CONTRIBUTIONS FROM THE MUSEUM OF PALEONTOLOGY

THE UNIVERSITY OF MICHIGAN

VOL. 27, NO. 5, p. 129-141 February 1, 1987

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ANN ARBOR

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CLIMATIC SIGNIFICANCE OF A LATE ILLINOIAN HERPETOFAUNA FROM SOUTHWESTERN KANSAS

By

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Abstract.—The Mt. Scott local fauna, Meade County, Kansas, has yielded at least three anurans, eight turtles, one lizard, and 12 snakes, and is one of the largest Illinoian herpetofaunas known. The amphibian and reptile fossils mainly represent animals living in or near a stream and pond environment. A few species lived in nearby woodlands. The herpetofauna is characteristic of the Illinoian rather than the Kansan Biotic Province, and has many eastern extralimital species. In fact, the only place that all of the Mt. Scott amphibians and reptiles can be found living in the same area today, is in extreme northeastern Missouri. The Mt. Scott plant, mollusk, fish, amphibian, reptile, and mammal assemblage indicates that southwestern Kansas had a cooler, moister climate, with more woodland in late Illinoian times.

INTRODUCTION

Large herpetofaunas from the Illinoian stage of the Pleistocene of Kansas were previously known from only two sites in central Kansas: the Sandahl local fauna of McPherson County (Holman, 1971), and the Williams local fauna of Rice County (Holman, 1984). Thus, information on a large snake fauna (this paper) coupled with interpretation of previous identifications of turtles (Preston, 1979) from the late Illinoian Mt. Scott local fauna in southwestern Kansas, provides new insights into the paleoecology and climate of the late Illinoian.

The herpetological fossils of the present report came from two quarrys within the Mt. Scott local fauna. UM-K2-59 was discovered by C. W. Hibbard in summer, 1957. This quarry is located in the SE 1/4 SE 1/4 Sec. 18, T 32 S, R 28 W in Meade County, Kansas. In the summers of 1959 and 1960, 27 tons of matrix was washed from this quarry.

UM-K1-60 was discovered by C. W. Hibbard in summer, 1960. This quarry is located in the SW 1/4 SW 1/4 Sec. 13, T 32 S, R 29 W in Meade County, Kansas. Seven tons of matrix was washed from this quarry in 1960 and 1961. Hibbard (1963) gave a detailed account of the stratigraphy of these quarries.

Previous studies on the Mt. Scott local fauna include: Kapp (1965, 1970) on pollen analysis; Miller (1961,1966) on the molluscan fauna; Lundberg (1975) and G. R. Smith (1963) on fishes; Milstead (1967), Preston and McCoy (1971), and Preston (1979) on turtles; Etheridge (1961) on lizards; and Hibbard (1963, 1970) on mammals.

My study deals with the identification of the large number of fossil snakes of the Mt. Scott local fauna, as well as with the identification of a few additional anuran and lizard remains. Turtles were previously identified from this fauna, but they were not interpreted in detail,

especially with regard to the ranges and habitats of their modern counterparts in Kansas. All of these herpetological records are here assembled and interpreted, and a comparison is made with interpretations gleaned from previous studies of pollen, mollusks, fishes, and mammals of the Mt. Scott local fauna.

ACKNOWLEDGEMENTS

The late C. W. Hibbard generously provided the Mt. Scott herpetological fossils for me to study. Rosemarie Attilio made the figures.

SYSTEMATIC PALEONTOLOGY

The following checklist is succeeded by an annotated list. Numbers are of the University of Michigan Museum of Paleontology Vertebrate Collections (UMMP V). The classification used follows Dowling and Duellman (1978).

Checklist
(* = extinct species)

Anura
- *Bufo* sp.
- ?*Acris* sp.
- *Rana pipiens* complex

Testudines
- *Sternotherus odoratus* (Latreille)
- *Chelydra serpentina* (Linnaeus)
- *Chrysemys picta* (Schneider)
- *Emydoidea blandingii* (Holbrook)
- **Pseudemys hibbardi* (Preston)
- *Pseudemys scripta* (Schoepff)
- *Terrapene carolina* (Linnaeus)
- *Trionyx* sp.

Squamata
- *Ophisaurus attenuatus* Baird
- *Heterodon* sp.
- *Diadophis punctatus* (Linnaeus)
- *Coluber* cf. *C. constrictor* Linnaeus
- *Elaphe vulpina* (Baird and Girard)
- *Lampropeltis getulus* (Linnaeus)
- *Pituophis melanoleucus* (Daudin)
- *Nerodia sipedon* (Linnaeus)
- *Regina grahami* Baird and Girard
- *Storeria* cf. *S. dekayi*
- *Thamnophis proximus* (Say)
- *Thamnophis radix* (Baird and Girard)
- Crotalinae indet.

Annotated List

Class Amphibia
Family Bufonidae
Bufo sp. indet.

Material.—Parts of a skeleton UMMP V60037 (Hibbard, 1963, p. 190).

Remarks.—Hibbard reports (1963, p. 197) that these elements lack specific characteristics. *Bufo cognatus* and *Bufo woodhousei* are found in Meade County, Kansas, (Collins, 1974, maps p. 50 and 55).

Family Hylidae
?*Acris* sp. indet.

Material.—A few limb elements UMMP V60038 (Hibbard, 1963, p. 190).

Remarks.—The species *Acris crepitans* is found in Meade County, Kansas, today (Collins, 1974, map p. 57).

Family Ranidae
Rana pipiens complex Schreber

Material.—Left ilium UMMP V60021 from UM-K2-59.

Remarks.—Holman (1971) discusses characters that distinguish the ilia of the *Rana pipiens* complex from other species of *Rana*. Collins (1974, map p. 77) indicates that *Rana pipiens* occurs in Meade County, Kansas, today, although he realizes that some workers refer these populations to a distinct species, *Rana blairi*. This frog is said to occur in every type of aquatic situation in Kansas today (Collins, 1974, p. 78).

Class Reptilia
Order Testudines
Family Kinosternidae
Sternotherus odoratus (Latreille)

Material.—Nuchal, left hyoplastron, right hyoplastron, left hypoplastron, right xiphiplastron, 27 peripherals, and various fragments UMMP V61842 from UM-K1-60 (Preston, 1974, p. 25).

Remarks.—The nearest this species gets to Meade County, Kansas, today is in Greenwood County in southeastern Kansas (Collins, 1974, map p. 91). This turtle prefers still or slow-moving water of lakes, swamps, sloughs, oxbows, and rivers (Collins, 1974, p. 91).

Family Chelydridae
Chelydra serpentina (Linnaeus)

Material.—Plastral fragments and caudal ossicle UMMP V61841 from UM-K1-60 (Preston, 1974, p. 28).

Remarks.—This turtle is found in Meade County, Kansas, today (Collins, 1974, map p. 87). This species is said to be found in every aquatic situation in Kansas today, but it prefers mud bottoms, pond-edge vegetation, and sunken logs and branches (Collins, 1974, p. 87).

Family Testudinidae
Chrysemys picta (Schneider)

Material.—Nuchal fragments, right epiplastron, carapacial and plastral parts UMMP V61844 from UM-K1-60 (Preston, 1979, p. 37).

Remarks.—This species is found in Meade County, Kansas today (Collins, 1974, map p. 107). This form prefers slow moving quiet water (Collins, 1974, p. 107-108).

Emydoidea blandingii (Holbrook)

Material.—Nuchal and second neural UMMP V57652, specific site number not given, (Preston, and McCoy, 1971, p. 24).

Remarks.—The nearest this species gets to Meade County, Kansas, today is in central Nebraska (Holman, 1984, Fig. 12, p. 35). This turtle is chiefly confined to the Great Lakes Region today; where it usually inhabits vegetation-choked, shallow bodies of water (personal observation).

Pseudemys hibbardi (Preston)

Material.—Left epiplastron and 10th peripheral fragment UMMP V61846 from UM-K1-60, a paratype of this extinct species (Preston, 1979, p. 35).

Remarks.—This extinct form is said to be related to the *Pseudemys floridana-concinna* section of *Pseudemys* (Preston, 1979, p. 34). Turtles of this group are found only in southeastern Kansas today (Collins, 1974, map p. 105). This extinct Illinoian species is known only from the Doby Springs fauna of Harper County, Oklahoma, and the Mt. Scott local fauna (Preston, 1979, p. 35).

Pseudemys scripta (Schoepff)

Material.—Pygal UMMP V65873 from UM-K1-60 (Preston, 1979, p. 35).

Remarks.—This species occurs in Meade County, Kansas, today, and it is a ubiquitous aquatic species (Collins, 1974, map and text p. 110). This turtle prefers quiet water (personal observation).

Terrapene carolina (Linnaeus)

Material.—Associated parts of left hyo and hypoplastron and additional fragments UMMP V43474 from UM-K2-59, and left xiphiplastron, two neurals and peripheral UMMP V61843 from UM-K1-60 (Preston, 1979, p. 29).

Remarks.—The nearest this species gets to Meade County, Kansas, today is an isolated record in Stratford County, in central Kansas (Collins, 1974, map p. 95). This form is said to prefer open woodlands in Kansas today (Collins, 1974, p. 96).

Family Trionychidae
Trionyx sp. indet.

Material.—Shell fragments UMMP V61848 from UM-K1-60 (Preston, 1979, p. 28).

Remarks.—Only the species *Trionyx spinifer* occurs in Meade County, Kansas, today (Collins, 1974, map p. 116). These turtles are found in a wide variety of aquatic habitats in Kansas today (Collins, 1974, p. 116).

Order Squamata
Family Anguidae
Ophisaurus attenuatus (Baird)

Material.—Three body vertebrae UMMP V41238, 43793, and 43902 from UM-K2-59 and one body vertebra UMMP V44373 from UM-K1-60 (all identified by Etheridge, 1961); and six body vertebrae UMMP V60022 from UM-K2-59 and one body vertebra UMMP V60023 from UM-K1-60 identified by J. A. Holman, this paper.

Remarks.—This species represents another form that lives east of Meade County, Kansas, today. *Ophisaurus attenuatus,* at present, reaches its westernmost distribution in central Kansas in Barber and Pratt Counties in the south, and in Ellis County in the north (Collins, 1974, map p. 145). This glass lizard is said to live in open grassland, prairies, and woodland edges, and to be frequently near streams and ponds (Collins, 1974, p. 145-146).

Family Colubridae
Subfamily Xenodontinae
Heterodon sp. indet.

Material.—One fragmentary trunk vertebra UMMP V60024 from UM-K1-60.

Remarks.—This vertebra is easily assigned to the genus *Heterodon* on the basis of its large size, depressed neural arch, and wide, flat hemal keel, but it is too fragmentary to identify to the specific level. Both the plains species, *Heterodon nasicus,* and the eastern species, *Heterodon platyrhinos,* occur in Meade County, Kansas, today (Collins, 1974, maps p. 159 and 163). Both species prefer sandy areas and are especially adapted to feed on toads of the genus *Bufo* (personal observations).

Diadophis punctatus (Linnaeus)

Material.—Two trunk vertebrae UMMP V60025 from UM-K2-59.

Remarks.—Auffenberg (1963, p. 169-170) discusses vertebral characters of *Diadophis punctatus.* The trunk vertebrae of *Diadophis punctatus* have more well-developed neural spines than in the vertebrae of *Tantilla,* and more elongate than in those of *Sonora.* Collins (1974, map p. 157) indicates that this species occurs in Meade County, Kansas, today. This snake is said to inhabit the rocky hillsides of open woodlands in Kansas today (Collins, 1974, p. 157).

Subfamily Colubrinae
Coluber cf. *Coluber constrictor* Linnaeus

Material.—Twelve trunk vertebrae UMMP V60026 from UM-K2-59 and two trunk vertebrae UMMP V60027 from UM-K1-60.

Remarks.—Some authors, including myself (Holman, 1981) have been unable to distinguish vertebrae of *Coluber* and *Masticophis.* But based on the smaller size of the Mt. Scott vertebrae, and the relatively small sizes of the neural canals, I am tentatively assigning these specimens to *Coluber constrictor.* The species occurs in Meade County, Kansas, today (Collins, 1974, map p. 169). This snake occurs in open grassland and prairies in Kansas at present (Collins, 1974, p. 110).

Elaphe vulpina (Baird and Girard)

Material.—Three trunk vertebrae UMMP V60028 (Fig. 1) from UM-K1-60.

Remarks.—Holman (1982) gave an osteological definition of *Elaphe vulpina.* Diagnostic characters of the trunk vertebrae are: neural spine usually longer than high, neural arch vaulted, condyle not enlarged, ventral processes of centrum gracile. Holman (1982, p. 40, table 2) gives the height of the neural spines of the trunk vertebrae of adult *Elaphe vulpina* compared with related colubrid species.

Elaphe vulpina from the Mt. Scott local fauna is quite outside of its present range. Today, the species gets no closer to Meade County, Kansas, than the northwestern part of Missouri and southeastern part of Nebraska. Collins (1974, p. 241) states "It is quite possible that the western fox snake will be found in extreme northeast Kansas." The fox snake has previously been recorded from the Illinoian of Rice County, Kansas (Holman, 1984) and had a much wider distribution in the Pleistocene than it has today (Holman, 1981, map p. 292). The importance of this extralimital species will be discussed later. The fox snake today is a grassland and woodland edge species (personal observation).

Lampropeltis getulus (Linnaeus)

Material.—Two trunk vertebrae UMMP V60029 from UM-K2-59.

Remarks.—Auffenberg (1963, pp. 184-185) discusses osteological variation in *Lampropeltis getulus* vertebrae and gives criteria for the identification of this species. This form occurs in Meade County, Kansas, today (Collins, 1974, map p. 186). This form is said to be generally an inhabitant of moist areas of open woodland, woodland edges, or lowlands; but it has been found in open prairie (Collins, 1974, pp. 186-187).

Pituophis melanoleucus (Daudin)

Material.—Two trunk vertebrae UMMP V60030 from UM-K2-59 trunk vertebrae UMMP V60031 from UM-K1-60.

Remarks.—Vertebral characters of *Pituophis melanoleucus* were given by Auffenberg (1963, pp. 183-184). This snake occurs in Meade County, Kansas, today (Collins, 1974, map p. 182). This form prefers open grassland, woodlands, and woodland edges today (Collins, 1974, p. 182).

Subfamily Natricinae

Nerodia sipedon (Linnaeus)

Material.—Twenty vertebrae UMMP V43849 from UM-K2-59 and 31 vertebrae UMMP V60032 from UM-K1-60.

Remarks.—Brattstrom (1967, p. 189) gives characters that separate the trunk vertebrae of *Nerodia* from *Thamnophis* in many cases. Holman (1967, p. 161) has given vertebral characters that allow one to distinguish *N. sipedon* from related large *Nerodia* species in eastern and central North America. Collins (1974, map p. 227) indicates that *Nerodia sipedon* is found in Meade County, Kansas, today. This snake is found in almost every aquatic situation in Kansas today (Collins, 1974, p. 227).

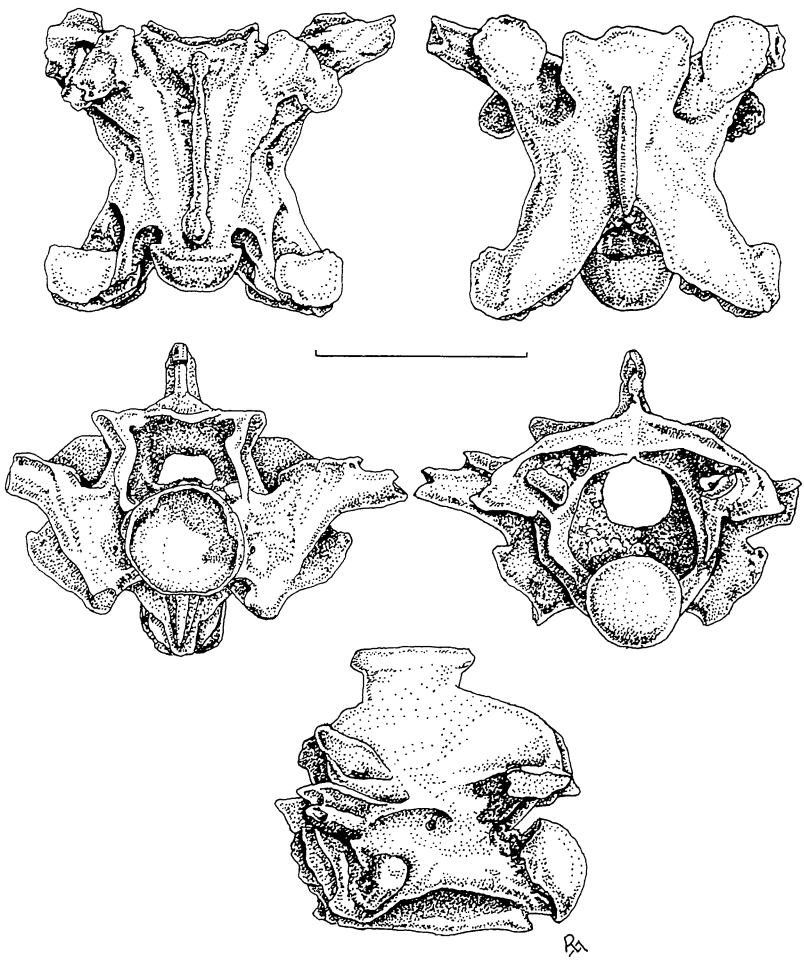

FIG. 1— Trunk vertebra of *Elaphe vulpina* UMMP V60028 from UM-K1-60. Upper left ventral, right dorsal; middle left anterior, right posterior; bottom lateral. The line equals 4 mm. and applies to all figures.

Regina grahami Baird and Girard

Material.—Two trunk vertebrae UMMP V60033 from UM-K2-59 (Fig. 2).

Remarks.—Holman (1972, p. 93) gives a combination of vertebral characters that separates the trunk vertebrae of *Regina grahami* from other North American species of *Regina, Nerodia,* and *Thamnophis.* Today, *Regina grahami* extends westward in Kansas only to Pratt, Stafford, and Barton Counties (Collins, 1974, map p. 219) about 88 km from the northeastern corner of Meade County. This species occurs near ponds and sluggish streams of prairie meadows and river valleys in Kansas today (Collins, 1974, pp. 219-220). This snake is said to subsist almost entirely on crayfish.

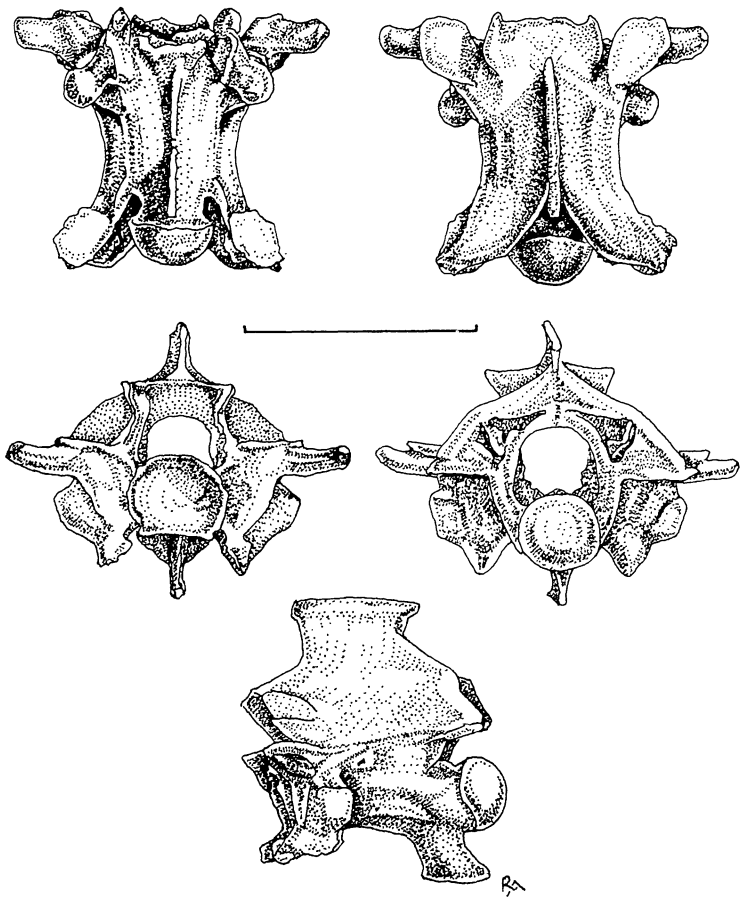

FIG. 2— Trunk vertebra of *Regina grahami* UMMP V60033 from UM-K2-59. Upper left ventral, right dorsal; middle left anterior, right posterior; bottom lateral. The line equals 4 mm. and applies to all figures.

Storeria cf. *Storeria dekayi* (Holbrook)

Material.—Four trunk vertebrae UMMP V60034 from UM-K2-59 and three trunk vertebrae UMMP V60035 from UM-K1-60.

Remarks.—Auffenberg (1963, p. 192) and Holman (1984, p. 29) discuss the identification of individual vertebrae of *Storeria dekayi.* This species has not been recorded from Meade County, Kansas, today, but has been recorded from Clark County, just to the east (Collins, 1974, map p. 215). This snake is said to be uncommon in western Kansas where it ".... ranges just into the High Plains in the north and into the Red Hills in the south" (Collins, 1974, p. 215). Today, this snake generally lives in moist situations in woodland and along woodland edges.

Thamnophis proximus (Say)

Material.—Fifty-five trunk vertebrae UMMP V36291 from UM-K2-59 (Fig. 3).

Remarks.—As pointed out before (Holman, 1984, p. 30) the trunk vertebrae of *Thamnophis proximus* and *T. sirtalis* are longer and more gracile than those of *T. radix* and *T. marcianus.* It now appears that vertebrae of large specimens of *T. proximus* may be rather confidently

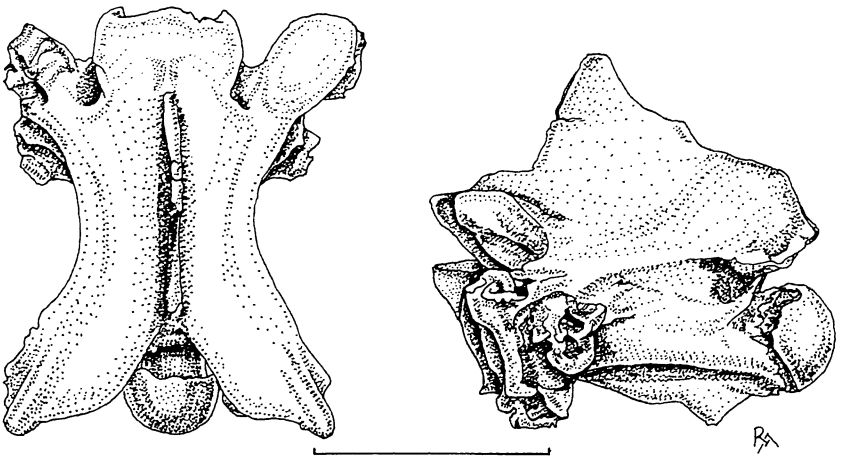

FIG. 3— Trunk vertebra of *Thamnophis proximus* UMMP V36291 from UM-K2-59. Left dorsal, right lateral. The line equals 4 mm. and applies to both figures.

separated from those of large specimens of *T. sirtalis* on the basis of the following characters in *T. proximus* (Figs. 4 and 5): (1) much weaker epizygapophyseal spines, and (2) less undercut anterior borders of neural spines. Based on these characters, all 55 of the elongate, gracile *Thamnophis* vertebrae from the Mt. Scott local fauna are assigned to *T. proximus*. This species occurs in Meade County, Kansas, today (Collins, 1974, map p. 203). This snake lives near the edges of streams, rivers, lakes, marshes, and swamps in Kansas today (Collins, 1974, p. 204).

Thamnophis radix (Baird and Girard)

Material.—One trunk vertebra UMMP V56285 from UM-K1-60 (Fig. 6).

Remarks.—This single vertebra is assigned to *T. radix* based on characters given in Holman (1984, p. 30, and Fig. 9). This garter snake occurs in Meade County, Kansas, today (Collins, 1974, map p. 205). *Thamnophis radix* is said to prefer open grassy prairies, particularly along the edges of streams, marshes, and lakes in Kansas today (Collins, 1974, p. 206).

Family Viperidae
Subfamily Crotalinae
Crotalinae indet.

Material.—vertebra UMMP V60036 from UM-K2-59.

Remarks.—This vertebra represents a crotaline viperid, but the fossil is too fragmentary for even generic determination.

DISCUSSION

The Mt. Scott fauna is one of the largest Illinoian herpetofaunas known, with at least three anurans, eight turtles, one lizard, and 12 snakes presently recorded. The combined pollen, mollusk, fish, and mammalian record (Kapp, 1965, 1970; Miller, 1961, 1966; G. R. Smith, 1963; and Hibbard, 1963) has already provided a picture of ecological and climatic conditions in

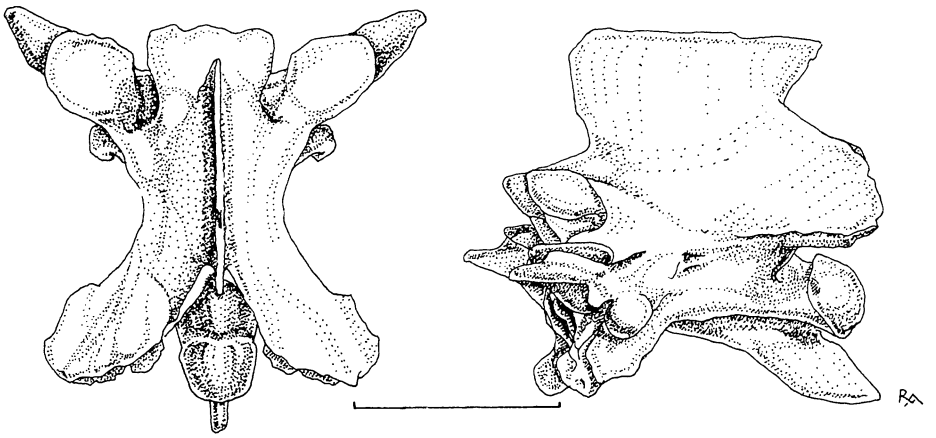

FIG. 4— Trunk vertebra of very large modern *Thamnophis proximus* MSU 3056. Left dorsal, right lateral. The line equals 4 mm. and applies to both figures.

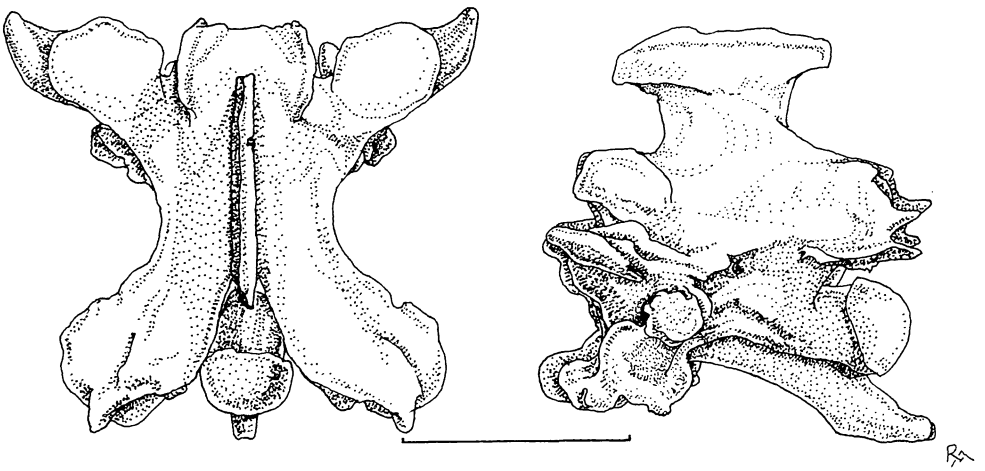

FIG. 5— Trunk vertebra of very large *Thamnophis sirtalis* MSU 3835. Left dorsal, right lateral. The line equals 4 mm. and applies to both figures.

southwestern Kansas in late Illinoian times. Smith (1963) states "In general, it may be said that during the time the Mt. Scott fauna lived, the climate in southwestern Kansas was similar to that of present-day southern Wisconsin, particularly with regard to summer temperature and moisture." This was based on an analysis of the distributional limits of 14 species of fishes from the Mt. Scott local fauna. Smith also suggests that southwestern Kansas was less arid when the Mt. Scott fauna occupied the area, and that a gravel-bottomed, clear stream was present with moderate current and riffles. Additional fishes and mollusks (Miller, 1961, 1966) represent a lacustrine or pond environment; and Hibbard (1963) suggests a stream 20 km. or less in length, fed by springs along its banks, and with impoundments in the valley caused by beaver dams. Hibbard, in turn (1963) considered the winter temperatures to have been like those at present in southern New Jersey, with cool summers as presently found in southeastern Wisconsin and northern New Jersey. Hibbard considered the climate to have been moist subhumid as defined by Thornthwaite (1948) and that the region must have received from 20 to 25 inches of rainfall,

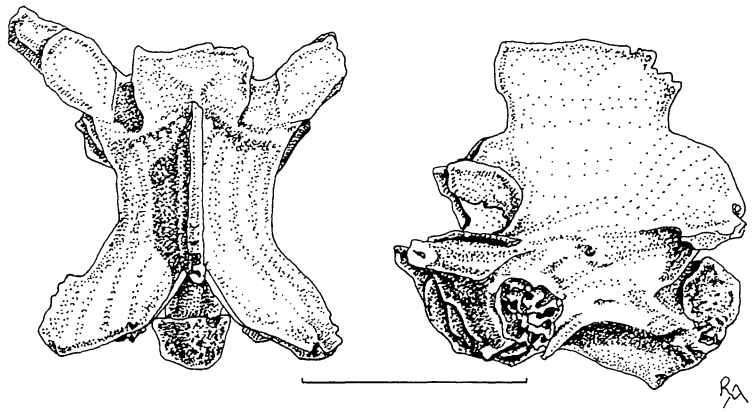

FIG. 6— Trunk vertebra of *Thamnophis radix* UMMP V56285 from UM-K1-60. Left dorsal, right lateral. The line equals 4 mm. and applies to both figures.

which fell in the warmer part of the year. Miller (1961) felt that the climate at the time the mollusks lived was similar to that which now occurs in eastern South Dakota and northeastern Nebraska.

Although all of these interpretations differ a little (obviously because they are based on different groups with different environmental responses) the general picture emerges of (1) a stream-pond environment as the major taphonomic force in the accumulation of the fossil fauna, and (2) a cooler, moister climate, with more woodland than occurs in southwestern Kansas today. The herpetofauna reinforces these general interpretations.

Herpetological species living in or very near the stream-pond environment would be *Rana pipiens* complex, *Sternotherus odoratus, Chelydra serpentina, Chrysemys picta, Emydoidea blandingii, Pseudemys hibbardi, Pseudemys scripta, Trionyx* sp., *Nerodia sipedon,* and *Regina grahami.* All of the turtles in the preceeding list would have been likely inhabitants of the beaver ponds postulated by Hibbard (1963).

Animals of the stream-pond edge would be *Bufo, ?Acris* sp., *Rana pipiens, Ophisaurus attenuatus, Storeria* cf. *S. dekayi,* and *Thamnophis proximus.* The remaining animals could be found in surrounding woodlands and include *Terrapene carolina, Heterodon* sp., *Diadophis punctatus, Coluber* cf. *constrictor, Elaphe vulpina, Lampropeltis getulus, Pituophis melanoleucus, Thamnophis radix,* and Crotalinae indet.

The Mt. Scott herpetofauna is characteristic of the Illinoian rather than the Kansan Biotic Province (Dice, 1943); and in fact, the only place where all of the modern herpetological species may be found living in the same area today is in extreme northeastern Missouri (Fig. 7). This information is based on maps in Collins (1974, already cited) and in Conant (1975, maps 3,7,22,25,26,28,33,26,97,99,110,118,120,128,130,133,139,147,148, and 156). It is interesting to note that the areas designated by Miller (1961), South Dakota and Eastern Nebraska; and Hibbard (1963) and Smith (1963), Southern Wisconsin, are also found in the Illinoian Biotic Province (Kendeigh, 1961, Fig. 20-2, p. 273).

Again, the statement made by Holman (1980) based only on evidence from the Sandahl local fauna (Illinoian, McPherson County, Kansas) that herpetological evidence did not support the classical idea of a cooler, moister climate for the Illinoian age in Kansas, should be modified. The Sandahl fauna had 17 herpetological species, all of which are found in the area today; but the Duck Creek Illinoian fauna (Ellis County, Holman, 1984) and the Williams fauna (Rice County, Holman, 1984) had herpetological species (*Rana sylvatica* - Duck Creek; *Emydoidea blandingii*

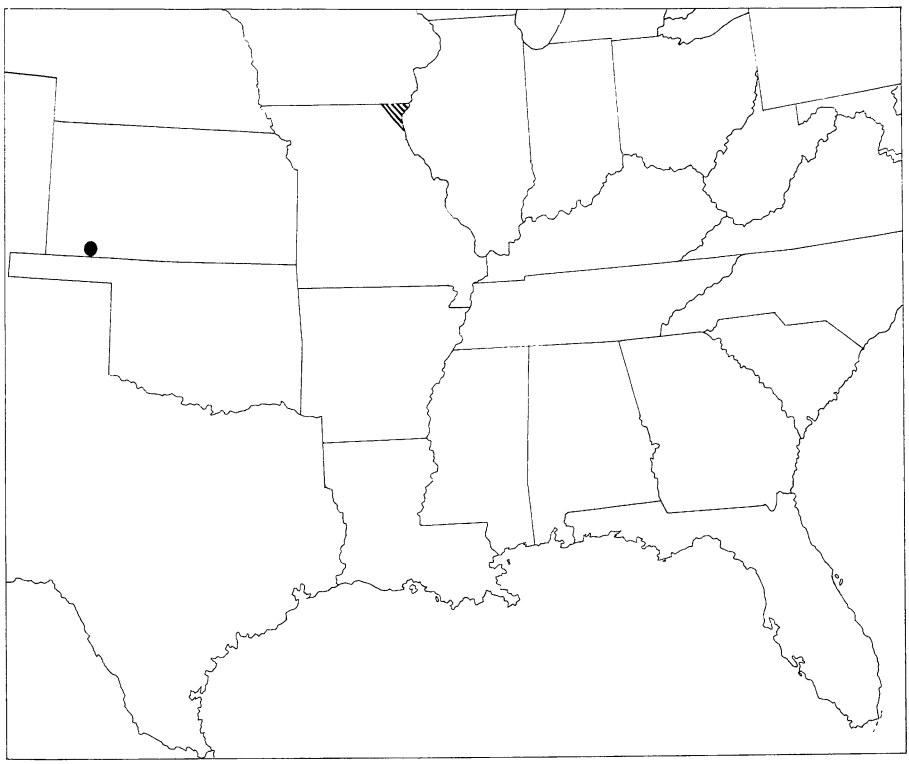

FIG. 7— Map showing location of Mt. Scott local fauna in Meade County, Kansas, (dot); and the only area where all the Mt. Scott fossil herpetofauna could be found living together today, which is in extreme northeastern Missouri (crosshatching).

and *Elaphe vulpina* - Williams) that indicate a somewhat cooler, moister climate, and the presence of more woodland than occurs in these areas today. Certainly, the Mt. Scott assemblage (flora, mollusks, fishes, herpetofauna and mammals), characteristic of the Illinoian rather than the Kansan Biotic Province, would indicate a cooler, moister environment, with more woodland than occurs in southwestern Kansas today.

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