

CONTRIBUTIONS FROM THE MUSEUM OF PALEONTOLOGY
UNIVERSITY OF MICHIGAN

Vol. IX, No. 7, pp. 227-245 (6 pls., 1 fig.)

DECEMBER 31, 1951

VERTEBRATE FOSSILS FROM THE
PLEISTOCENE STUMP ARROYO MEMBER,
MEADE COUNTY, KANSAS

BY
CLAUDE W. HIBBARD



UNIVERSITY OF MICHIGAN PRESS
ANN ARBOR

CONTRIBUTIONS FROM THE MUSEUM OF PALEONTOLOGY

UNIVERSITY OF MICHIGAN MUSEUM OF PALEONTOLOGY

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ARROYO MEMBER, MEADE COUNTY, KANSAS

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INTRODUCTION AND ACKNOWLEDGMENTS

WHILE collecting vertebrate fossils in Meade County, Kansas, in September, 1949, Mr. Don Rosenberry gave the author the lower jaws of *Stegomastodon mirificus* (Leidy), which he and Mr. Vincent Finkeldei had collected July 7, 1949, in the Allen E. Seger gravel pit. This gravel pit is 7 miles west and $4\frac{3}{4}$ miles south of Meade, Kansas. The Seger gravel pit was visited with Mr. Rosenberry to see where the jaws had been found. At that time additional fossils were obtained in a newly excavated part of the pit.

The Seger gravel pit was revisited in the summer of 1950 by a field party from the University of Michigan. The members of the party were James P. Rogers, Frederick T. Sparrow, Dwight W. Taylor, Thomas M. Oelrich, and Claude W. Hibbard. During the summer the investigation of exposed beds was extended to the surrounding country, including Stump Arroyo and its tributaries, between the Seger gravel pit and the Meade County State Park.

This study was aided by the loan of specimens by Dr. G. G. Simpson from the American Museum of Natural History. The University of Michigan field party is greatly indebted to Mr. Dave Leahy, Director of the Kansas Forestry, Fish and Game Commission, and to Mr. Harry Smith, Superintendent of Meade County State Park, for permission to live and work at the park. The author is also indebted to the many citizens of Meade County whose thoughtfulness and co-operation have made possible the detailed study of this region; especially to Mr. Robert A. Seger for permission to work on the Seger ranch; to Mr. J. D. Gollhofer of Plains, Kansas; and Mr. David J. Wilson of Meade, Kansas, for special information in regard to early records and localities. The illustrations of this paper were made possible by financial support from the Faculty Research Fund of the University of Michigan. The drawings were made by Jane S. Mengel.

STRATIGRAPHIC POSITION OF SEGER GRAVEL PIT

The Seger sand and gravel pit is located at the site of the Tom Plotner spring in the SW. $\frac{1}{4}$ SE. $\frac{1}{4}$ sec. 33, T. 32 S., R. 29 W., Meade County, Kansas. The sand and gravel pit is developed in the Stump Arroyo member of the Crooked Creek formation (Hibbard, 1949, p. 71). At the site of the sand and gravel pit the Stump Arroyo member lies unconformably upon the Missler member of the Meade formation.

H. T. U. Smith was the first to study these deposits and report upon them. Smith (1940, p. 108) gave the location of the gravel pit as the NE. $\frac{1}{4}$ sec. 33, T. 32 S., R. 29 W. and assigned the sand and gravel to the "*Equus niobrarensis* beds." Smith assigned the underlying Missler member of the Meade formation at the Seger pit to the Rexroad beds on the basis of the vertebrate fossils which it contained.

These outcrops were later studied by John C. Frye. Frye (1942, Pl. 1) assigned the outcrop of the Meade formation along the banks of Stump Arroyo at the site of the Seger pit, in sec. 33, T. 32 S., R. 29 W., to the Rexroad member of the Ogallala formation, but the sand and gravel of the Seger pit he assigned to the Meade formation.

Meade sand and gravel on a tributary of Stump Arroyo, approximately $1\frac{1}{4}$ miles southwest of the Seger pit in sec. 8, was correctly assigned to the Meade formation by Frye (1942, p. 104, Pl. 11A). Downstream from the Seger pit, however, the same Meade sand and gravel he assigned to the Rexroad member of the Ogallala formation. Frye (1942) followed the description given by Smith for the geographical location of the exposure at the Seger pit. The Tom Plotner spring, which issues at the contact of the Stump Arroyo sand and gravel with the underlying Missler silt and clay, is at the site of the Seger pit and not on the Berghaus property as reported by Frye (p. 52).

No exposures of the Rexroad formation are known to occur in sections 33 and 28, T. 32 S., R. 29 W., along the headwaters of Stump Arroyo. Rexroad beds do crop out, however, downstream from the Seger pit in Stump Arroyo, where the stream has cut through the Meade formation (Plate III, Figs. 1 and 2) and also along the west bank of the stream about halfway between the Seger sand and gravel pit and Meade County State Park.

Along the southwest bank of Stump Arroyo at the Seger pit the Missler member in the upper part of the Meade formation is well exposed. It consists of silts having an abundance of caliche stringers and nodules. On the same side of the valley upstream are good exposures of the massive caliche in the Missler member of the Meade formation (see Pl. IV, Fig. 1). The Stump Arroyo member of the Crooked Creek formation occupies a deep channel in these silts (Pl. IV, Fig. 2; Pl. V, Fig. 1). The basal part is not typical of the sand and gravel observed at the type locality of the member in sec. 21, T. 33 S., R. 28 W., or at the type locality of the Meade formation, sec. 7, T. 32 S., R. 28 W. (Hibbard, 1949). Lenses of cemented gravel and (or) sand occur in the base of the Stump Arroyo member, but at no place were they observed to contain the iron- and manganese-stained pockets so characteristic of the Meade Gravels member of the Meade formation.

The stream which deposited the Stump Arroyo member flowed from the southwest to the northeast at an angle of nearly 90 degrees to the trend of the present stream. In Plate V, Figure 1, is shown

the irregularity of the old stream bed. The man in the foreground is standing on the Missler member and the channel deepens 8 to 12 feet in the foreground. After this channel was cut and filled, the stream spread over its previous banks depositing thick sand and gravel over its flood plain to a considerable depth. No exposure is known in which the Stump Arroyo sand and gravel rests unconformably upon the Rexroad formation. From a study of the Seger pit it is evident that the stream depositing the sand and gravel cut deeply into the Meade formation, if not through it into the underlying Rexroad formation. Large blocks of cemented Meade sand and gravel were observed in the Stump Arroyo member. Plate V, Figure 2, shows a large piece of the iron- and manganese-stained and cemented sand from the Meade Gravels member. It appears that the reworked pebbles in the Stump Arroyo member, considered by Smith as being Ogallala, are derived from the Meade formation and perhaps in part from the Rexroad formation. One large piece of clay, from the underlying Meade or Rexroad formation, was recovered from the sand. The clay contained the toe bone of a small sloth. The toe bone was in place in the piece of clay and had not served as a nucleus around which a clay ball had developed.

North and west of the pit the upper part of the Crooked Creek formation has not been removed by erosion to the level of the Stump Arroyo sand and gravel. In this area the overlying silts and sandy silts are exposed along the rim of the upland surface. They contain considerable calcium carbonate and weather to form prominent benches (Plate VI, Figs. 1-2). The Pearlette Ash member of the Crooked Creek formation has not been observed in this area.

SIGNIFICANCE OF VERTEBRATES FROM SEGER GRAVEL PIT

Plesippus in the past has been considered as an index fossil of Upper Pliocene, Blancan age. *Nannippus* has been considered as having its last appearance in deposits of Blancan age (see Wood, 1941). But *Plesippus* and *Nannippus* persisted well past the deposition of the Rexroad formation as probably did other Upper Pliocene genera and species. The vertical extension of range of such genera that have been used in the past as index fossils has led, and will

continue to lead, to confusion in the correlation of widely separated deposits. It has been suggested (Hibbard, 1944, p. 716) that the remains of *Nannippus* were probably reworked from Pliocene beds into which the Meade gravels were channeled. Further collecting in Clark, Meade, and Seward counties, Kansas, however, has shown that the remains of this horse is far more common in the Meade gravels than in the underlying Rexroad formation (Hibbard and Riggs, 1949, p. 841).

Hibbard (1948, p. 595) discussed the presence of two channel deposits of sand and gravel in the beds called the Meade formation by Frye and Hibbard (1941), and designated the lower deposits the basal Meade sand and gravel and the upper as the Meade second channel phase (later named the Stump Arroyo member). Hibbard (1948, p. 595) stated that "*Plesippus* and *Nannippus* occur in the Rexroad fauna and in the two overlying Meade sands and gravels." This statement was based on the recovery of fossils in the summer of 1945. In the NW.¼ SE.¼ sec. 20, T. 34 S., R. 30 W., just northwest of the farmhouse on the upland, the Meade Gravels member is exposed in the bed of a small canyon. Above this member there are 10 to 20 feet of red sandy silts of the Missler member. Channeled into these silts is the Stump Arroyo member of the Crooked Creek formation, 6 to 10 feet in thickness. This sand and gravel contains numerous red pebbles and white quartz pebbles in contrast to the lower-lying dark Meade Gravels member. In the exposure of the Stump Arroyo sand and gravel were fragments of a mastodon tooth, teeth of *Plesippus*, and a single tooth of *Nannippus*. These specimens are in the collection of the University of Kansas Museum of Natural History.

On August 15, 1945, the University of Kansas field party collected fossils from sand and gravel of a dissected sink on the east side of Crooked Creek which is just east and a little north of the Fred Borchers house. The sink is in sec. 29, T. 33 S., R. 28 W. The south wall of the sink is plainly visible from the road. The base of the sink is not exposed as the walls plunge steeply below Crooked Creek Valley. It was formed by the collapse of the underlying Permian beds in this area which resulted in the dropping of the over-

lying Ogallala beds to form the walls of the sink. There is a thick deposit of Stump Arroyo sand and gravel in the sink from which fossil vertebrates were collected. A part of a lower jaw of *Equus (Plesippus) simplicidens* with four teeth (K.U. No. 7606) and a tooth of *Nannippus* (K.U. No. 7605) were taken near the east edge of the exposure. The sink, after filling with these earlier Pleistocene gravels, collapsed in part a second time and became filled along the northwest edge with late Pleistocene sediments. The late Pleistocene beds were later involved in a further sinking, so that on the northwest edge of the sink the late Pleistocene silt and clay, which contains remains of *Bison*, dips toward the down-plunging Ogallala beds. This area is along the east side of the Crooked Creek fault (see Frye, 1942, p. 24, Fig. 4B).

Three miles south of this locality in the NE.¼ SW.¼ of sec. 8, T. 34 S., R. 28 W., is an exposure of the Pleistocene Stump Arroyo member which rests unconformably upon the Ogallala formation. From this Pleistocene sand and gravel teeth of *Equus (Plesippus) simplicidens* were collected in the summer of 1950. The specimens of *E. (P.) simplicidens* and *Nannippus phlegon* (Hay) taken from the Seger pit, along with the other specimens known from the Stump Arroyo member, seem to establish the fact that these horses lived at the time the Stump Arroyo sand and gravel were deposited.

At the present time it is impossible to separate the Meade Gravels member of the Meade formation from the Stump Arroyo member of the Crooked Creek formation on the basis of vertebrate fossils; although the two members are distinct stratigraphically and lithologically. The overlying Stump Arroyo sand and gravel can not be considered as a deposit which was laid down by a shifting of the stream that deposited the Meade sand and gravel, because distinctive silts, clay and caliche horizons, occur above the Meade sand and gravel; reworked caliche nodules and blocks of consolidated Meade sands are found in the Stump Arroyo sand and gravel. Moreover, the distribution of the two formations is not the same.

Meade (1950, p. 1485) reported the presence of *Gigantocamelus*, *Stegomastodon*, and *Hippotigris* (= *Plesippus*), associated with the remains of the mammoth and *Equus*, at the Holloman gravel-pit de-

posits at Frederick, Oklahoma. Meade considers *Gigantocamelus*, *Stegomastodon*, and *Hippotigris* as short-range genera characteristic of the Blanco (Nebraskan). He considers faunas of Kansan age as being characterized, in part, by the presence of the mammoth and *Equus* and by the absence of the above three genera which he considered characteristic of the Blanco. He therefore concluded that the occurrence of this association at the Holloman gravel pit probably indicates a fauna of Aftonian age.

Harold Cook (1928) made an important contribution to the study of this area, and to much of the High Plains region, when he pointed out that the sand and gravel pit from which *Bison chaneyi* Cook was taken is situated practically on a level with the present water channel of the Red River. He stated, "This simply means that the great erosion which lowered the river channels roughly 280 feet, in southern Oklahoma and northern Texas, occurred between the phase of the Pleistocene represented by the Holloman gravel pit deposits at Frederick and a later Pleistocene phase in which this great bison lived."

The development of the present streams and their terrace systems in southwestern Kansas is post-Crooked Creek formation in age. It appears that the entrenchment of the present streams and the development of their terrace systems began at approximately the same time in the plains country.

On the basis of the fossils recovered and the topographic position of the Holloman gravel pit, the deposits appear to be in part comparable in age to the Stump Arroyo member of the Crooked Creek formation in southwestern Kansas. If the mammoth and *Equus* actually lived in association with *Stegomastodon*, *Plesippus*, and *Gigantocamelus*, the gravel deposit is definitely a post-Meade formation. *Equus* (*sensu stricto*) has not been found in association with *Plesippus* and *Stegomastodon* in southwestern Kansas. *Stegomastodon*, *Plesippus*, and *Nannippus* occur in the base of the Crooked Creek formation and the earliest evidence of *Equus* (*ss*) to date was in the silts just below the Pearlette Ash member of this formation. *Equus* is common in the Crooked Creek beds above the ash. Two large camel astragali, which were collected with the Borchers

fauna (Hibbard, 1941, p. 217), cannot be distinguished from specimens of *Gigantocamelus* recovered from Upper Pliocene deposits of Meade County, Kansas. Size alone does not warrant their assignment to the genus *Gigantocamelus*, since little is known about the Pleistocene camels of North America. Remains of the mammoth have been collected above the Pearlette Ash in the Crooked Creek formation. It therefore appears that the Holloman gravel-pit deposit at Frederick, Oklahoma, is equivalent to part of the Crooked Creek formation.

VERTEBRATES FROM STUMP ARROYO MEMBER

ORDER TESTUDINATA

Family Testudinidae

Testudo sp.

A piece of the carapace (U.M.M.P. No. 26365) from the sacral region of a large land turtle, referable to the genus *Testudo*, was recovered from the Seger sand and gravel pit, September 5, 1949.

ORDER EDENTATA

Megalonyx?

(Pl. I, Figs. 1-2; Fig. 1D)

On September 5th, 1949, an ungual phalange (U.M.M.P. No. 26364) of a small sloth (Fig. 1D) was recovered from a piece of clay found in place in the Seger pit. The clay was reworked from older beds but appears to have been moved only a short distance. The clay is typical of the Rexroad formation in that region. Whether or not it was reworked from the Meade or Rexroad formations is not known. The phalange corresponds in size to that of the sloth reported by Hibbard and Riggs (1949, p. 835, Pl. 5, Fig. 7).

In the summer of 1950, a right astragalus (U.M.M.P. No. 26980; Pl. I, Figs. 1-2) of a sloth was recovered from the Stump Arroyo sand and gravel of the Seger pit. The type of preservation is the same as that of the other specimens to be described from the deposit, but it differs from the ungual recovered from the piece of clay in that it is lighter in color.

The astragalus is slightly smaller than the specimen (No. 8640, American Museum of Natural History) figured by Stock (1925,

Fig. 31, A', B', C', and D') from the Pleistocene Port Kennedy fissure deposit in Pennsylvania. It also differs markedly from the Port Kennedy specimen in the development of the articular facets. If the shape and the articular facets of the astragali of the sloths are as consistent in form as those of the horses and camels, the two specimens represent two distinct genera.

These specimens have been referred questionably to the genus *Megalonyx*. Generic and specific identification cannot be made until better material is known from Upper Pliocene and early Pleistocene deposits of North America.

ORDER PROBOSCIDEA

Family Gomphotheriidae

Stegomastodon mirificus (Leidy)

(Pl. I, Figs. 3-4; Pl. II)

Mastodon mirificus Leidy, 1858, *Proc. Acad. Nat. Sci. Phila.*, Vol. 10, p. 10.

Stegomastodon mirificus (Leidy) Pohlig, 1912, *Bull. Soc. belg. Geol.*, Vol. 26, pp. 187-93.

The lower jaws (U.M.M.P. No. 26363) recovered by Rosenberry and Finkeldei were complete and intact at the time of discovery, but were broken in removal from the quarry. The jaws are those of an old adult. If the reduced anterior part of M_3 is considered as a ridge crest, the tooth possessed $7\frac{1}{2}$ ridge crests. If the anterior part of the tooth is considered as part of the cingulum, the tooth consists of $6\frac{1}{2}$ ridge crests (see Pl. I, Fig. 3). The anteroposterior length of the LM_3 is 237.0 mm. The greatest transverse width of the tooth is 86.0 mm. across the third ridge crest (loph). Cement is present on the sides of the teeth and in the external and internal enamel valleys between the lophs. The distance from the anterior edge of the mental foramen to the anterior tip of the jaw is 198.0 mm.

The specimen does not seem distinguishable from those of *Stegomastodon* recovered from the Meade gravels. The lower molars of *S. mirificus* are more rectangular in appearance than those of *Stegomastodon successor* (Cope) from the Rexroad formation of Meade County. The lower third molars of *Stegomastodon successor* recovered from the Rexroad deposits consist of an anterior cingulum

and $5\frac{1}{2}$ ridge crests, and the teeth have an appearance of an elongated triangle in comparison to the rectangular appearance of the M_3 of *S. mirificus*.

ORDER PERISSODACTYLA

Family Equidae

Nannippus phlegon (Hay)

(Fig. 1A)

Equus minutus Cope, 1893, 4th Ann. Rept. Texas Geol. Surv., p. 67.

Equus phlegon Hay, 1899, Amer. Geol., Vol. 24, p. 345.

Hipparion cragini Hay, 1917, Kans. Univ. Sci. Bull., Vol. 18, No. 2, p. 42.

Nannippus phlegon Matthew, 1926, Quart. Review Biol., Vol. 1, No. 2, p. 165.

A distal end of a metapodial (U.M.M.P. No. 26979) of this small horse was recovered from the Seger gravel pit. The type of preservation is the same as that of the *Stegomastodon* jaws and the maxillaries of *Plesippus*. The specimen shows no signs of abrasion or evidence of having been reworked from an older deposit. It appears that this little horse lived at the time the sand and gravel were deposited at the Seger pit.

Equus (Plesippus) cf. simplicidens Cope

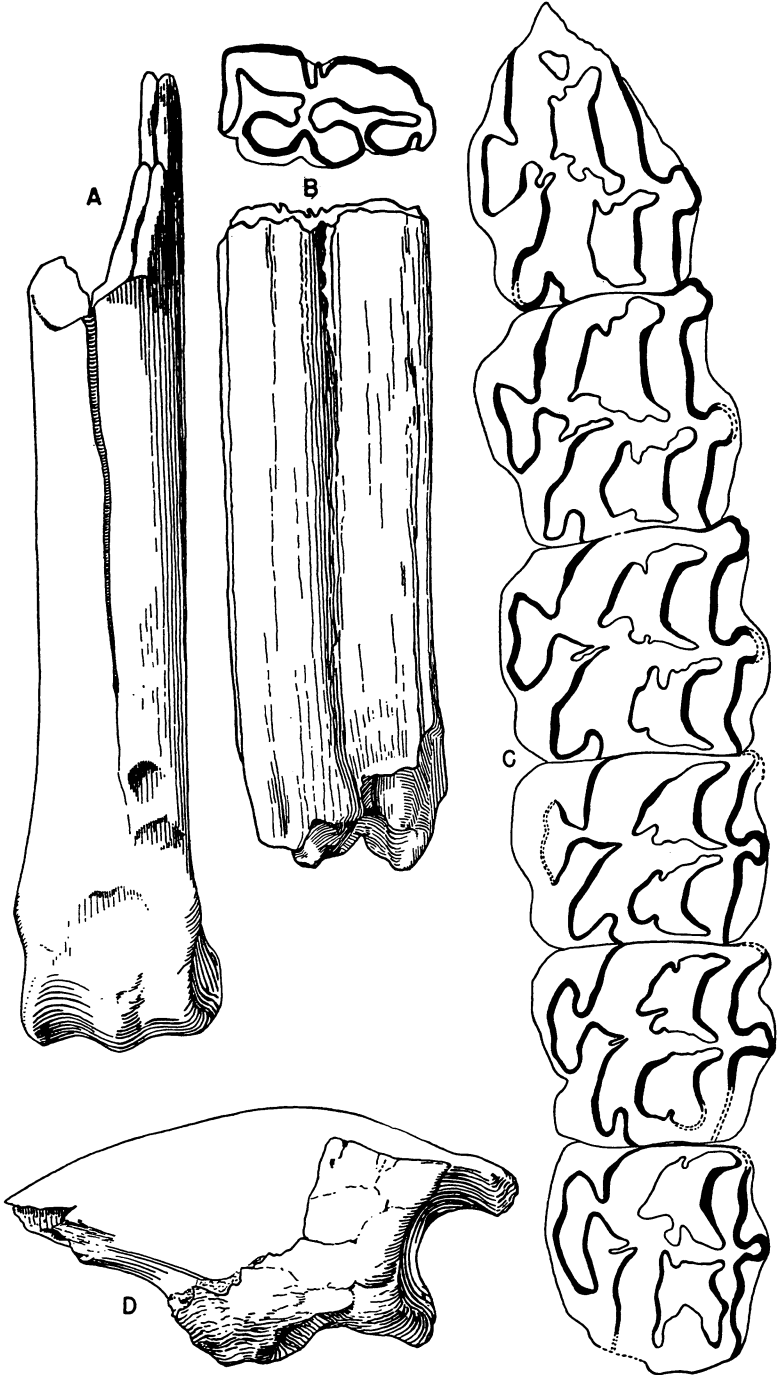
(Fig. 1B-C)

Equus simplicidens Cope, 1892, Proc. Amer. Philos. Soc., Vol. 30, p. 124.

Plesippus simplicidens (Cope) Matthew, 1924, Am. Mus. Novitates, No. 131, p. 2.

The right and left maxillaries (U.M.M.P. No. 26367) of an adult horse bearing LP^2-M^3 and RP^2-M^2 were recovered from the sandy wall of the Seger pit, September 5, 1949. The specimen is referred to *Equus (Plesippus) simplicidens* Cope, though the inner side of the prefossettes and postfossettes of the premolars are more flattened than in the specimen figured by Matthew (1926, p. 162, Fig. 19) of *Plesippus simplicidens* (Cope) from Mount Blanco, Texas. The above difference may be due chiefly to the difference in age of the two specimens. The pli caballin fold is well developed on the premolars (see Fig. 1C), absent on M^1 and weakly developed on M^2 and M^3 . Its absence from M^1 may be due to age; if originally present it was weakly developed as in the other molars. The proto-

FIG. 1. Vertebrate remains from the Stump Arroyo member of the Crooked Creek formation. All $\times 1$. Drawings by Jane S. Mengel. A. *Nannippus phlegon* (Hay). U.M.M.P. No. 26979. Distal end of metapodial. B. *Equus (Plesippus) simplicidens* Cope. U.M.M.P. No. 26982. Right lower premolar or molar. C. *Equus (Plesippus) simplicidens* Cope. U.M.M.P. No. 26367. Left P^2-M^3 . D. *Megalonyx?* U.M.M.P. No. 26364. Ungual phalange of small sloth.



cone is small and shows a slight anterior development which is not as great as in *E. (Plesippus) idahoensis* (Merriam), as figured by Schultz (1936, p. 4, Fig. 1g).

The anterior part of the maxillary is missing but the antero-inner face of P² is flattened as though P¹ had been present. The anterior palatine foramina end posteriorly, opposite the posterior edge of the protocone of M².

TABLE I

MEASUREMENTS (IN MILLIMETERS) OF *Equus (P.) simplicidens*
U.M.M.P. No. 26367

Dimension	LP ²	LP ³	LP ⁴	LM ¹	LM ²	LM ³
Anteroposterior length ..	41.2	30.0	28.0	23.0	26.1	29.1
Transverse width	29.5	32.4	32.3	30.0	27.9	26.5
Anteroposterior length of protocone	8.0	12.1	11.8	10.1	11.6	13.8
Height of crown	38.8	45.5	54.0	39.9	48.5	52.5

A lower and three upper molars of this horse (U.M.M.P. No. 26982) were recovered July 14, 1950, from the Stump Arroyo sand and gravel in the NE.¼ SW.¼ sec. 8, T. 34 S., R. 28 W., on the Isaac Ross Ranch. This locality is approximately 8 miles southeast of the Seger pit and approximately 4½ miles south and ½ mile west of the type section of the Crooked Creek formation. The teeth are those of young adult horses. A narrow V-shaped groove is present between the metaconid and metastylid of the lower molar (Fig. 1B).

The subgenus *Plesippus* Matthew is here used for the North American zebras instead of the subgenus *Hippotigris* Hamilton Smith (which includes one group of living zebras) as suggested by McGrew, 1944. A large number of zebra-like forms lived in North America and, until these forms are better known, it will probably cause less confusion to use *Plesippus* for them, since there are at least three recognized genera or subgenera of living zebras, *Dolichohippus* Heller, *Quagga* Shortridge and *Hippotigris*, to which the fossil forms could be assigned.

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Submitted for publication January 30, 1951

EXPLANATION OF PLATE I

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Figs. 3-4. U.M.M.P. No. 26363. Left ramus: (3) Occlusal view of LM ₃ ; (4) lateral view.	

PLATE I

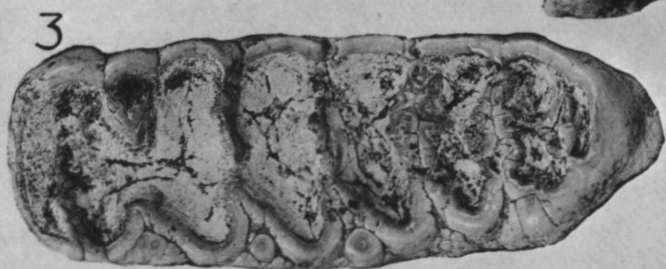
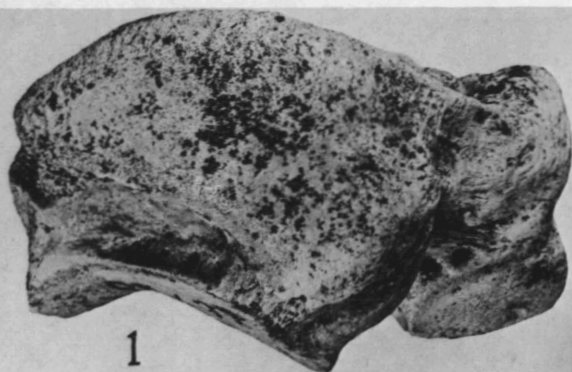
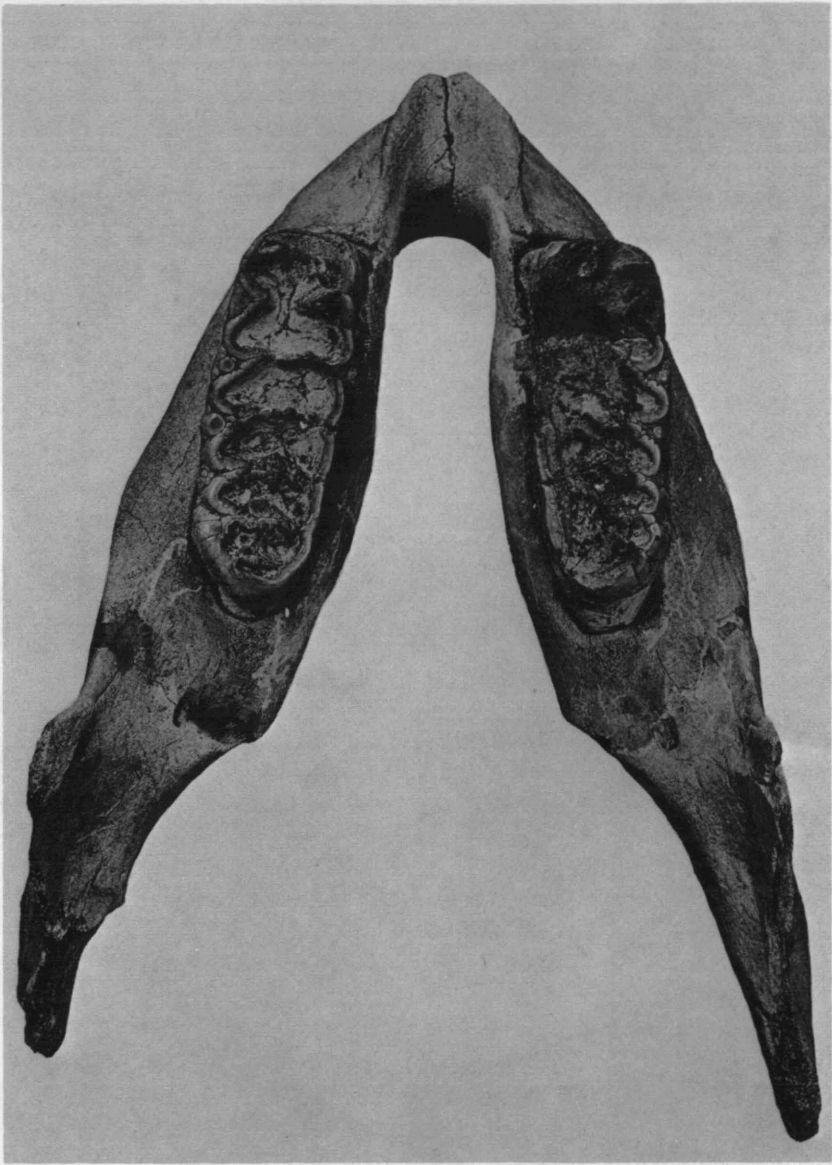


PLATE II



EXPLANATION OF PLATE II

	PAGE
<i>Stegomastodon mirificus</i> (Leidy)	235
U.M.M.P. No. 26363. Mandible with right and left M ₃ . Approximately × 3/10.	

EXPLANATION OF PLATE III

FIG. 1. Cemented Meade Gravels member of Meade formation along west bank of Stump Arroyo.

FIG. 2. Cemented Meade gravels resting unconformably upon silt and clay of the Rexroad formation in bed of Stump Arroyo, southeast of Seger ranch house.

PLATE III



FIG. 1



FIG. 2

PLATE IV

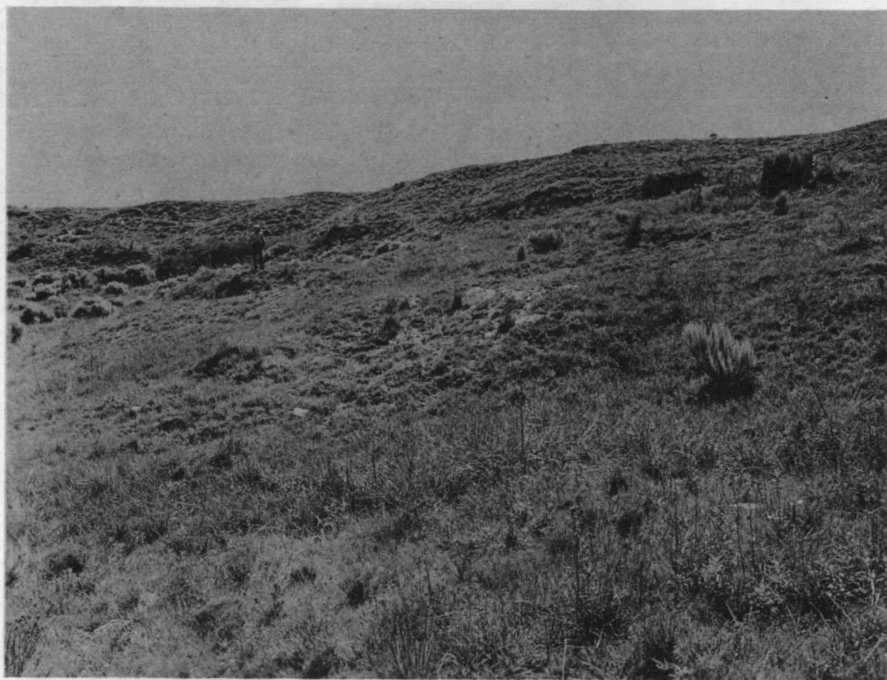


FIG. 1



FIG. 2

EXPLANATION OF PLATE IV

FIG. 1. View along southwest valley wall of Stump Arroyo above Seger gravel pit. Man standing on contact between Crooked Creek formation and Meade formation. Outcrop of caliche in foreground is in Missler member of Meade formation.

FIG. 2. Gravel pit in Stump Arroyo member of Crooked Creek formation resting unconformably upon the Missler member of the Meade formation, northeast side of Stump Arroyo; on section line between sections 33 and 34, T. 32 S., R. 29 W.

EXPLANATION OF PLATE V

FIG. 1. View in Seger gravel pit. Stump Arroyo sand and gravel channeled deeply into the Missler member of the Meade formation. Man standing on Missler member of Meade formation, which is exposed in wall of pit; SW.¼ SE.¼ sec. 33, T. 32 S., R. 29 W.

FIG. 2. Large block of cemented Meade sand and gravel, iron- and manganese-stained, taken from Stump Arroyo sand and gravel in Seger gravel pit.

PLATE V



FIG. 1

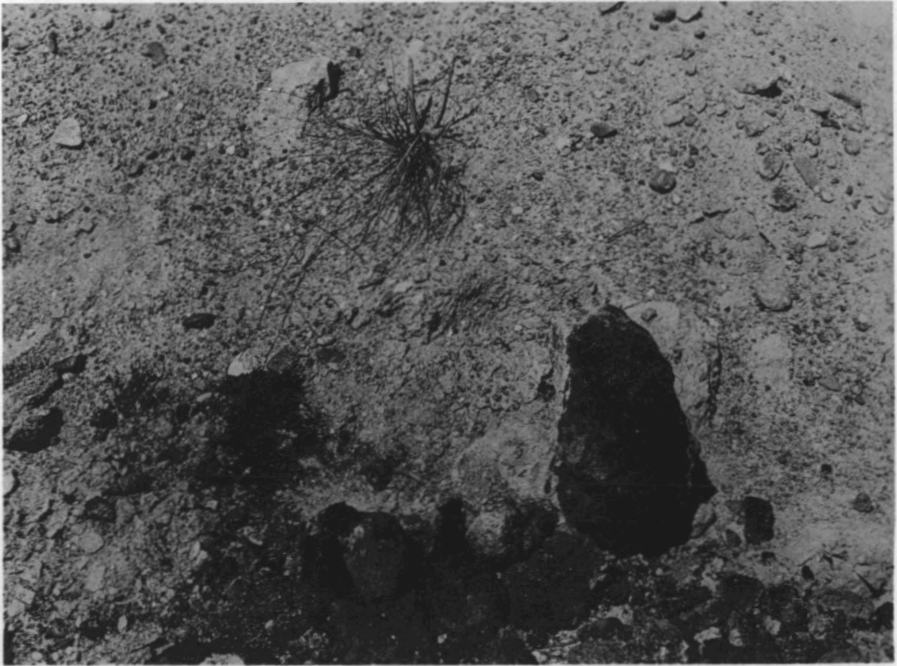


FIG. 2

PLATE VI



FIG. 1



FIG. 2

EXPLANATION OF PLATE VI

FIG. 1. South valley wall of Stump Arroyo west of Seger gravel pit. Man standing on contact between Meade formation and Crooked Creek formation. Note consolidated bed of Crooked Creek formation at sky line.

FIG. 2. Close-up view of weathered consolidated bed of Crooked Creek formation above the Stump Arroyo member.

VOLUME IX

1. Check List of Fossil Invertebrates Described from the Middle Devonian Traverse Group of Michigan, by Erwin C. Stumm. Pages 1-44. Price \$.75.
2. Ostracods of the Family Hollinidae from the Bell Shale of Michigan, by Robert V. Kesling and Gordon W. McMillan. Pages 45-81, with 7 plates. Price \$.75.
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