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NEW HERPETOLOGICAL SPECIES AND RECORDS FROM THE NORDEN BRIDGE FAUNA (MIOCENE: LATE BARSTOVIAN) OF NEBRASKA

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New herpetological species and records from the Late Barstovian Norden Bridge Quarry, Brown County, Nebraska, are reported. New species include a softshell turtle and a watersnake. Forms reported from the fauna for the first time include the boid snake *Geringophis depressus,* the colubrid snakes *Ameiseophis robinsoni, Nebraskophis skinneri, Neonatrix elongata,* and *Salvadora paleolineata,* and an indeterminate viperid snake. The caudal vertebra and humerus of the salamander *Ambystoma minshalli* are described and figured for the first time. Genera of the snakes are archaic and have been previously reported only from Arikareean to Late Barstovian times.

† † †

INTRODUCTION

The Norden Bridge Quarry has been one of the most productive Late Tertiary herpetological sites in North America (Holman and Sullivan, 1981: Table 1, p. 142-143). The present paper reports new herpetological species and records that are mainly the result of collections made by Michigan State University Museum field parties from 1974 through 1979.

The site lies in Brown County, Nebraska, near the Norden-Johnstown Road, about 274 m south of the Norden Bridge across the Niobrara River, at an elevation of 661 m in SE ¼ SW ¼ Sec. 33, T. 33 N., R. 23 W., Brown County, Nebraska. It lies in the lowermost part of the Valentine Formation and represents a heretofore unnamed lithologic unit whose mammalian remains indicate Late Barstovian as well as Clarendonian relationships (Morris F. Skinner, personal communication). The fauna represents Late Barstovian times based on the presence of certain herpetological forms not reported from Clarendonian sites (Holman, 1973b). Future collecting will likely reveal new herpetological material since additional excavations at the Norden Bridge Quarry are underway.

SYSTEMATIC PALEONTOLOGY

Class Amphibia
Order Caudata
Family Ambystomatidae

Genus *Ambystoma* Tschudi, 1838
Ambystoma minshalli Tihen and Chantell, 1963

Material. Six vertebrae (including three trunk vertebrae, one caudal vertebra, and two vertebrae of uncertain position), and one right humerus (Michigan State University Vertebrate Paleontology Number 944).

Remarks. The trunk vertebrae do not differ in any important way from those of the type material described by Tihen and Chantell (1963:509-510). The caudal vertebra and humerus (Fig. 1) of this important species have not heretofore been illustrated and described.

The caudal vertebra has the following noteworthy characteristics. In dorsal view, it is about twice as long as wide. The prezygapophyseal articular surfaces are ovaloid. The centrum extends anteriorly between the prezygapophyseal articular surfaces. The neural spine is poorly developed and is in the form of a very weak keel. The posterior end of the neural

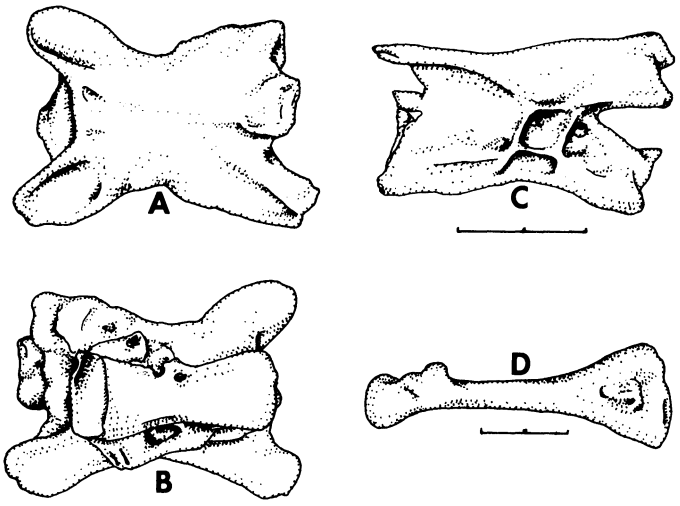

FIGURE 1. *Ambystoma minshalli,* MSUVP 944. **A-C.** Caudal vertebra in dorsal, ventral, and lateral view. **D.** Humerus in lateral view. Projections equal 2 mm; that below C applies equally to A-C. Anterior right in A and B; left in C.

arch is truncated. The right postzygapophysis is missing. The tip of the left postzygapophysis extends posterior to the neural arch.

In lateral view, the rib-bearing processes are broken. The neural arch is almost flat with only a very slight upsweep in its posterior portion. In ventral view, the centrum is elongate, constricted in its middle, and amphicoelous. In posterior view, the top of the neural arch is slightly convex. The round cotyle is larger than the neural canal. In anterior view, the top of the neural arch is slightly convex. The subrounded cotyle is much larger than the neural canal.

Measurements and ratios are as follow: length of centrum 3.6 mm, width of centrum anteriorly 1.1 mm, width through postzygapophyses 3.0 mm, length through zygapophyses 4.8 mm. Ratio of centrum length to anterior centrum width is 3.27.

The humerus has the following important characteristics. In lateral view, the head is ovaloid and depressed. Below the head is an excavated area. The *crista ventralis* is about one and one-half times the length of the width of the head and is sharply produced from the shaft. On the anterior portion of the shaft, just below the *crista ventralis,* is a distinct protuberance. The distal end of the bone is divided into rather indistinct external and internal condyles. The greatest length of the bone is 7.1 mm.

This species was originally described from the Norden Bridge Quarry by Tihen and Chantall (1963) and was listed by Holman (1973b).

Order Anura
Family Bufonidae

Genus *Bufo* Laurenti, 1768
Bufo hibbardi Taylor, 1936

Material. Right ilium, MSUVP 1013.

Remarks. This ilium is assigned to the species *B. hibbardi* on the basis of the height and shape of the dorsal prominence. *Bufo* cf. *hibbardi* was reported from the Norden Bridge Quarry by Estes and Tihen (1964) and *Bufo hibbardi* was reported from the Norden Bridge Quarry by Holman (1973b).

Bufo kuhrei Holman, 1973

Material. Proximal portion of a right tibiofibula, MSUVP 890.

Remarks. Bufo kuhrei was previously known only on the basis of a single large ilium from the Norden Bridge fauna (Holman, 1973b). The tibiofibula from the present collection represents a toad of equal or perhaps even larger size than the one represented by the type. In fact, the tibiofibula is about as large as that of the "giant toad," *Bufo marinus,* from which it differs in being much more anteroposteriorly flattened. The greatest width through proximal end of the fossil is 8.9 mm. This measurement in five modern adult *Bufo marinus* ranges from 8.1 to 9.6 mm with a mean of 9.1 mm.

Class Reptilia
Order Testudines
Family Trionychidae

Genus *Trionyx* Geoffroy, 1809
Trionyx quinni n. sp.

Etymology. The specific name is in memory of James Quinn, native Nebraskan and vertebrate paleontologist.

Holotype. MSUVP 952 (Fig. 2 A and B). A left hypoplastron collected by Alisa Griggs, J. A. Holman, Mark Podell, and Carl Wellstead, July 1976.

Hypodigm. (Figs. 2-5). Type and left hypoplastron, MSUVP 953; left hypoplastron, MSUVP 954; right hypoplastron, MSUVP 955; two fragmentary pieces of a right hyoplastron, MSUVP 956; six fragmentary pieces of pleural bones, MSUVP 957. These bones were collected in 1971, 1974, 1975, and 1976 by Michigan State University Museum field parties.

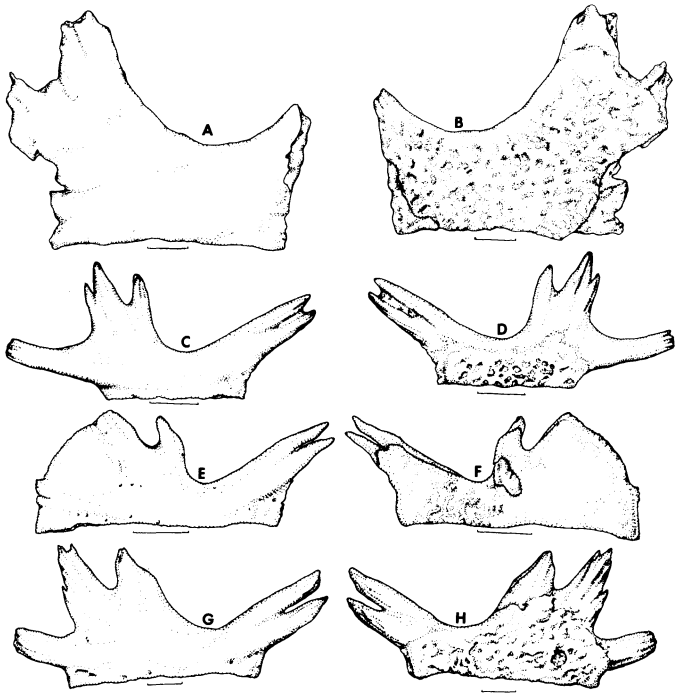

FIGURE 2. A-H. Left hypoplastra of species of *Trionyx*; left-hand figures in dorsal view, right-hand figures in ventral view. **A** and **B**. Holotype of *Trionyx quinni* n. sp., MSUVP 952. **C** and **D**. *Trionyx ferox*. **E** and **F**. *Trionyx muticus*. **G-H**. *Trionyx spinifer*. Projections equal 5 mm. Posterior toward top in all.

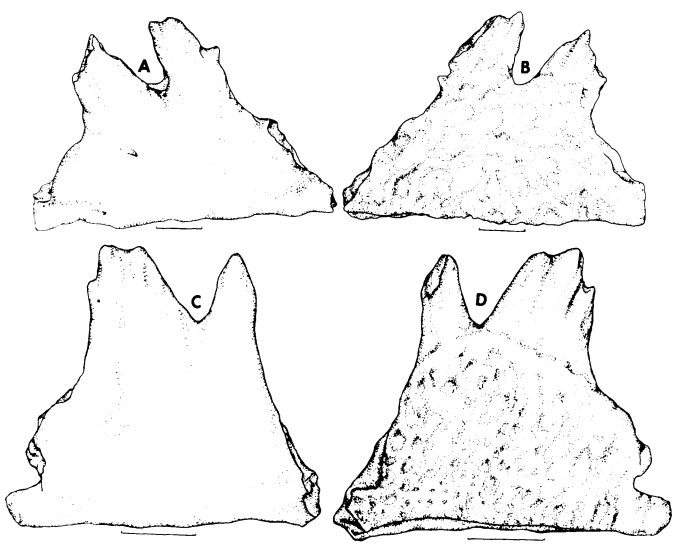

FIGURE 3. A-D. Left hypoplastra of *Trionyx quinni* n. sp; left in dorsal view, right in ventral view. **A** and **B**. MSUVP 953. **C** and **D**. MSUVP 954. Projections equal 10 mm. Posterior toward right in A and C; left in B and D.

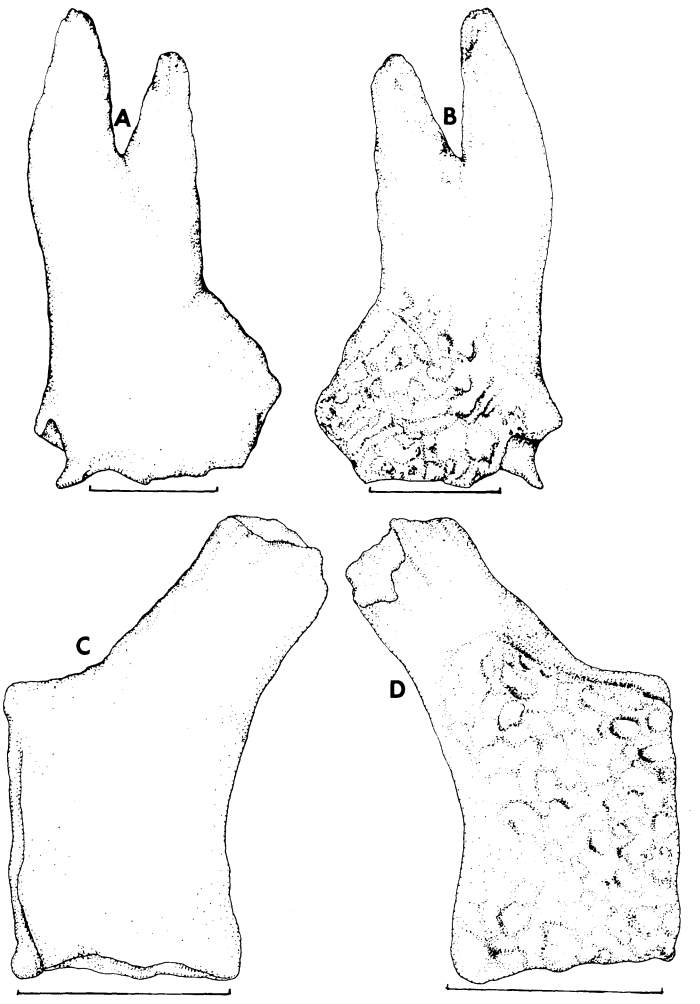

FIGURE 4. **A** and **B**. Piece of left hypoplastron of *Trionyx quinni* n. sp., MSUVP 955. **C** and **D**. Piece of left hyoplastron of *Trionyx quinni* n. sp., MSUVP 956; left in dorsal view, right in ventral view. Projections equal 10 mm. Posterior toward left in A and C; right in B and D.

Locality. Norden Bridge Quarry, Valentine Formation, Brown County, Nebraska.

Diagnosis. Hypoplastron with (1) moderately concave posterior margin; (2) short, wide, striated posteromedial processes; (3) notch between posteromedial processes intersecting sculptured area; (4) sculpturing well developed; and (5) posterolateral processes short and wide.

Description of the Holotype. In ventral view, the bone is heavily sculptured. Its posterior margin is moderately concave. The lateral part of this hypoplastron is broken and thus the posterolateral processes are missing (these processes present in MSUVP 955, Fig. 4 A and B). The tips of the posteromedial processes are broken off, but the shape of the remaining

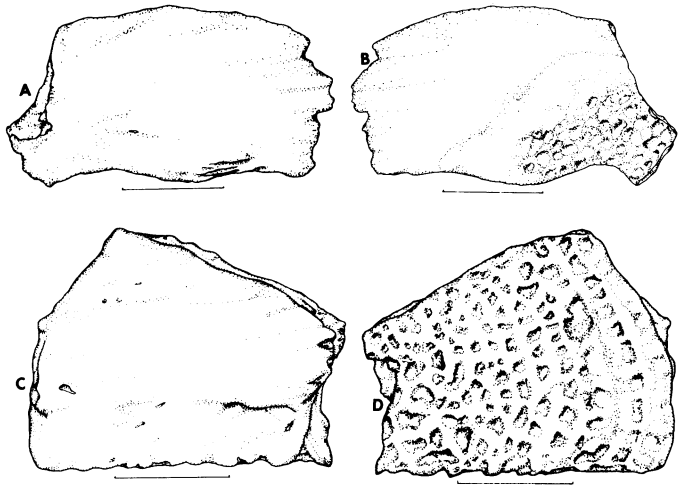

FIGURE 5. **A** and **B**. Piece of right hyoplastron of *Trionyx quinni* n. sp., MSUVP 956. **C** and **D**. Fragmentary right pleural bone of *Trionyx quinni* n. sp.; left in dorsal view, right in ventral view. Projections equal 10 mm. Posterior toward top in A and B; toward bottom in C and D.

parts is short and wide, and the notch between them intersects the sculptured area of the bone. The greatest length of the bone, through the middle of the concavity of the posterior margin, is 12.3 mm.

Discussion. The hypoplastra of the three modern North American species, *Trionyx ferox, T. muticus,* and *T. spinifer* are all separable from one another (Fig. 2 C-H). The hypoplastra of the new species, *T. quinni,* is separable from all of the modern species by more than one character, yet it mainly appears to have a composite of the characters found in the modern forms. It may indeed be that *T. quinni* is near the ancestry of the three modern species.

The posterior margin of the hypoplastron is not as strongly concave as in *T. ferox* and *T. muticus,* but on the other hand it is more concave than in *T. spinifer.*

The posteromedial processes are striated as in *T. ferox* and *T. spinifer,* but these processes are smooth in *T. muticus.*

The posteromedial processes are short and wide as in *T. muticus,* but these processes are much longer in *T. ferox* and *T. spinifer.*

The notch between the posteromedial processes intersects the sculptured area as in *T. muticus* and *T. spinifer,* but this notch does not intersect the sculptured area in *T. ferox.*

The sculpturing is deep as in *T. ferox,* differing from *T. muticus* and *T. spinifer* where this sculpturing is not so deep.

Other elements of the hypodigm (Figs. 2-5) are not particularly diagnostic except that they show rather heavy sculpturing as in modern *T. ferox* rather than the lighter sculpturing of *T. muticus* and *T. spinifer.*

Carapace and pastron fragments of an unidentified species of *Trionyx* were previously reported from the Norden Bridge Quarry by Holman (1973b). These (MSUVP 728) are now tentatively assigned to *T. quinni.*

Order Squamata

Family Scincidae

Genus *Eumeces* Wiegmann, 1834
Eumeces sp.

Material. Left dentary, MSUVP 966.

Remarks. Other material of this genus of lizard was previously reported from the Norden Bridge Quarry by Holman (1976) and by Holman and Sullivan (1981). The material eventually may be shown to represent a new species.

Family Boidae

Genus *Geringophis* Holman, 1976
Geringophis depressus Holman, 1976

Material. One trunk vertebra, MSUVP 893.

Remarks. This is the first record of this very distinctive genus from north-central Nebraska. It has previously been reported from the Early Miocene of Wyoming and western Nebraska and from the Late Miocene of southeastern Nebraska (Holman, 1979). *Geringophis depressus* differs from *G. yatkolae* Holman, 1977, of the Early Miocene Harrison Formation of western Nebraska in having (1) a more depressed neural arch, (2) a less depressed condyle, (3) a broadly U-shaped rather than V-shaped posterior border of the neural arch, (4) a thicker hemal keel, and (5) stronger subcentral ridges. The fossil agrees with *G. depressus* in all of these characters.

This fossil record may be additional evidence for a Late Barstovian rather than a Clarendonian age for the Norden Bridge fauna, as the very distinctive genus *Geringophis* is unreported from Clarendonian localities.

Family Colubridae

Genus *Ameiseophis* Holman, 1976
Ameiseophis cf. *Ameiseophis robinsoni* Holman, 1976

Material. Trunk vertebra, MSUVP 891.

Remarks. This distinctive form has previously been reported only from the Middle Miocene of Wyoming and the Late Miocene of South Dakota (Holman, 1979). The very strong hemal keel and subcentral ridges are striking characters of the genus. The single vertebra is tentatively referred to the previously described species *A. robinsoni.* This record may be another indication that the Norden Bridge fauna is of Late Barstovian age, as *Ameiseophis* has not been reported from Clarendonian localities.

Genus *Nebraskophis* Holman, 1973
Nebraskophis skinneri Holman, 1973

Material. Trunk vertebra, University of Nebraska State Museum Number 61037.

Remarks. This is the first report of this form from the Norden Bridge fauna. The specimen was collected by J. A. Tihen and his field parties in the 1960s. The vertebra shows no difference from the type, which was collected from the Late Barstovian Egelhoff fauna across the Norden Bridge in Keya Paha County, Nebraska (Holman, 1973a). *Nebraskophis skinneri* is known only from the Late Miocene of north-central and southeastern Nebraska (Holman, 1979).

Genus *Neonatrix* Holman, 1973
Neonatrix elongata Holman, 1973

Material. Trunk vertebra, MSUVP 967.

Remarks. This is the first definite record of a species of this genus from the Norden Bridge fauna. This species has elongate vertebra with very small hypapophyses. It has previously been reported only from the Middle Miocene of South Dakota and Texas, and the Late Miocene of Nebraska and Texas (Holman, 1979). It is thought that this is a primitive natricine genus.

Neonatrix magna n. sp.

Etymology. The specific name, Latin, is in reference to the relatively large size of the fossil trunk vertebra.

Holotype. Trunk vertebra, MSUVP 943 (Fig. 6). Collected by Alisa Griggs, J. A. Holman, Mark Podell, and Carl Wellstead in July 1976.

Locality. Norden Bridge Quarry, Valentine Formation, Brown County, Nebraska.

Diagnosis. A *Neonatrix* differing from the only previously known species, *Neonatrix elongata,* in having its trunk vertebra (1) larger, (2) with a shorter vertebral form, (3) with a more vaulted neural arch, (4) with the ventral surface of the hypapophysis bevelled, (5) with the condyle more compressed, and (6) with the subcentral ridges stronger.

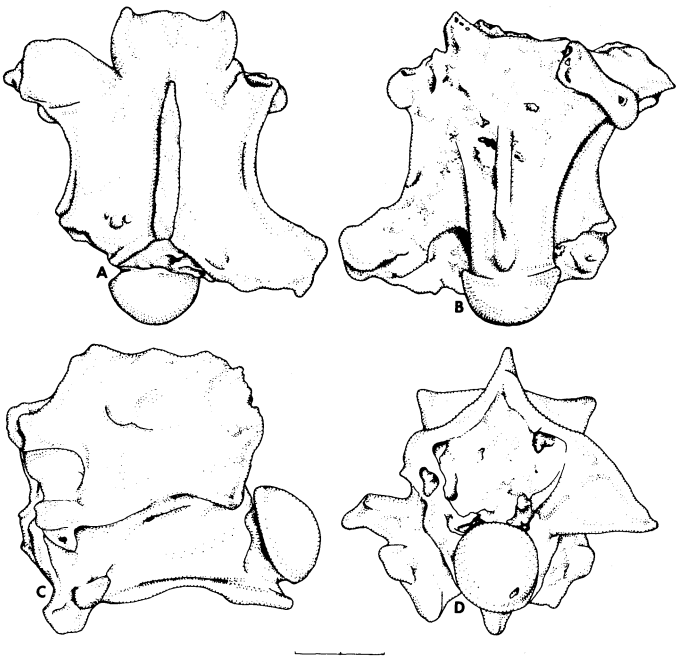

FIGURE 6. Holotype trunk vertebra of *Neonatrix magna* n. sp., MSUVP 943. **A.** Dorsal. **B.** Ventral. **C.** Lateral. **D.** Posterior. Projection between C and D equals 2 mm and applies equally to A-D.

Description of the Holotype. In anterior view, the cotyle has its top broken, but it appears to be round and about the same size as the neural canal which is filled with sandy matrix. The neural canal has its sides slightly convex laterally. The zygosphene is straight dorsally. The prezygapophyses are tilted slightly upward. The excavations on either side of the cotyle are small. Each excavation has a single foramen in its center. Both paradiapophyses are damaged.

In dorsal view, the centrum is about as long as it is wide. The right prezygapophysis is missing; the tip of the left zygapophysis is broken, but appears to have been ovaloid. The anterior edge of the zygosphene is slightly convex. The neural spine is moderately thick and it has a slight posterior overhang. The right diapophysis is broken, the left diapophysis is slightly produced laterally. There is no epizygapophyseal spine.

In posterior view, the neural arch is highly vaulted. The postzygapophyses are tilted slightly downward. The oval condyle is slightly compressed and appears to be about the same size as the neural canal which is filled with matrix. The hypapophysis projects only slightly below the condyle.

In ventral view, the subcentral ridges are strong. The hypapophysis is narrow and ends well anterior to the end of the condyle. The bottom of the hypapophysis is bevelled.

In lateral view, the vertebra has a moderately shortened form. The neural spine is broken, but it appears to have been somewhat longer than high. The strong subcentral ridges are straight. The hypapophysis is very short and wide and has a pointed tip; it ends anterior to the end of the condyle and has its ventral surface bevelled.

The length of the vertebra, through the posterior zygapophysis and the zygosphene, is 5.8 mm.

Remarks. This snake is assigned to the genus *Neonatrix* on the basis of its very poorly developed hypapophysis. It is quite distinct from *Neonatrix elongata,* the only other known species in the genus, in several vertebral characters, and must have had much different habits.

Genus *Salvadora* Baird and Girard, 1853
Salvadora paleolineata Holman, 1973

Material. Trunk vertebrae, MSUVP 892 (2), and MSUVP 968 (1).

Remarks. This species was described from the Egelhoff local fauna in adjacent Keya Paha County, Nebraska, by Holman (1973a), but it has never been reported from the Norden Bridge fauna. The species is rather widely distributed in the Late Tertiary and is known from the Middle Miocene of Wyoming, South Dakota, and Nebraska, and the Late Miocene of South Dakota, Nebraska, and Texas (Holman, 1979).

Family Viperidae

Viperid indet.

Material. Trunk vertebra, MSUVP 889.

Remarks. The vertebra is typically viperid in having the hypapophysis much thicker than in the Elapidae, Hydrophiidae, and Natricinae. This is only the third record of the Viperidae from a Late Barstovian locality; other records being from the Late Barstovian of Texas and of southeastern Nebraska (Holman, 1979).

DISCUSSION

The Norden Bridge Quarry has already yielded a large Late Barstovian herpetofauna (Holman and Sullivan, 1981) and it is remarkable that it continues to yield new species and records. The addition of archaic snake genera *Ameiseophis, Geringophis, Nebraskophis,* and *Neonatrix* tend to confirm a Late Barstovian rather than a Clarendonian age for the Norden Bridge fauna, as none of these genera has been reported from Clarendonian localities. It is hoped that continued collecting at the Norden Bridge Quarry will yield more information about the herpetological life of Nebraska in Late Miocene times.

ACKNOWLEDGMENTS

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