodiametric and more or less granulated on prothorax to meshed on elytra (modified from Lindroth 1963, pp. 369-370).

Material.--2 specimens, UND Acc. Nos. A2422j, A2422i.

Hypotype.--UND Cat. No. 140327.

Geographic range.--Transamerican, primarily northern, ranging to the Arctic Circle in the interior, south to Oregon and Colorado (Lindroth 1963, p. 370); absolute southern distribution unknown.

Remarks.--Lindroth found this species on moist, firm ground, with sparse vegetation consisting primarily of grasses. B. nigripes is found on both the seashore and by the margins of lakes and pools, only occasionally in alkaline situations (Lindroth 1963, p. 371).

Genus Tachys Stephens

Diagnosis.--Up to 3.5 mm long; head exhibits shallow, foveate frontal furrows; rudimentary maxillary palpi; prothorax with transverse sulcus near base; elytra with recurrent striae (modified from Lindroth 1966, p. 409).

Tachys incurvus Say

Diagnosis.--Length 2.0-2.5 mm; head black; prothorax and elytra brownish black; prothorax with sides rounded, straight in basal third; hind angles slightly obtuse; lateral basal carina short and straight; basal transverse impression of sharp and regular punctures; 2 elytral striae suggested (modified from Lindroth 1966, p. 416).

Material.--2 specimens, UND Acc. Nos. A2422f, A2422h.

Hypotype.--UND Cat. No. 140328.

Geographic range.--Transamerican, except for Pacific coast; southern Canada, southern limit in United States unknown (Lindroth 1966, p. 409).

Remarks.--Found on dry sand, possibly mixed with clay. Usually found near water, but higher on the shore, where vegetation is sparse (Lindroth 1966, p. 417).

Genus Patrobus Dejean

Diagnosis.--Up to 14.8 mm long; brownish black or black in color, shiny; head and prothorax devoid of microsculpture; head with constricted neck and transverse impression; prothorax more or less cordate, deep basal fovea, longitudinal carinae inside hind angles; elytra with complete striae; margin of elytra incomplete inside shoulder; 3rd interval with 3-4 punctures (modified from Lindroth 1961, p. 177).

Patrobus stygicus Chaudoir

Plate II, Figure 6

Diagnosis.--Up to 12.0 mm long; slender; prothorax cordate with long, almost parallel-sided constriction at base; elytral microsculpture of transverse meshes, more or less joined into chains (modified from Lindroth 1961, p. 182).

Material.--1 specimen, UND Acc. No. A2422c.

Hypotype.--UND Cat. No. 140329.

Geographic range.--Transamerican; found near Lake Superior in Minnesota (Lindroth 1961, p. 183); remainder of range in United States not reported.

Remarks.--P. stygicus is hygrophilous, and occurs at the border of standing water, and slowly moving rivers; the vegetation is usually high and dense, and the soil is soft, often peaty (Lindroth 1961, p. 183).

Genus Pterostichus Bonelli

Diagnosis.--Size highly variable; stout; prothorax with single or double latero-basal fovea; elytra usually with crossed epipleura (modified from Lindroth 1966, p. 446).

Pterostichus leconteianus Lutshnik

Plate II, Figure 5

Diagnosis.--Length 7.0-8.5 mm; black; elytra iridescent; prothorax with rounded hind angles; latero-basal fovea linear, impunctate; shoulder rounded; microsculpture of elytra extremely dense, consisting of fine transverse lines (modified from Lindroth 1966, p. 502).

Material.--1 specimen, UND Acc. No. A2422k.

Hypotype.--UND Cat. No. 140330.

Geographic range.--Transamerican; restricted to southern provinces, possibly disjunct on the prairie; south to Colorado, with remainder of southern limit not reported (Lindroth 1966, pp. 502-503); P. leconteianus has been collected in North Dakota (Entomology Department collection, North Dakota State University).

Remarks.--Often on sandy soil, P. leconteianus is found in open meadow (Lindroth 1966, p. 503).

Genus Agonum Bonelli

Diagnosis.--Up to 16.0 mm long; upper surface usually dark, fore-body and elytra may contrast; prothorax with more or less shallow and simple latero-basal fovea; margin with 2 setigerous punctures; elytral striae regular; 3 interval with several dorsal punctures, rarely with extra punctures on remaining intervals; epipleura not crossed (modified from Lindroth 1966, p. 555).

Agonum corvus LeConte

Plate II, Figure 7

Diagnosis.--Up to 10.5 mm long; black; prothorax nearly circular, greatest width just behind middle; protruding front angles; hind angles rounded; basal fovea with more or less pronounced internal linear striae; elytra with pointed apex; usually 3 dorsal punctures; elytral microsculpture of irregularly isodiametric or transverse meshes, joined into irregular transverse rows (modified from Lindroth 1966, p. 603).

Material.--1 specimen, UND Acc. No. A24221.

Hypotype.--UND Cat. No. 140331.

Geographic range.--Seemingly restricted to interior of southern Canada; south to Washington (Lindroth 1966, p. 603) and at least into southern North Dakota (Entomology Department collection, North Dakota State University).

Remarks.--A. corvus is found on the prairie at the margin of sloughs. Commonly associated with vegetation such as carices (Lindroth 1966, p. 603).

Agonum cupripenne Say

Diagnosis.--Up to 9.3 mm long; upper surface brilliantly metallic; forebody green, golden, or bluish; elytra cupreous red with green or bluish sides; head small; prothorax with hind angles completely disappeared; sides widening towards base; elytral striae fine, depression at the base of 5; shoulders prominent; microsculpture isodiametric (modified from Lindroth 1966, p. 591).

Material.--2 specimens, UND Acc. No. A2422k.

Hypotype.--UND Cat. No. 140332.

Geographic range.--Transamerican; southern Canadian Provinces; south to North Carolina, Kansas, and Oregon (Lindroth 1966, p. 591).

Remarks.--This species occurs in open country, often on sand and gravel. A. cupripenne is often found near water (Lindroth 1966, p. 591).

Genus Stenolophus Stephens

Diagnosis.--Size variable; basal bead of prothorax thin, developed laterally, or absent; elytra with scutellar striae; strict division of lateral elytral punctures into 2 subgroups of 4+4; microsculpture variable (modified from Lindroth 1968, pp. 903-904).

Stenolophus conjunctus Say

Diagnosis.--Up to 4.3 mm long; head black, prothorax reddish brown, elytra brownish black; front angles of prothorax protruding; widest anterior to middle; basal foveae small, but deep; basal bead very fine, nearly complete; elytral striae fine; shallow subapical sinuation; microsculpture absent or obsolete on head and possible

prothorax, consisting primarily of wide, short meshes on elytra (modified from Lindroth 1968, p. 921).

Material.--1 specimen, UND Acc. No. A2422k.

Hypotype.--UND Cat. No. 140333.

Geographic range.--Transamerican, southern Canadian Provinces, south to California and Florida (Lindroth 1968, pp. 921-922).

Remarks.--S. conjunctus occurs in open, dry habitats with sparse vegetation. Lindroth (1968, p. 922) stated that this species can be found on sage-brush prairie. Common today in central and west-central North Dakota (Entomology Department collection, North Dakota State University).

Genus Chlaenius Bonelli

Diagnosis.--Up to 23.0 mm long; dark, extreme margins of prothorax may be paler; at least prothorax and elytra pubescent; pronotal basal foveae simple, possibly indistinct; prothorax lacks middle lateral, setigerous puncture; elytral striae complete to apex; epipleura crossed apically; 3 interval without dorsal punctures (modified from Lindroth 1969, p. 970).

Chlaenius alternatus Horn

Diagnosis.--Up to 14.0 mm long; upper surface black, or at times faintly bronzed; prothorax lateral reflection widening anteriorly; elytral humeri angulate; all striae interrupted on several points; intervals connected by convexities, giving a corrugated appearance; microsculpture of prothorax and elytra irregularly isodiametric (modified from Lindroth 1969, p. 992).

Material.--2 specimens, UND Acc. Nos. A2422e, A2422k.

Hypotype.--UND Cat. No. 140334.

Geographic range.--Transamerican; all but northernmost Canada, south to Montana and northeastern Washington (Lindroth 1969, p. 993).

Remarks.--C. alternatus has been collected on rather firm soil, near the edges of slow moving rivers (Lindroth 1969, p. 993).

Chlaenius sericeus Forster

Diagnosis.--Up to 16.1 mm long; entire upper surface with brilliant, green, bluish or bronze metallic tinge; margins of prothorax convex, base with setigerous punctures, punctate microsculpture; elytra subopaque (modified from Lindroth 1969, p. 983).

Material.--1 specimen, UND Acc. No. A2422e.

Hypotype.--UND Cat. No. 140335.

Geographic range.--Transamerican; southern portion of southern Canadian Provinces, south to Florida, Texas, and Arizona in the United States (Lindroth 1968, p. 983). C. sericeus has been collected alive at the study site.

Remarks.--C. sericeus is found close to the margins of standing or running water. Often it is associated with moderately moist, firm ground with dense vegetation, possibly carices and grasses (Lindroth 1963, p. 983).

Genus Metabletus Schmidt-Goebel

Diagnosis.--Very small; flat; prothorax cordiform, with greatest width well anterior to middle; sides straight or faintly sinuate in front of the small but usually distinct hind angles; elytra with complete

basal margin; apex oblique with suggested sinuation; elytral sculpture isodiametric (modified from Lindroth 1969, p. 1055).

Metabletus americanus Dejean

Diagnosis.--Length from 2.7-3.5 mm; black; upper surface faintly bronze; elytral striae fine and shallow; microsculpture strong, irregularly isodiametric except on prothorax (from Lindroth 1969, p. 1056).

Material.--1 specimen, UND Acc. No. A2422k.

Hypotype.--UND Cat. No. 140336.

Geographic range.--Transamerican; all except extreme southern Canada; south to Colorado and Arizona in the United States (Lindroth 1969, p. 1056). This species is commonly collected in North Dakota (Entomology Department collection, North Dakota State University).

Remarks.--M. americanus is the only species of this genus in North America; it occurs on sandy, rarely peaty soil with sparse, low vegetation (Lindroth 1969, p. 1056).

Family Dytiscidae

Diagnosis.--Up to 40.0 long; broadly fusiform; color highly variable; head small; prognathous, smooth; 1st sternite divided by metacoxal processes; pronotum broader at base than at head, surface smooth; elytra streamlined, as broad at base as prothorax, widened in middle, narrowed towards apex, striae obscure to prominent (modified from Arnett 1971, pp. 215-216).

Tribe Agabini

Diagnosis.--Linear group of cilia at posterior apical angle of metafemur (modified from Leach 1942).

Material.--4 specimens, UND Acc. Nos. A2422g, A2422k, A2422l.

Hypotype.--UND Cat. No. 140337.

Remarks.--External morphological characters of the Agabini are often very similar; therefore identification beyond tribe is often impossible with only fossil fragments.

Family Hydrophilidae

Diagnosis.--Up to 40 mm long; color highly variable; head prominent, antennae capitate; prothorax broader than head, borders narrowly margined, surface smooth to punctate; elytra broader at base than prothorax, widest near middle, apices acute or subacute; elytral surface smooth, punctate striate or rugose (modified from Arnett 1971, pp. 215-216).

Genus Helophorus Fabricius

Diagnosis.--Size variable; pronotal texture granulated, with 5 longitudinal grooves on upper surface; lateral margin minutely serrate; elytral striae punctate (modified from Hatch 1965, pp. 23-24).

Material.--30 specimens, UND Acc. Nos. A2422c, A2422d, A2422f, A2422g, A2422h, A2422i, A2422j, A2422k, A2422l.

Hypotype.--UND Cat. No. 140338.

Remarks.--In all but one species, the identification of Helophorus fragments beyond genus level is impossible, due to external morphological similarities.

Genus Tropisternus Solier

Diagnosis.--Size variable, normally greater than 10 mm; elongate-ovate to ovate; color variable, shiny; elongate, keeled prosternal

process; prothorax and elytra variable (modified from Gordon and Post 1965, p. 34).

Material.--1 specimen, UND Acc. No. A24221.

Hypotype.--UND Cat. No. 140339.

Remarks.--Species of Tropisternus are too similar to be separated by external morphology, unless the specimen is complete.

Genus Cercyon Leach

Diagnosis.--Small; narrowly ovate to broadly ovate, flat to strongly convex; black to tannish black, commonly with yellow tip on elytra; prothorax variable; elytra variable in color and microsculpture, though usually striated (modified from Blatchley 1910, pp. 265-266; Smetana 1978, pp. 49-50).

Material.--11 specimens, UND Acc. Nos. A2422c, A2422f.

Hypotype.--UND Cat. No. 140340.

Remarks.--Species of Cercyon cannot be distinguished by only elytra. Elytra were the only fragments of this genus isolated from the study sediments.

Family Limnebiidae

Diagnosis.--Length 1.2-1.7 mm; broadly ovate to elongate; black to tan; head prominent, smooth or punctate and rugose; thorax broader than head; lateral borders arcuate or slightly sinuate; surface smooth or punctate, rugose; elytra wider than prothorax; widest near the middle (modified from Arnett 1971, pp. 227-228).

Genus Ochthebius Leach

Diagnosis.--Small; elongate; pronotum narrowed at base, with more or less abrupt, slight sinuation, margin transparent, sculpture of foveae;

elytral striae of punctures variable in size, depth, and position;
lateral margins slightly explanate (modified from Horn 1890, pp. 17-18).

Material.--12 specimens, UND Acc. Nos. A2422e, A2422f, A2422i,
A2422j, A2422k, A2422l.

Hypotype.--UND Cat. No. 140341.

Remarks.--Species of Ochthebius cannot be identified by only
elytra, the only fragments isolated from this genus.

Family Staphylinidae

Diagnosis.--Up to 20.0 mm long; elongate, sides parallel; black,
metallic blue, green tan, reddish, occasionally with white or red spots;
head quadrate or triangular, often restricted behind eyes; pronotum
usually larger than head, variably shaped; borders usually margined;
elytra most often truncate; entire surface smooth or punctate or rugose
(modified from Arnett 1971, pp. 233-234).

Remarks.--External morphological similarities between members of
this family make identification of fossil fragments to species level
impossible. All identifications of members of this family, in this
study, were made courtesy of Dr. Smetana, Agricultural Experiment
Station, Ottawa.

Genus Carpelimus Leach

Diagnosis.--Small; flattened to subcylindrical; head with dis-
tinct neck; transverse pronotum; lateral carina entire; quadrate elytra
(modified from Moore & Legner 1979, p. 220).

Material.--10 specimens, UND Acc. Nos. A2422g, A2422h, A2422i,
A2422j, A2422k, A2422l.

Hypotype.--UND Cat. No. 140342.

Subgenus Anotylus Thomas

Diagnosis.--Length 1.0-6.0 mm, broad to slender, depressed to subcylindrical; anterior margin of head broadly rounded, truncated, or emarginate; pronotum transverse; incomplete carina close to marginal beading; elytral sutural ridge with longitudinal groove present or absent; strong to moderate sculpture (modified from Herman, 1970, p. 415).

Material.--30 specimens, UND Acc. Nos. A2422c, A2422d, A2422e, A2422f, A2422g, A2422h, A2422i, A2422k, A2422l.

Hypotype.--UND Cat. No. 140343.

Genus Stenus Latreille

Diagnosis.--Medium-sized, cylindrical; very coarse sculpture; head narrowed from behind to form neck; prothorax narrowed from behind; entire lateral carina, though possibly obscured by coarse sculpture; elytra quadrate; epipleura not delimited by carina (modified from Moore & Legner 1979, pp. 292-293).

Material.--19 specimens, UND Acc. Nos. A2422e, A2422f, A2422g, A2422h, A2422i, A2422j, A2422k, A2422l.

Hypotype.--UND Cat. No. 140344.

Genus Euaesthetus Gravenhorst

Diagnosis.--Small; robust; head subquadrate; pronotum narrowed from behind; without fovea; lateral carina deflexed to base; elytra quadrate (modified from Moore & Legner 1979, p. 244).

Material.--1 specimen, UND Acc. No. A2422i.

Hypotype.--UND Cat. No. 140345.

Subfamily Xantholininae

Diagnosis.--Variable in size; elongate; usually shiny; distinct neck plate; elytra bileveled and imbricate; epipleura not delimited by carina (modified from Moore & Legner 1979, p. 53).

Material.--2 specimens, UND Acc. Nos. A2422i, A2422k.

Hypotype.--UND Cat. No. 140346.

Genus Philonthus Curtis

Diagnosis.--Variable in size; elongate, parallel to subfusiform; head narrowed to form distinct neck; pronotum quadrate to narrowed in front, series of punctures on each side of midline, or scattered punctures throughout; elytra subquadrate (modified from Moore & Legner 1979, p. 29).

Material.--5 specimens, UND Acc. Nos. A2422c, A2422f, A2422i, A2422l.

Hypotype.--UND Cat. No. 140347.

Subfamily Aleocharinae

Diagnosis.--Variable in size; elongate; 5 segmented tarsi on all legs; antennae 11 segmented; maxillary palpi 5 segmented; labial palpi 4 segmented (modified from Moore & Legner 1979, p. 82).

Material.--5 specimens, UND Acc. Nos. A2422g, A2422h, A2422i, A2422j.

Hypotype.--UND Cat. No. 140348.

Genus Aleochara Gravenhorst

Diagnosis.--Large; pronotum large, convex, two-fifths broader than long; pronotum pubescent (modified from Seevers 1978, p. 135).

Material.--3 specimens, UND Acc. Nos. A2422f, A24221.

Hypotype.--UND Cat. No. 140349.

Family Silphidae

Diagnosis.--Up to 35.0 mm long; moderately elongate, sides parallel to elongate ovate; black, tan, or black with orange or yellow markings; head somewhat elongate, bulging at eyes, deflexed; antennae clubbed; pronotum much larger than head, wide as elytra, ovate, cordate, or quadrate, borders margined, smooth, punctate or rugose (modified from Arnett 1971, pp. 329-330).

Genus Heterosilpha Portevin

Diagnosis.--Large; prothorax black; head with row of prominent erect hair just behind eyes; antennae clubbed; prothorax with well developed pleural lobe, punctuation dense, and simple (modified from Miller and Peck 1979).

Heterosilpha ramosa Say

Diagnosis.--Length 12.0-16.0 mm; black, glabrous; head and prothorax densely punctate; elytra with 3 costae, 3rd costa truncate from behind; elytral intervals reticulate by raised lines joining costae (modified from Hatch 1957, pp. 9-10).

Material.--1 specimen, UND Acc. No. A2422f.

Hypotype.--UND Cat. No. 140350.

Geographic range.--Southern Canada, south to at least Colorado.

Remarks.--Hatch (1957, p. 10) reported that H. ramosa is very common in carrion and decaying organic debris.

Family Leiodidae

Diagnosis.--Up to 6.5 mm long; ovate, convex; tan to brownish black; head flattened, broad; prothorax much wider than head, widening anteriorly and emarginate, surface smooth or striate-punctate (modified from Arnett 1971, pp. 343-544).

Genus Agathidium

Diagnosis.--Small; shape variable; head often widest posterior to eyes; elytra striae less than nine, punctate (modified from Peck, 1980).

Material.--16 specimens, UND Acc. Nos. A2422c, A2422f, A2422h, A2422i, A2422j, A2422k.

Hypotype.--UND Cat. No. 140351.

Remarks.--Only elytra were isolated from sediments of the study section; members of this genus cannot be identified only by elytra, as many are similar.

Family Histeridae

Diagnosis.--Length 0.5-10 mm; circular, cylindrical, ovate, or flattened-ovate; surface smooth, carinate, or with glandular lobes, or raised bosses; prothorax large, variable, usually margined, elytra apically truncated; striae usually present, or costae or tubercles (modified from Arnett 1971, pp. 369-370).

Genus Hister Linnaeus

Diagnosis.--Size variable; rounded to ovate; pronota with two marginal striae; elytra striated, number and length of striae variable (modified from Blatchley 1910, p. 602).

Material.--1 specimen, UND Acc. No. A2422j.

Hypotype.--UND Cat. No. 140352.

Remarks.--Only one elytron was identified from this genus. Morphological similarities of the elytra from members of this genus make species identification impossible.

Family Scarabaeidae

Diagnosis.--May be greater than 100 mm long; convex dorso-ventrally, ovate antero-posteriorly; often brightly colored; head short and broad; antennae clubbed; prothorax usually short and broad, variable (modified from Arnett 1971, pp. 395-396).

Genus Aphodius Illiger

Remarks.--About 4.0-8.0 mm long; elongate-ovate; head usually with tubercles, mandible concealed below clypeus; antennae nine segmented; pronotum without transverse furrows and swellings (modified from Helgesen and Post 1967).

Aphodius concavus Say

Diagnosis.--Up to 7.7 mm long; elongate-ovate, reddish black to black; clypeus rounded; pronotum with coarse punctures at sides; elytral striae wide, deeply punctured (modified from Helgesen and Post 1967).

Material.--1 specimen, UND Acc. No. A2422h.

Hypotype.--UND Cat. No. 140353.

Remarks.--A. concavus is found in association with fecal pellets of burrowing mammals (Helgesen and Post 1967).

Aphodius distinctus Müller

Diagnosis.--Length 5.0 mm; head, prothorax, and scutellum black, elytra yellow-brown, with 5 black spots; pronotum sparsely punctate; elytral striae with close, coarse punctures (modified from Helgesen and Post 1967).

Material.--1 specimen, UND Acc. No. A2422e.

Hypotype.--UND Cat. 140354.

Remarks.--A. distinctus is found in cow, sheep, deer, and buffalo dung (Helgesen and Post 1967).

Genus Rhyssemus Mulsant

Diagnosis.--Small, elongate-ovate; apical metatibial spur shorter than first two tarsal segments; mandibles concealed behind clypeus; prothorax with transverse and medial furrows (modified from Helgesen and Post 1967).

Rhyssemus sonatus LeConte

Diagnosis.--Length 3.7 mm; brownish black; prothorax tuberculate; elytral striae moderately deep, intervals with two rows of irregular tubercles (modified from Helgesen and Post 1967).

Material.--1 specimen, UND Acc. No. A2422b.

Hypotype.--UND Cat. No. 140355.

Remarks.--This species is abundant around animal burrows, especially those of the prairie dog (Helgesen and Post 1967).

Family Helodidae

Diagnosis.--Length 2.0-4.0 mm; ovate, convex; head ovate, punctate; prothorax short, broad; anterior border broadly emarginate; lateral border

nearly straight; posterior border sinuate; elytra surface punctuate; epipleural fold entire (modified from Arnett 1971, p. 445).

Material.--3 specimens, UND Acc. No. A2422e.

Hypotype.--UND Cat. No. 140356.

Remarks.--Similar external morphological characters make identification of members of this family difficult with fossil fragments.

Family Heteroceridae

Diagnosis.--Length 4.0-6.0 mm; brown or black, variegated with undulating bands or spots; finely punctuate, densely pubescent; head triangular; antennae clubbed; prothorax broader than head, subovate; elytra convex with vague striae; shallowly punctuate; moderate epipleural fold (modified from Arnett 1971, p. 465).

Material.--8 specimens, UND Acc. Nos. A2422e, A2422i, A2422j, A2422k.

Hypotype.--UND Cat. No. 140357.

Remarks.--Two taxa of this family were identified on the basis of elytra size and ariation.

Family Limnichidae

Diagnosis.--Length 1.0-2.0 mm; brown to brownish black; finely and densely pubescent; head small; prothorax subquadrate; borders margined; elytra convex, punctuate (modified from Arnett 1971, p. 467).

Material.--2 specimens, UND Acc. No. A2422k.

Hypotype.--UND Cat. No. 140358.

Remarks.--The elytra identified in this study were similar to those of many genera from this family.

Family Elmidae

Diagnosis.--Length 1.0-8.0 mm; elongate; brownish black; prothorax broader than head; irregularly quadrate; borders laterally crenulate; surface rugose, carinate; elytral surface rugose punctuate, carinate (modified from Arnett 1971, p. 474).

Material.--1 specimen, UND Acc. No. A2422k.

Hypotype.--UND Cat. No. 140959.

Remarks.--Generic level identification often cannot be made with only an elytron, due to similarities in size, shape, and sculpture.

Family Elateridae (Leach)

Diagnosis.--Up to 30.0 mm long; elongate; usually dark brown or black; prothorax quadrate, elongate, or ovate; borders usually margined, with acute posterior angles projecting posteriorly; prosternal process elongate, broad; elytra elongate, striated, and usually apically rounded (modified from Arnett 1971, pp. 497-498).

Material.--1 specimen, UND Acc. No. A2422j.

Hypotype.--UND Cat. No. 140360.

Remarks.--With only a fragment of an elytron identified genus level identification was impossible.

Family Tenebrionidae

Diagnosis.--Length 2.0-3.5 mm; often elongate; usually black; head ovate, eyes slash-like, surface smooth to rugose; prothorax wider than head, shape variable, borders usually margined, smooth to rugose; elytra usually striated, intervals may or may not be ridged (modified from Arnett 1971, p. 646).

Genus Helops Fabricius

Diagnosis.--Large; elongate-ovate to short ovate; dark metallic; margins of prothorax feebly sinuate to distinctly undulate; surface often coarsely and deeply punctate; elytra variable, though most often punctate (modified from Blatchley 1910, pp. 1268-1269).

Material.--1 specimen, UND Acc. No. A2422k.

Hypotype.--UND Cat. No. 140361.

Remarks.--Only the head, and part of the prothorax of one individual were identified. Similarities of these parts between members of this genus, made further identification impossible.

Family Anthicidae

Diagnosis.--Small to medium; elongate, cylindrical; head deflexed, strongly constricted; pronotum somewhat elongate ovate, often with horizontally projected horn over head; surface glabrous to punctate; elytra entire, punctate (modified from Arnett 1971, p. 747).

Genus Notoxus Geoffroy

Diagnosis.--Small, about 3.5 mm long; elongate ovate; prothorax with horn extending over head (modified from Blatchley 1910, p. 1334).

Notoxus anchora Henitz

Diagnosis.--Length 3.0-3.5 mm; reddish-yellow; elongate; prothorax ovate, densely and regularly punctate; horn and crest narrow and long, margined and toothed at sides, crest narrowed and slightly

elevated; elytral surface densely and finely punctate; variable, yet distinguishable elytral coloration, consists of dark, transverse posterior patch at about 3/4 of elytral length, and a dark sutural stripe extending to anterior of transverse patch (modified from Blatchley 1910, pp. 1335-1336).

Material.--7 specimens, UND Acc. Nos. A2422d, A2422j, A2422k.

Hypotype.--UND Cat. No. 140362.

Geographic range.--Northwest Territories, south-central Canada, northern United States, south to New York, Iowa, Arizona, North Dakota.

Remarks.--Blatchley (1910, p. 1336) stated that N. anchora is found on foliage near water. I have collected this species by sweeping grasses near a small pond in southeastern North Dakota.

Family Cryptophagidae

Diagnosis.--Size ranging from 1.0-5.0 mm in length; elongate to ovate; tan to brownish black; head moderate in size; punctate; prothorax broader than head, quadrate; margined borders; elytra with punctate striae; indistinct epipleural fold (modified from Arnett 1971, p. 783).

Genus Anchicera

Diagnosis.--Small; subovate, convex; color variable; possibly bicolored elytra; prothorax transverse, rounded or angulated at or before middle; decumbent pubescence (modified from Hatch 1962, p. 218 and p. 221).

Material.--3 specimens, A2422h, A2422i, A2422k.

Hypotype.--UND Cat. No. 140363.

Remarks.--Elytra from members of this genus are too similar for identification to species.

Family Coccinellidae

Diagnosis.--Size variable, up to 10.0 mm long; circular, very convex, usually red or black, with various markings; head quadrate; pronotum broader than head, transverse and short; elytra entire, surface smooth to finely rugose (modified from Arnett 1971, pp. 805-806).

Remarks.--Most identifications were made courtesy of Dr. Gordon, USDA Systematic research laboratory.

Genus Hippodamia Chevrolat

Diagnosis.--Pronotal base not margined with bead (modified from Brown and DeRuelle 1962, p. 648).

Hippodamia tridecimpunctata (Linnaeus)

Diagnosis.--Length 5.2-6.2 mm; black head and prothorax, with anterior and lateral margins of prothorax yellowish white, elytra red-orange with seven black spots (Belicek 1976, p. 342).

Hippodamia tridecimpunctata tibialis Say

Diagnosis.--Elytra with scutellar spot not confluent with spot 3, which is not confluent with suture (Hatch 1962, p. 503).

Material.--2 specimens, UND Acc. Nos. A2422j, A2422k.

Hypotype.--UND Cat. No. 140364.

Geographic range.--Western North America, except Mexico, northern United States, southern Canada (Belicek 1976, p. 342).

Remarks.--H. tridecimpunctata occurs in cultivated fields of alfalfa and in grasslands (Belicek 1976, p. 342). No reference for the subspecies was found.

Genus Hyperaspidius Crotch

Diagnosis.--Length 1.0-4.0 mm; elongate-ovate to oblong; pale yellow to brownish black, elytra with brownish black spots on pale yellow background; elytral suture narrowly beaded (Belicek 1976, p. 308).

Material.--4 specimens, UND Cat. Nos. A2422i, A2422j, A2422k.

Hypotype.--UND Cat. No. 140365.

Family Chrysomelidae

Diagnosis.--Up to 20.0 mm long; elongate-cylindrical to flat and ovate; antennae inserted under eye and base of mandible, filiform; pronotum variable, usually wider than head, quadrate or ovate; elytra usually entire, rounded apically, with striae present or absent; entire surface smooth, punctate or rugose (modified from Arnett 1971, pp. 899-900).

Genus Graphops LeConte

Diagnosis.--Small, cylindrical; color variable, metallic hue; prothorax ovate; elytra convex; pubescent (modified from Blatchley 1910, pp. 1143-1144).

Graphops curtipennis (Melsheimer)

Diagnosis.--Up to 3.5 mm long; oblong, ovate; pronotum about 1/3 wider than long, sides rounded; punctures in transverse line, wrinkling disc; elytra with prominent humeri, finely and densely punctate (modified from Blake 1955, pp. 274-275).

Material.--1 specimen, UND Acc. No. A2422k.

Hypotype.--UND Cat. No. 140368.

Remarks.--No reference of habitat for this species has been found.

Subfamily Donaciinae Fabricius

Diagnosis.--Moderate to large; elongate, cylindrical; color variable, metallic; prothorax not margined, short cylindrical; elytra complete; sculpture variable (modified from Marx 1957, pp. 199-201).

Remarks.--Species of this subfamily cannot be identified as fossils in all but one case.

Genus Donacia Fabricius

Diagnosis.--Elytra with sutural margin straight to apex (modified from Marx 1957, p. 201).

Material.--6 specimens, UND Acc. Nos. A2422d, A2422f, A2422i, A2422j, A2422k.

Hypotype.--UND Cat. No. 140366.

Genus Plateumaris Thomson

Diagnosis.--Sutural margin of elytra curving outwards near apex (modified from Marx 1957, p. 201).

Material.--54 specimens, UND Acc. Nos. A2422c, A2422g, A2422i, A2422j, A2422k, A2422l.

Hypotype.--UND Cat. No. 140367.

Family Curculionidae

Diagnosis.--Up to 35.0 mm long; shape variable, depressed to compressed, cylindrical, subovate; usually brownish black to black; usually scaled; usually robust; head usually globular with elongate

snout; prothorax broader than head, not margined, somewhat cylindrical; elytra entire or nearly so, smooth, costate, or striate (modified from Arnett 1971, pp. 971-972).

Genus Apion Herbst

Diagnosis.--Size variable, but usually small; subovate; often black; beak variable, often elongate; pronotum often with rounded sides, evident apical and basal contractions; elytra variable, narrow with parallel sides to ovate; striae variable (modified from Fall 1898, pp. 106-107).

Material.--13 specimens, A2422c, A2422f, A2422i, A2422j, A2422k, A2422l.

Hypotype.--UND Cat. No. 140369.

Remarks.--Morphological similarities between members of this genus make identification of species impossible from fossil fragments.

Genus Barilepton LeConte

Diagnosis.--Length about 3.0 mm; elongate, slender; thick, convex beak; large, convex head; prothorax variably punctate, most often scaled; elytra usually with fine striae, punctate, scaled (modified from Blatchley and Leng 1916, pp. 414-415).

Material.--70 specimens, UND Acc. Nos. A2422c, A2422d, A2422e, A2422f, A2422g, A2422h, A2422i, A2422j, A2422k, A2422l.

Hypotype.--UND Cat. No. 140370.

Remarks.--Although there are only six species within this genus, similar external morphology prevents identification below genus level.

Genus Perigaster Dietz

Diagnosis.--Length approximately 3.0 mm; robust; beak stout, shorter than prothorax; prothorax strongly narrowed at front; broadly ovate elytra, wider than prothorax (modified from Blatchley and Leng 1916, p. 455).

Material.--1 specimen, UND Acc. No. A2422k.

Hypotype.--UND Cat. No. 140371.

Remarks.--Similar external morphology prevents identification beyond generic level.

PLATE I

Fossil Molluscs from the Stanton Site, North Dakota

Figure¹

1. Aplexa hypnorum, UND Cat. No. 140309, apertural view, x9.3.
2. Stagnicola caperata, UND Cat. No. 140304, apertural view, x16.9.
3. Euconulus fulvus, UND Cat. No. 140319, apertural view, x42.2.
4. Armiger crista, UND Cat. No. 14307, x39.7
 4. apical view.
 - 4b. umbilical view.
5. Hawaiiia miniscula, UND Cat. No. 140318, x36.6.
 5. apical view.
 - 5b. umbilical view.

¹All figures are scanning electron microscope photographs, 15 KV.
All specimens were gold coated.



PLATE II

Fossil Coleoptera from Stanton Site, North Dakota

Figure

1. Dyschirius setosus, UND Cat. No. 140324, right elytron
x35.5.
2. Elaphrus olivaceus, UND Cat. No. 140321, right elytron,
x13.6.
3. Barilepton sp., UND Cat. No. 140370, head, right lateral
view, x72.8.
4. Pasimachus elongatus, UND Cat. No. 140323, right mandible,
x13.6.
5. Pterostichus leconteianus, UND Cat. No. 140330, prothorax,
anterior up, x21.8.
6. Patrobus stygicus, UND Cat. No. 140329, prothorax, anterior
up, x27.3.
7. Agonum corvus, UND Cat. No. 140331, prothorax, anterior up,
x27.3.



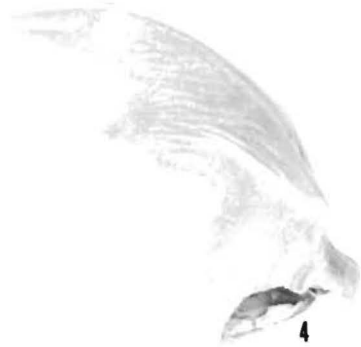
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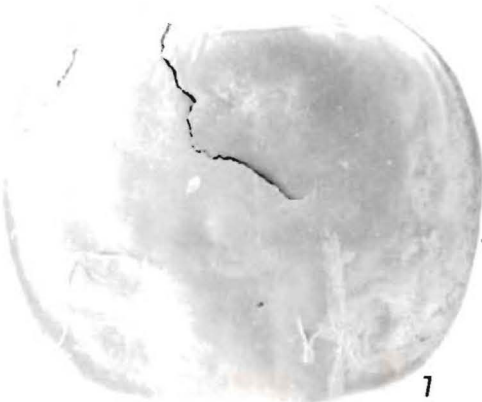
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APPENDICES

APPENDIX A

STRATIGRAPHIC OCCURRENCE OF FOSSILS IN THE MEASURED

SECTION AT THE STANTON SITE, NORTH DAKOTA

STRATIGRAPHIC OCCURRENCE OF FOSSILS IN THE MEASURED
SECTION AT THE STANTON SITE, NORTH DAKOTA

Stratigraphic units are presented in Figure 4, p. 18. The 0-15-cm interval, UND Accession Number A2422a, overlies, and is not contemporaneous with the organic section of the study site. The 15-20-cm interval, UND Accession Number A2422b, was measured separately, thus allowing the remainder of the 119 cm section to be sampled in 10 cm units, UND Accession Numbers A2422c-A2422l.

TABLE 1

STRATIGRAPHIC OCCURRENCE OF THE MOLLUSCAN FAUNA IN THE MEASURED SECTION, STANTON SITE, NORTH DAKOTA

Unit Number	6	6	5	4	4	3	3	3	3	3	2
UND Acc. No. A2422 ¹	b	c	d	e	f	g	h	i	j	k	l
Taxon (aquatic)											
<u>Stagnicola caperata</u> (Say) ²	93	199	61	101	61	28	71	79	78		47
<u>Stagnicola elodes</u> (Say)		10	1								
<u>Stagnicola</u> spp.	344	488	337	84	36	58	24	260	117		221
<u>Gyraulus parvus</u> (Say)	356	190	527	365	209	39	73	127	124		153
<u>Gyraulus</u> spp.			3								
<u>Armiger crista</u> (Linnaeus)	7	10	1	2				1			
<u>Aplexa hypnorum</u> (Linnaeus)	10	43	41	14	8		2			2	
<u>Physa integra</u> Haldeman		1	6					2			2
Physidae	88	160	176	96	36		4	4			
<u>Pisidium casertanum</u> (Poli)			2	2		5	12	77	13		
<u>Pisidium ventricosum</u> Prime	1					1					

TABLE 1--Continued

UND Acc. No. A2422	b	c	d	e	f	g	h	i	j	k	l
<u>Pisidium</u> spp.				4	1	1	1	14	3		4
Taxon (terrestrial)											
<u>Catinella</u> <u>avara</u> (Say)	27	70	47	28	29	11	15	37			
<u>Oxyloma</u> <u>retusa</u> (Lea)		1	3					1	9		
Succineidae		27	3	3					1		
<u>Gastrocopta</u> <u>pentodon</u> (Say)	1	1									
<u>Vertigo</u> <u>ovata</u> Say		2	1		1		3	5			
<u>Hawaiiia</u> <u>miniscula</u> (Binney)	7						5				
<u>Euconulus</u> <u>fulvus</u> (Müller)	13		5					1	4		
<u>Carychium</u> <u>exiguum</u> (Say)		1									
<u>Zonitoides</u> <u>arboreus</u> (Say)								1			
<u>Deroceras</u> spp.								1			1

¹ Sample designated UND Acc. No. A2422b was collected from a depth of 15-20-cm. Subsequent samples were taken at 10-cm intervals to a depth of 119 cm.

² Number of individuals per 1 litre of sediment.

TABLE 2

STRATIGRAPHIC OCCURRENCE OF THE COLEOPTERAN FAUNA IN THE MEASURED SECTION, STANTON SITE, NORTH DAKOTA

Unit Number	6	6	5	4	4	3	3	3	3	3	2
UND Acc. No. A2422	b	c	d	e	f	g	h	i	j	k	l
Taxon											
Carabidae											
<u>Elaphrus olivaceus</u> LeConte ¹											
<u>Loricera</u> sp.				11,	11,					11,2r	11,
<u>Pasimachus elongatus</u> LeConte				11,						1h,	
<u>Dyschirius setosus</u> LeConte											11,lr
<u>Dyschirius</u> sp.											11,lr
<u>Bembidion canadianum</u> Casey											
<u>Bembidion frontale</u> LeConte											,3p
<u>Bembidion</u> cf. <u>B. intermedium</u> Kirby											,1p
<u>Bembidion nigripes</u> Kirby										1h,1p	1h,1p 11,lr
<u>Bembidion</u> cf. <u>B. nigripes</u> Kirby											,2p
<u>Bembidion</u> cf. <u>B. pseudocautum</u> Lindroth											,1p

TABLE 2--Continued

UND Acc. No. A2422	b	c	d	e	f	g	h	i	j	k	l	
<u>Bembidion timidum</u> LeConte or <u>Bembidion versicolor</u> LeConte		,lp										
<u>Bembidion</u> cf. <u>B. timidum</u> LeConte or cf. <u>B. versicolor</u> LeConte									,4p	,2p		
<u>Bembidion</u> sp. 1			11,	11,		,lr	,lr	11,	11,		,2r	
<u>Bembidion</u> sp. 2										11,		
<u>Bembidion</u> sp. 3												
<u>Bembidion</u> sp.4									11,lr	,lr	,lr	11,
<u>Bembidion</u> sp. 5					41,	21,lr		11,lr	11,lr	31,lr	10l,10r	
<u>Bembidion</u> spp.	,lp	,lp			,lr	41,				,lp	11, 6h,lp	3h,
<u>Tachys</u> cf. <u>anceps</u> LeConte			,lp			,lp						
<u>Tachys incurvus</u> (Say)						,lp			,lp			
<u>Tachys</u> spp.											,lp	
<u>Patrobus stygicus</u> Chaudoir			,lp									
<u>Pterostichus leconteianus</u> Lutshnik											,lp	
<u>Agonum corvus</u> LeConte											,lp	

TABLE 2--Continued

UND Acc. No. A2422	b	c	d	e	f	g	h	i	j	k	l	
<u>Agonum cupripenne</u> Say												
<u>Stenolophus conjunctus</u> (Say)										,2r ,1p		
<u>Chlaenius alternatus</u> Horn											,1r	
<u>Chlaenius sericeus</u> Forster											,1r	
<u>Metabletus americanus</u> Dejean												
Genus unidentified		,2p						1h,			,11	
Dytiscidae												
Agabini												
Hydrophilidae												
<u>Helophorus</u> spp.		,9p ,3r	,2p			,5p	,2p	,2p	,2p	1h,1p ,1r	,3p 31,3r	31,3r
<u>Tropisternus</u> cf. <u>T. mixtus</u> (LeConte)												1h, 11,1r
<u>Enochrus</u> or <u>Cymbiodyta</u>												11,1r 11,1r
<u>Cercyon</u> spp.												
Genus unidentified		,2r 2h, 11,3r				91,3r 2h,2p ,1r	1h,1p ,2r	,2p	,1p	3h,2p 11, 21,2r	1h,4p ,1r	11,1r

TABLE 2--Continued

UND Acc. No. A2422	b	c	d	e	f	g	h	i	j	k	l
<u>Limnebiidae</u>											
<u>Octhebius</u>				11,2r	21,2r			11,1r	,2p 21,2r	41,2r	,1r
<u>Staphylinidae</u>											
<u>Carpelimus</u> spp.						,1p	,1p	,1p		1h,3p	
<u>Anotylus</u> spp.	2h,1p			3h,8p	1h,6p	2h,5p	1h,	2h,1p	,1r	,4p	,1r
<u>Stenus</u> spp.		,1r	11,	2h,		1h,	1h,	3h,	2h,	3h,	,1r
<u>Euaesthetus</u> sp.				,1r	41,	21,1r	11,1r	31,1r	,2r	21,1r	,2r
<u>Xantholinae</u>								,1p		1h,	
<u>Philonthus</u> spp.	2h,							,1p			1h,
<u>Aleocharinae</u>						,1r	,1r	,1r	21,2r		
<u>Aleochara</u> spp.						,2p					,1p
Genus unidentified	,1p	1h,	,5p	,4p	2h,3p		,3p	,1p			
	,3r	11,	11,	51,1r	31,		,2r	21,5r	31,4r	21,	11,
<u>Silphidae</u>											
<u>Heterosilpha ramosa</u> Say					11,						
<u>Leiodidae</u>											
<u>Agathidium</u> spp.	,1r			21,			31,3r	31,	21,	11,5r	

TABLE 2--Continued

UND Acc. No. A2422	b	c	d	e	f	g	h	i	j	k	l
Genus unidentified							,1r				
Histeridae											
<u>Hister</u> cf. <u>H. depurator</u> Say									11,		
Scarabaeidae											
<u>Aphodius concavus</u> Say										,1p	
<u>Aphodius distinctus</u> (Müller)				1h,							
<u>Aphodius</u> cf. <u>A. granarius</u> (Linnaeus)											
<u>Aphodius</u> cf. <u>A. leopardus</u> Horn											
<u>Aphodius</u> cf. <u>A. tenellus</u> Say											
<u>Aphodius</u> (Diapterna) sp.											
<u>Aphodius</u> spp.				21,	21,						
<u>Rhyssenus sonatus</u> LeConte				11,		21,		11,			
Helodidae											
Genus unidentified											
Heteroceridae											
Genus unidentified											

TABLE 2--Continued

UND Acc. No. A2422	b	c	d	e	f	g	h	i	j	k	l
Limnichidae											
Genus unidentified											,2r
Elmidae											
Genus unidentified											,1p
Elateridae											
Genus unidentified											,1r
Tenebrionidae											
<u>Helops</u> sp.											1h,1p
Anthicidae											
<u>Notoxus anchora</u> Henitz											,1p ,4p
Genus unidentified											,2p
Genus unidentified											,2p
Cryptophagidae											
<u>Anchicera</u> spp.											,1p
							11,				,1r
											11,1r
Coccinellidae											
<u>Hippodamia</u> cf. <u>H. convergens</u> Guerin											,1p
<u>Hippodamia tridecimpunctata</u> <u>tibialis</u> (Say)											,1p 1h,
<u>Hyperaspidium</u> spp.											,1p
							11,				,1r 21,

TABLE 2--Continued

UND Acc. No. A2422	b	c	d	e	f	g	h	i	j	k	l
Chrysomelidae											
<u>Graphops</u>											
<u>curtipennis</u>											
(Melsheimer)											
Donaciinae											
<u>Donacia</u>											
<u>Plateumaris</u>											
			,lr		1l,			1l,	2l,lr	1l,	
		,lr				,lr		3l,2r	25l,17r	23l,22r	2l,
Curculionidae											
<u>Apion</u> spp.											
<u>Barilepton</u> sp.											
<u>Perigaster</u>											
Genus											
unidentified											
	,2p	,lp		1h,	,3p	,2p	,2p	1h,		,3p	1h,lp
	2l,3r				,lr					,lr	,lr

¹Numbers and types of fragments present in approximately 2.0 k of sediment. 1h,lp
1l,lr would indicate the
identification of one head, one prothorax, one left elytron, and one right elytron for that taxon in a
given interval

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