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ABSTRACT

In May 1965, mammoth remains were exposed during the excavation of a borrow pit for construction of Interstate Highway 40, 2 mi northeast of Hazen, Prairie County, Arkansas. The proboscidian remains consisted of a skull with tusks, mandibles, atlas and other skeletal elements. The vertebra material was scattered over approximately 150 m² (1,600 sq ft) but was confined to a layer of red clayey-silt 6.7 m (22 ft) below the surface. No additional fauna or flora was recovered.

The mammoth remains are referred to *Mammuthus columbi* (Falconer, 1857) on the basis of characteristics of the dentition, particularly the comparison of index of hypsodonty to functional plate density. *Mammuthus columbi* was widely distributed in southeast North America during the late part of the Pleistocene Epoch (Sangamon-Wisconsin Stages).

INTRODUCTION

During May 1965, scattered mammoth remains were uncovered in a borrow pit while contractors were removing dirt to be used for the construction of the Interstate Highway 40/State Highway 11 overpass about 2 mi northeast of Hazen, Prairie County, Arkansas. The pit is in the Wattensaw Game Management area and is now being used as a pond by the Arkansas Game and Fish Commission.

W.C. Clevenger, a heavy equipment operator from Lonoke, initially discovered the mammoth remains and uncovered parts of the skull and right tusk. William Evans, Assistant Professor of Biology, Little Rock University (now UALR), cleaned and removed the right mandible and later donated it to the University of Arkansas Museum. The excavation of the site was completed under the supervision of James A. Scholtz, Research Associate in Archeology, University of Arkansas Museum, through provisions of the existing Joint Salvage Archeology and Research Project (No. HPR-1 (3)445) agreement between the Arkansas State Highway Commission and the University of Arkansas. The remaining skeletal elements were excavated by a small field crew using hand excavations under the direction of Scholtz, after removal of overburden with heavy equipment.

The proboscidian remains were scattered over an area of at least 150 m² (1,600 sq ft). They were 6.7 m (22 ft) below the surface and were confined to an extensive layer of red clayey silt. The clayey-silt layer is overlain by deposits of alluvial sand and clay. Unfortunately, there was no detailed stratigraphic analysis of the site; thus it is impossible to determine its exact depositional environment. Rapid burial of the Hazen mammoth remains at or near the site of death is suggested by the proximity of the skeletal elements. The mandibles were near the tips of the tusks. The atlas and several other vertebrae were between the mandible and skull, nearly under the left tusk. A mass of disarticulated ribs and vertebrae was behind the skull. The limb bones and at least one other vertebra were scattered well away from the concentration of the remains. Soil samples were processed for small mammal and pollen remains but none were found. All remains were examined *in situ* for butchering marks and other signs of human activity but with negative results.

The skull and right tusk of the mammoth were damaged somewhat by heavy earthmoving machinery. A large portion of the other skeletal remains also had been damaged or destroyed by this equipment. Most of the bones were very soft, crumbly and partially crushed by the overburden. Therefore a field decision was made to salvage only part of the major skeletal elements. The skull, tusks, atlas and proximal end of the right humerus were treated with applications of dilute Elmer's glue solution, and encased in reinforced plaster jackets. The damaged right tusk collapsed during cleaning and it was salvaged in three large sections. The 2.43-m (8-ft) left tusk was sawed from the skull and removed as a single unit. The left mandible, one vertebra fragment, ball joint of a femur and distal end of the right femur were stabilized with the glue solution but removed without plaster jackets. All remains were moved to the University of Arkansas, Fayetteville, where the glue solution and plaster were removed where conditions permitted. Final preservation was accomplished by applications of both gelva-15 and acyloid. The preserved remains are housed at the University of Arkansas Museum, Fayetteville (UAM Accession No. 65-169).

The mammoth remains are referred to *Mammuthus columbi* (Falconer, 1857) on the basis of characteristics of the dentition, particularly the comparison of the index of hypsodonty to functional plate density. *Mammuthus columbi* was widely distributed in central and southeast North America during the late part of the Pleistocene Epoch (Sangamon-Wisconsin Stages) (Hibbard, 1970).

SYSTEMATIC PALEONTOLOGY

Order Proboscidea (Illiger, 1811)
Family Elephantidae (Gray, 1821)
Mammuthus columbi (Falconer, 1857)

Material Studied. Skull with dentition (UA65-169-1-1); left mandible with dentition (UA65-169-1-2); right mandible with dentition (UA65-169-1-3); atlas (UA65-169-1-4); vertebra fragment (UA65-169-1-5); ball joint of femur (UA65-196-1-6); fragment of distal end of right femure (UA65-169-1-7); proximal end of right humerus (UA65-169-1-8); distal end of right humerus (UA65-169-1-9); left tusk (UA65-169-1-10); right tusk (UA-169-1-11). All materials are reposited at the University of Arkansas Museum, Fayetteville, Arkansas.

Measurements by Vernier Calipers of the more important skeletal elements are plotted in Table I.

Results and Discussion. Studies of proboscidian taxonomy published posthumously by H.F. Osborn (1936, 1942) are still the most comprehensive works in the field. The publications summarize earlier systems of nomenclature and evaluate criteria for species recognition, primarily the morphology of the permanent dentition. Osborn (1942) recognized several genera of the family Elephantidae that are now referrable to *Mammuthus* (Romer, 1966). Species assignments to these genera and *Mammuthus* were based primarily on the number of ridge-plates per tooth, number of ridge-plates per 100 mm on the occluded surface and other characteristics. Dentition data for the most commonly recognized species of North American *Mammuthus* are summarized in Table II.

Little North American work on Elephantidae taxonomy, particularly *Mammuthus*, was published for the two decades after Osborn's work (1942). Some workers (Skeels, 1962) followed the system established by Osborn. However, others (Aguirre, 1969; Meiring, 1955; Whitmore et al., 1967) noted considerable variation and overlap in the dentition characteristics between and among proboscidian species.

Variations in tooth morphology occur in many ways including ridgeplate thickness and wear of the occluded surface due to the mode of replacement of mammoth molars (described by Whitmore et al., 1967). Generally mammoths utilized only one molar in each half of each jaw, or a total of four, simultaneously. The tooth erupted and was worn as it moved forward along the jaw. As the tooth wore away, the anterior enamel ridge-plates dropped out one by one and the tooth rotated in a plane parallel with the anterior-posterior orientation of the jaw. As a result, the angle of the occluded surface was constantly changing, and molars of different individuals in different stages of wear are difficult to compare.

Whitmore et al. (1967) and Aguirre (1969) plotted a comparison of the index of hypsodonty to the functional plate density to minimize nonspecific variations in the molars, particularly those developed through wear. This plot has been used most recently by Davis et al. (1972, p. 64) to differentiate species of *Mammuthus* and is also followed herein (Fig. 1).

Aguirre (1969, p. 1367) also demonstrated that enamel thickness of the ridge-plates (*M. imperator* 2.4-3.2 mm, *M. columbi* 1.8-2.4 mm, *M. primigenius* 1.2-2.1 mm) can be used to differentiate species of mammoths. However, this measurement is seldom used because of the great variability in enamel cover of proboscidian molars. The thickness varies noticeably not only among the ridges of individuals within a species, but also among the ridges of a single molar and along the section of a single ridge. Although enamel thickness measurements are not precise enough for species identification, they have been utilized in differentiating species of different evolutionary lineages and for generic comparisons (Aguirre, 1969, p. 1368).

The Hazen mammoth remains are referred to *Mammuthus columbi* (Falconer, 1857) on the basis of three observations: (1) ridge-plates per 100 mm, (2) total ridge-plates per tooth and (3) the comparison of the index of hypsodonty to functional plate density. Ridge-plates per 100 mm and total ridge-plate measurements on the Hazen mammoth (Table I) compare very

Table I. Measurements (mm) and Counts on Molars of Hazen Mammoth

	LM^3	RM^3 +	LM_2	RM_2
Height	240*	225*	187*	190*
Length	230*	230*	312*	310*
Length of occluded surface	183	---	170	175
Number of ridge-plates per tooth *	18-20	---	16	15-16
Number of ridge-plates in occluded surface of tooth	11	---	11.5	11
Average number of ridge-plates per 100 mm (2 measurements per tooth)	6.5	7	6	6
Width of crown at midpoint				
Enamel plate	88.1	---	87	84.2
Enamel plate + cement	93.3	---	93	86
Maximum width of crown				
Enamel plate	91.5	88	87	84.2
Enamel plate + cement	93.6	92	93	86
Average ridge-plate thickness at midline of tooth (8 measurements per tooth)	11.4	10.3	10.5	10.1
Average enamel thickness at midline of tooth (15 measurements per tooth)	2.54	2.66	2.49	2.28
Average distance between ridge-plates at midline of tooth (7 measurements per tooth)	5.1	3.9	6.5	7.8

+ Tooth damaged.
* Measurement or count estimated.

closely with those given for *M. columbi* by Osborn (1942) summarized in Table II. A plot of the index of hypsodonty to functional plate density (Fig. 1) shows that both of the lower M3 and LM^3 molars of the Hazen mammoth are in the range of *M. columbi* as given by Davis et al. (1972, p. 64). This plot indicates vertically deeper, more narrow teeth in relation to the number of ridge-plates per 100 mm for the Hazen mammoth in comparison to those of *M. imperator*. However, examination of molar measurements plotted in Figure 1 suggests some confusion in present species assignment of mammoth molars. The overlapping parameters shown in Figure 1 and the geographic distribution of mammoth remains suggest the possibility of either a group of closely related species or a cline, *M. imperator* the western form, *M. columbi* the southcentral to southeast form, and *M. jeffersoni* the northern form.

Enamel thicknesses of the Hazen mammoth range from 1.9 to 3.1 mm on individual M3 molars, substantiating Aguirre's (1960, p. 1368) contention that this characteristic is of little value for species recognition within *Mammuthus* or other Elephantidae genera.

Table II. Summary of M3 Characteristics for Species of *Mammuthus* Compiled by Osborn (1942)

Mammuthus columbi
1. M3 ridge-plate count, 18-19. 16+
2. Average number of ridge-plates per 100 mm, 6.5.
3. M3 relatively short anteroposteriorly and deep vertically.
4. Thin cement on outer coating.
5. Tooth relatively narrow as to width.
Mammuthus imperator
1. M3 ridge-plate count, 17-18. 18-20
2. Average number of ridge-plates per 100 mm, 3.5 to 5.
3. M3 relatively short and very broad.
4. Heavy cement outer coating.
Mammuthus jeffersoni
1. M3 ridge-plate count, 24-26. 24
2. Average number of ridge-plates per 100 mm, 7 to 9.
3. Molar crowns broad, M3 short with enamel of intermediate thickness, more or less crimped or sinuous.
Mammuthus primigenius
1. M3 ridge-plate count, 24-27. 24-27
2. Average number of ridge-plates per 100 mm, 10 (range 9 to 13).
3. Relative abbreviation and depth of M3 which is compressed into a much smaller, shorter space anteroposteriorly.

ACKNOWLEDGEMENTS

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M. G. Gross, AHD Division of Planning and Research, provided effective liaison with appropriate AHD staff. District Engineer E. E. Hurley, Resident Engineer R. B. Jones and Vernon Ellis of the AHD Maintenance Headquarters at Hazen went out of their way to be helpful during the several days of salvage excavation. The site was guarded at night by deputies of Prairie County Sheriff S.E. Grady and personnel of the State Wildlife Serivce. The crew hired for the project consisted of Scott Vick, Ken Scott, Roger Taylor and James Gray, all from the Hazen area. Dr. James H. Quinn (Geology Dept.), Dr. Walter L. Manger (Museum and Geology Dept.) and David Wolf (Anthropology Dept.), all at the University of Arkansas, Fayetteville, provided advice in collection, identification and preservation techniques.

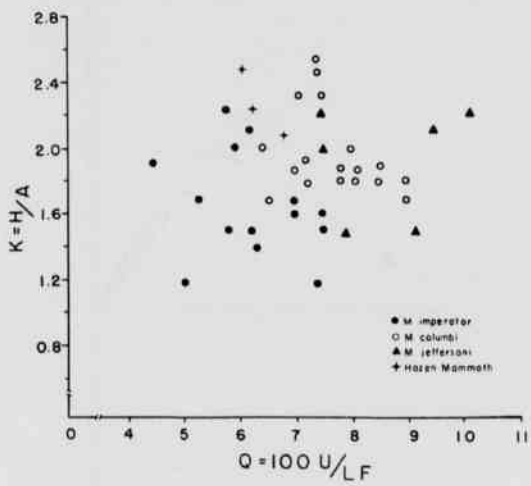

Figure 1. Distribution of 38 third molars of *Mammuthus columbi*, *M. jeffersoni*, *M. imperator* and the Hazen mammoth based on comparison of hypsodonty (ratio of height to width) and functional plate density (100 x ratio of plates on occlusal surface to length). Modified from Davis et al. (1972, p. 64).

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