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SCIMITAR CATS, *HOMOTHERIUM SERUM* COPE FROM GASSAWAY FISSURE, CANNON COUNTY, TENNESSEE AND THE NORTH AMERICAN DISTRIBUTION OF *HOMOTHERIUM*.

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ABSTRACT

The discovery of three specimens of the scimitar, saber-tooth cat *Homotherium serum* Cope from Gassaway Fissure, Cannon County, Tennessee represents the first occurance of the species in the state. Dentations of the three individuals, two old adults and one juvenile allows for a detailed description of both the permanent and deciduous teeth. The juvenile specimen represents an individual in the process of shedding deciduous teeth and replacing them with the permanent teeth.

The widespread distribution of *Homotherium* remains in North America is demonstrated. The recovery of *Homotherium* specimens associated with *Mammut americanum* from Gassaway Fissure gives further credence to the theory that *Homotherium* was a frequent predator on Probosidians.

INTRODUCTION

Three saber-tooth cats, *Homotherium serum,* are described from a solution channel-fill in the Cannon Limestone (Ordovician), Cannon County, Tennessee. Excavations of the fissure, termed the Gassaway Fissure by Whitlatch and Arden (1942), were completed in 1941 and 1942. The saber-tooth cat remains include the teeth and fragmentary cranial and post-cranial elements of two adults and the deciduous and permanent dentation of a juvenile. This discovery represents the first report of the scimitar cat from Tennessee and its third locality east of the Mississippi River. Specimens from Gassaway Fissure have the anagram UTGM (University of Tennessee, Knoxville, Geology Museum). Comparative materials from Friesenhahn Cave, Bexar County, Texas are designated TMM (Texas Memorial Museum, The University of Texas, Austin, Texas).

HISTORY OF THE FIND

Homotherium serum remains were excavated from a fissure in northeastern Cannon County in central Tennessee. The geographic location is 35°57′ north latitude, 86°01′ west longitude. Whitlatch and Arden (1942) discuss the history of the site. The original discovery of bone was by the landowner, Mr. Shela George. Whitlatch and George began excavation in October 1941, with Collins joining the team in the summer of 1942. The fissure developed in Ordovician limestone of the Cannon Formation; vertebrate remains were found in a fill of limestone blocks, chert fragments and yellow brown clay. *Homotherium* remains were found associated with bones of mastodon, *Mammut americanum.* The vertebrate producing fissure fill has been completely eroded since 1942 (John Guilday, personal communication).

MATERIALS

The materials collected represent three *Homotherium serum,* two old individuals and one juvenile. The juvenile specimen (UTGM 2a and 2b) is represented by several fragmentary portions of the skull, the right and left premaxillary and maxillary and the right mandibular ramus, and associated teeth. A well preserved right mandibular ramus (UTGM 1c) and a crushed left mandibular ramus of a mature individual represent the first old adult. Remains of a second old adult, include both $\overline{\text{I1}}$, both $\overline{\text{C}}$, R$\overline{\text{P3}}$, both $\overline{\text{P4}}$, and all the upper teeth. Only a few scattered pieces of skull were found associated with these two adult specimens. Associated post-cranial elements include parts of the right and left scapula, left feumr, right humerus, two right ulna, right radius, 12th and 13th thoracic vertebrae, eight metapodials and several rib fragments. Post-cranial elements are from adults, but could not be assigned to either adult described above.

SYNONOMY

Fabrini	1890	*Homotherium* (n. gen.) based on *Machairodus crenatidens* and *M. nestianus,* Val d'Arno, Italy.
Cope	1893	*Dinobastis serus* (n. gen., n.sp.) from western Oklahoma.
Hay	1919	*Dinobastis serus,* Bulverde Cave, Texas.
Meade	1961	*Dinobastic serus,* Friesenhahn Cave, Texas.
Kurten	1962	*Homotherium=Epimachairodus=Dinobastis.*
Churcher	1966	*Dinobastis serus = Homotherium serum.*

Whitlatch and Arder (1942) tentatively assigned the three individuals from Gassaway Fissure to *Smilodon.* Collins' analysis of the specimens resulted in the reassignment of the animals to *Dinobastis.* The type *Dinobastis serus* Cope was established on the basis of a partial skull and teeth and a few limb bones from Oklahoma.

In 1962, Kurten synonomized *Dinobastis* and *Homotherium.* Churcher (1966) extensively analyzed *Dinobastis serus* and gave a complete diagnosis of the species based on Cope's type and material from Friesenhahn Cave, Texas. All the *Homotherium serum* specimens from Friesenhahn Cave were available for comparative use in identifying the saber-tooth cats from Gassaway, Fissure.

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ADULT MANDIBULAR DENTITION

$\overline{\text{I1}}$ is a small laterally compressed tooth with a basal cusp on the posterolateral side. $\overline{\text{I2}}$ is larger than $\overline{\text{I1}}$ and has basal cusps on both sides of the crown. $\overline{\text{I3}}$ is the largest of the lower incisors and has a small basal cusp next to $\overline{\text{I2}}$ and a larger basal cusp next to the lower canine. Table I gives the measurements for all teeth of both adult individuals. The anterior surface of the lower incisors is rounded and the posterior surface of the crowns is flattened. All lower incisors are laterally compressed and show heavy wear on the tips of the crown and the tops of the basal cusps. No serrations are visible of the lower incisors in the adult specimens. The lower canine is a somewhat laterally compressed incisiform tooth with anterior and posterior ridges. A deep wear facet passes down the anterior ridge of the crown to the top of the root. The upper part of the posterior ridge has a wear facet. Faint serrations are visible at the base of the posterior ridge. The lower $\overline{\text{P3}}$ is a small conical, single rooted, single cusped tooth showing no sign of the primitive two rooted condition. The base of the tooth flares into a cingulum at the posterior margin of the crown. $\overline{\text{P3}}$ is set at a slight angle projecting posteriorly and separated from $\overline{\text{P4}}$ by a short diastema (4.9 mm in UTGM 1c.). There are serrations on the posterior part of the cusp. The tip of the cusp is worn and no serrations are visible of the anterior part of $\overline{\text{P3}}$. $\overline{\text{P4}}$ is a backward projecting tooth with two roots and three cusps. The low rounded parastylid is separated from the central paraconid by a tight notch. The paraconid is the highest cusp on the $\overline{\text{P4}}$. There are deep wear facets on the labial surface of the paraconid and metaconid. The lower carnassial, $\overline{\text{M1}}$, is a slender double rooted tooth. The paraconid and metaconid form a sharp blade with a wide deeply incised notch between them. The labial surface of $\overline{\text{M1}}$ is heavily worn and the pulp cavities are exposed in the paraconid and metaconid.

FIG. 1. *Right mandible. UTGM 1c,* Homotherium serum.

The mandible of UTGM 1c (Figure 1) is 177.0 mm long with a low rounded coronoid process. The condyloid process is absent from the otherwise complete right ramus, however, part of the left condyloid process was recovered. The rounded flange on the anterior of the ramus is not well developed and extends only 10.2 mm below the level of the mandibular symphysis. The condyloid process has a long broad aritculation with the glenoid fossa. The mandibular symphysis is deep and forms a flat chin typical of the Machairodont felids.

ADULT MAXILLARY DENTITION

The upper teeth of the adult *Homotherium serum* are shown in Figure 2. Upper incisors are large and robust with well developed basal cusps. I1 is flattened on the lingual side with a basal cusp at a higher level than on the labial side. I1's are heavily worn and the pulp cavity of the left $\underline{\text{I1}}$ of the first individual is exposed. The basal cusp on the lingual side of $\underline{\text{I2}}$ is higher than on the labial side. The roots of $\underline{\text{I1}}$ and $\underline{\text{I2}}$ are laterally compressed but not to as great a degree as those of the lower incisors. $\underline{\text{I3}}$ is a conical tooth similar in shape to the lower canine. A long facet on the anterior ridge extends to the tip of the basal cusp. The posterior wear facet extends to the base of the crown. No serrations are visible on the upper incisors.

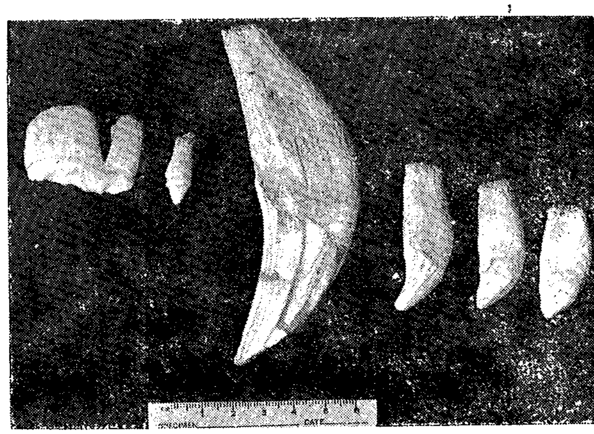

FIG. 2. *Upper teeth of* Homotherium serum *adult arranged in order from I1 on the right to P4 on the left.*

The upper canines are laterally compressed, curved and heavily worn. The left canine of the first individual was broken in life and the edges are rounded and worn. The anterior edge of the right upper canine of the first individual is worn but the posterior edge is finely serrated. The upper P3 is a single rooted, single cusped conical tooth similar to the lower $\underline{\text{P3}}$. The root of $\underline{\text{P3}}$ is straight while that of $\overline{\text{P3}}$ is inclined slightly. The cingulum around the crown of $\underline{\text{P3}}$ lacks the prominence found on the cingulum of P3. No serrations are visible of the cusp. The upper carnassial, $\underline{\text{P4}}$, is a long blade-like tooth. It is more slender than the upper carnassial of *Smilodon*. There are two roots on the $\underline{\text{P4}}$, a slender anterior root and a broad posterior root. The cusps of $\underline{\text{P4}}$ consist of the parastyle, paracone, and metacone. Lingual sides of $\underline{\text{P4}}$ are heavily worn and the pulp cavity is exposed. No $\underline{\text{M1}}$ was found in any of the Tennessee specimens. This tooth is also unknown from the Friesenhahn Cave specimens, however, skulls (TMM 933-3582 and TMM 933-3231) from Texas have the alveolus for M1. They show that M1 was a small single rooted tooth set at a transverse angle to $\underline{\text{P4}}$.

TABLE I: *Measurements of the adult specimens of* Homotherium serum *from Gassaway Fissure, Tennessee, In millimeters.*

	1st individual Rt.	1st individual Left	2nd individual Rt.	2nd individual Left	1st individual Rt.	1st individual Left	2nd individual Rt.	2nd individual Left
	I1				I2			
length of tooth	38.5	34.5	—	37.5	42.4	45.4	39.9	43.6
anterior-posterior diameter of crown	13.1	12.7	—	11.5	12.9	13.0	11.9	12.0
lateral diameter of crown at base	7.5	7.6	—	7.2	9.3	9.2	8.7	8.7
	$\overline{\text{I3}}$				$\overline{\text{I1}}$			
length of tooth	50.4	51.5	49.8	56.8	25.8	29.7	26.3	27.3
anterior-posterior diameter of crown	16.0	16.0	17.0	17.3	7.9	8.7	8.4	8.2
lateral diameter of crown at base	9.9	9.7	10.7	10.4	4.4	—	4.9	4.5
	$\overline{\text{I2}}$				$\overline{\text{I3}}$			
length of tooth	39.4	39.4	—	—	47.9	46.7	—	—
anterior-posterior diameter of crown	10.0	10.4	—	—	10.5	11.2	—	—
laterial diameter of crown at base	6.0	6.6	—	—	9.7	9.5	—	—

(Continued next Page)

	$\overline{C}$				$\overline{C}$			
length of tooth	114.0	95.8	60.0	72.4	52.3	53.0	50.7	50.0
length of crown	62.9	47.5	—	—	—	—	—	—
anterior-posterior diameter of crown	40.2	37.9	—	—	16.3	15.7	—	—
lateral diameter at base of crown	12.8	13.2	—	13.0	9.5	9.6	10.5	10.5
	$\overline{P3}$				$\overline{P3}$			
length of tooth	24.9	19.7	—	—	—	24.6	24.2	—
anterior-posterior diameter of crown	8.8	9.9	—	—	8.3	9.0	8.5	—
lateral diameter of crown at base	6.3	7.6	—	—	6.0	6.4	5.9	—
maximum height of crown	9.8	6.0	—	—	8.3	10.0	8.9	—
	$\overline{P4}$				$\overline{P4}$			
length of tooth	29.2	30.6	30.6	33.3	—	—	35.3	36.7
anterior-posterior diameter of crown	38.8	39.2	41.2	39.9	19.0	18.9	19.6	20.0
lateral diameter of crown at base	9.7	10.0	11.7	—	7.4	6.8	7.0	7.0
depth of notch	19.0	19.0	20.0	19.7				
maximum height of crown					12.4	8.4	11.2	11.7
	$\overline{M1}$				$\overline{M1}$			
anterior-posterior diameter of crown	none found				26.5	26.7	—	—
lateral diameter of crown at base					10.3	10.2	—	—
	mandible 1st individual				mandible 2nd individual (UTGM 1C)			
total length as preserved	196.0				177.0			
length C to M	105.5				112.0			
length of diastema	31.5				32.8			

MANDIBULAR DENTITION OF THE JUVENILE

The juvenile specimen was a half-grown individual with the deciduous upper and lower canines and the lower right d$\overline{P3}$ remaining. All the other deciduous teeth had been shed and were in the process of being replaced by the permanent teeth. The right teeth from $\overline{I3}$ to $\overline{M1}$ were found in a portion of the mandibular ramus. The remaining lower teeth were found scattered nearby. Figure 3 shows the individual teeth of the juvenile.

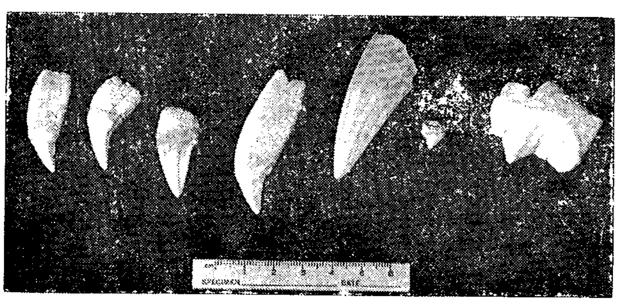

FIG. 3. *Upper teeth of the juvenile in order from left to right I1, I2, I3, dC1, C1, P3, and P4.*

Crowns of the lower $\overline{I1}$ and $\overline{I2}$ are well developed enamel caps with the basal cusps. Pulp cavities and roots were incompletely formed. The margins of $\overline{I1}$ and $\overline{I2}$ are finely serrate. $\overline{I3}$ was incompletely formed, only a small enamel tip of the crown was found. The permanent lower canines were not yet formed sufficiently to be preserved. A small alveolar pit internal to the deciduous canine suggests that development of the permanent canine had however, begun in the mandibular ramus. Deciduous lower canines are small laterally compressed teeth with a basal cusp on the anterior ridge of the crown. At a lower position on the posterior ridge is a simple knob-like cusp. No serrations are visible. The right d$\overline{P3}$ is isolated on a pedestal of bone above, and is the functional predacessor of the errupting $\overline{P4}$. The left d$\overline{P3}$ was not found and may have been shed in life. The dP3 projects backward in the jaw. There are four cusps in a line. The principal cusp is the paraconid. Anterior to the paraconid is a low parastylid. At the same level as the parastylid behind the paraconid is the metaconid followed by the metastylid. The cusps are worn and no serrations are present. The permanent $\overline{P4}$ is just emerging with the posterior cusps, paraconid and metaconid visible. The parastylid is hidden under the bone pedestal supporting d$\overline{P3}$. The root and pulp cavity of $\overline{P4}$ are incompletely formed and the crown is finely serrate. The crown of the lower carnassial, $\overline{M1}$, is near adult size but the root and pulp cavity are incompletely formed. The enamel cap of $\overline{M1}$ is finely serrate on the paraconid and metaconid. Wear facets are present on the labial side of the cusps. Figure 4 shows the mandible with the deciduous canine through the permanent earnassial.

MAXILLARY DENTITION OF THE JUVENILE

Several broken portions of the maxilla were found containing teeth or showing the shape and position of the alveoli. The fragments of skull and mandible of the juvenile specimen were sufficient for an accurate reconstruction. Measurements for the juvenile specimen are given in Table II.

TABLE II: *Measurements of juvenile* Homotherium serum *from Gassaway Fissure, Tennessee. In millimeters.*

	dC		dC	
	Right	Left	Right	Left
length	50.6	51.0	31.0	31.5
ant.-post. diameter	13.3	13.3	9.8	10.7
lateral diameter	4.8	4.5	3.9	3.9
maximum crown height	16.0	16.5	8.2	8.3
	dP3	dP3	P4	P4
	Right	Left	Left	Left
length	16.5	9.2	22.3	31.8
ant.-post. diameter	9.9	8.5	19.0	36.9
lateral diameter	4.5	6.3	8.6	10.9
maximum crown height	8.0	8.8	15.0	—
	$\overline{I1}$		$\overline{I2}$	
	Right	Left	Right	Left
length	30.5	25.0	32.2	28.5
ant.-post. diameter	7.7	9.1	10.0	10.3
lateral diameter	6.0	—	9.2	9.4
maximum crown height	13.2	—	18.8	—
	$\overline{I3}$		$\overline{C}$	
	Right	Left	Right	Left
length	29.7	30.3	27.0	26.0
ant.-post. diameter	10.5	10.8	14.8	14.3
lateral diameter	11.6	11.7	9.0	8.8
maximum crown height	20.7	20.5	26.0	26.0
	I2		I3	
	Right	Left	Right	Left
length	—	30.3	31.5	31.4
ant.-post. diameter	11.3	12.5	14.6	15.9
lateral diameter	9.1	9.0	9.8	10.4
	I1	C	dP4	
	Left	Left	Right	
length	36.0	52.6	8.0	
ant.-post. diameter	11.6	21.0	9.9	
lateral diameter	7.5	9.8	4.5	
	$\overline{M1}$			
	Right	Left		
length	31.6	31.9		
ant.-post. diameter	27.4	28.2		
lateral diameter	10.4	10.7		

Upper incisors were in the same state of development as the lower incisors. I1 and I2 have well developed crowns with basal cusps present. Root and pulp cavities are incompletely formed. The tip of I3 was preserved, but the basal cusps were not developed. The crowns of the upper incisors are all serrated. Both the deciduous and permanent upper canines are present in the maxilla. Deciduous upper canines are very small sabers compared to the permanent canines. The deciduous canine is very thin and laterally compressed; sides of the roots are concave in contrast to the convex shape of the permanent upper canine root. The permanent upper canines of the juvenile are incompletely formed and only a small serrated tip of each crown was preserved. The permanent upper canines were errupting lingual to the deciduous canines. Both permanent and deciduous upper canines are serrated.

Only a small portion of the crown of P3 was found in the maxilla, and is insufficient to describe the tooth. The tip is serrated.

The enamel crown of P4 is well developed and adult size. The principal cusps, parastyle, paracone and metacone are serrated. Faint wear facets are present on the lingual side of the metacone. The metacone is not a perfectly straight blade as appears in the worn adult specimens but the top is curved with a concave labial side. No evidence for the upper M1 was found in the fragmentary juvenile skull.

FIG. 4. *Right mandible, UTGM 2b, of the juvenile. The permanent lower incisor is visible beneath the deciduous lower incisor.*

COMPARISONS OF ADULT AND JUVENILE DENTITION

Deciduous lower canines are more laterally compressed than the permanent lower canines. The deciduous lower canine has basal cusps on both the anterior and posterior ridges. In contrast the permanent lower canine has serrated anterior and posterior ridges but no cusps. Upper deciduous canines are less saber shaped than the permanent upper canines. Both the permanent and deciduous upper canines are compressed and have finely serrate anterior and posterior edges. The crown of the permanent canine is ½ the tooth's length, that of the deciduous canine is barely ¼ the total length of the tooth. The deciduous lower P3 is the functional equivalent to the permanent P4. Both teeth are inclined backward and project above the parastylid of the carnassial. DP3 has four cusps compared to three in P4. The extra cusp is a small posterior cusp, the metastylid in dP3. Deciduous teeth of *Homotherium serum* from Friesenhahn Cave, Texas are identical to those from Gassaway Fissure, Tennessee. Complete deciduous dentitions available from Friesenhahn Cave show the tendency for greater lateral compression of the teeth and accessory cusps common to all deciduous teeth of *Homotherium serum*, but not found in the permanent teeth. Juvenile and unworn adult teeth from Friesenhahn Cave demonstrate that all teeth of *Homotherium serum* were serrated when errupted. Measurements of the teeth (Tables 1 and 11) of the Gassaway Fissure specimens agree in size with those of the Friesenhahn Cave *Homotherium serum* specimens.

DISTRIBUTION OF HOMOTHERIUM *IN NORTH AMERICA*

1. Old Crow Basin, Yukon Territory, 2. Dawson Locality 9, Yukon Territory, 3. American Falls Lake Beds, Idaho, 4. San Francisco Bay, California, 5. Delmont local fauna, South Dakota, 6. Sand Draw Quarry, Nebraska, 7. Sanhahl local fauna, Kansas, 8. Hennessey, Oklahoma, 9. Slaton local fauna, Texas, 10. Baggett Cave, Texas, 11. Gilliland local fauna, Texas, 12. Luback Cave, Texas. 13, Friesenhahn Cave, Texas. 14. Gassaway Fissure, Tennessee, 15. Reddick 1A, Florida, 16. Inglis 1A, Florida.

Figure 5 shows the distribution of *Homotherium* remains in North America. The genus was widespread in the western and southern United States. Specimens range in age from Blancan to Late Wisconsin. Because of the fragmentary specimens many of the finds have not been assigned to species. Additional locality information, specimens identified, ages and the reference for each locality on the distribution map follows:

Old Crow Basin Locality 21, Yukon Territory; right mandible P4-M1; late Pleistocene; Harrington, (personal communication, 1975) and 1978.

Old Crow Basin Locality 66, Yukon Territory; left upper canine; late Pleistocene; Harrington, (personal communication, 1975) and 1978.

Dawson Locality 9, Yukon Territory; distal ⅔ right humerus; late pleistocene; Harrington, (personal communication, 1975) and 1978.

American Falls, Lake Beds, Power County, Idaho; posterior ⅓ of skull; Late Pleistocene; Hopkins, et al. 1969.

San Francisco Bay, California; basicranium and upper canine; Irvingtonian; Savage, 1951.

Delmont local fauna, Douglas County, South Dakota; complete skull, *Homotherium* cf. *crenatidens;* Blancan; Martin & Harksen, 1974, Cain, 1975.

Sand Draw Quarry, Brown County, Nebraska; right mandible, P4, femur; Blancan; McGrew, 1944; Skinner and Hibbard, 1972.

Sandahl local fauna, McPherson County, Kansas; calcaneum and partial cranium; Illinoian to Wisconsin; Hibbard, 1952 Semken, 1966.

Hennessey, Oklahoma (50 miles west of Hennessey, exact locality unknown); type specimen, *Homotherium serum;* teeth and some post-caranial elements; age undetermined; Cope, 1893.

Slaton local fauna, Lubbock County, Texas; ulna, 2 calcaneum, fibula, 3rd metatarsal; early Illionian, Dalquest, 1967.

Baggett Cave, Crockett County, Texas; upper canine; late Pleistocene; E. L. Lundelius, Jr. personal communication.

Gilliland local fauna, Knox County, Texas; permanent upper canine, deciduous upper canine; Kansan; Hibbard and Dalquest, 1966.

Lauback Cave, Williamson County, Texas; deciduous upper canine; late Pleistocene; Lundelius and Davidson, 1975.

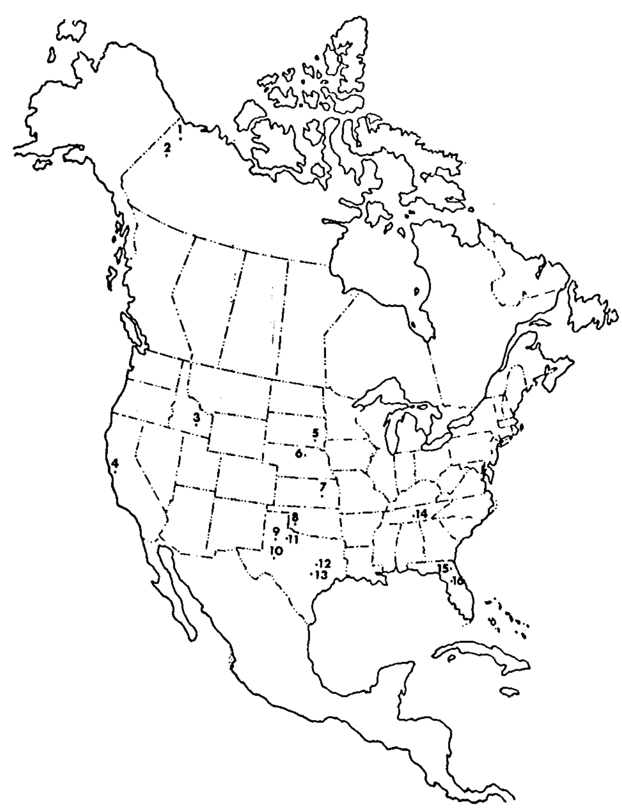

FIG. 5. *Distribution of Homotherium*

Friesenhahn Cave, Bexar County, Texas; complete skulls and postcranial collections; Rancho LaBrean; Hay, 1920 Meade, 1961.

Gassaway Fissure, Cannon County, Tennessee; partial skulls, mandibles and post-cranial elements of three individuals; late Pleistocene; this paper.

Reddidk I A, Marion County, Florida; right lower I2-M1, left lower I1 and I2, left upper I1 and I2; *Homotherium serum;* Rancho La Brean; Waldrop, 1974.

Inglis IA, Citrus County, Florida; premax with I3 and upper canine fragment; Irvingtonian; Webb, 1974.

Early and late Pleistocene species of *Homotherium* have been recovered from Europe, Asia and Africa. *Homotherium* had a very extensive range in the eastern hemisphere during the Pleistocene, but until recently, the genus was felt to be rare in North America. The distribution map indicates however, that *Homotherium* had a broader range both in time and space in North America than was formerly thought.

Discussion

The specimens from Gassaway Fissure, Tennessee are the third reported late Pleistocene *Homotherium* from the Eastern United States. The three individuals from the Gassaway Fissure are far more complete than the Florida material (Waldrop, 1974 and Webb, 1974) and represent the second largest number of individuals of the genra found in one place in North America. The juvenile specimen is of particular interest because of the information it sheds of the replacement process of deciduous by prmanent teeth. The Gassaway Fissure remains were found associated with the limb bones of a mastodon. Meade (1961) and Graham (1976) have suggested that mammoth and mastodon were the main prey species of *Homotherium serum* in Friesenhahn Cave, Texas.

Specific indentification of *Homotherium serum* is based on comparison of the teeth from Gassaway Fissure and a large sample from Friesenhahn Cave. The measurements of teeth as well as the observed non-quantitative characteristics match closely. Particular care was taken to note tooth serration as this feature, diagnostic of the species, is dependent on wear. The juvenile from Gassaway Fissure represents an older juvenile than those found in Friesenhahn Cave. The specific assignment of *Homotherium serum* suggests a late Pleistocene age for the Gassaway Fissure fill.

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