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ABSTRACT BOOK

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Occurrences of bone growth variations in Columbian mammoth, *Mammuthus columbi* at the Mammoth Site of Hot Springs, SD

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Since the discovery of the Mammoth Site in South Dakota in 1974, the remains of 61 mammoths, 59 Columbian and two Woolly mammoth were recorded after 35 years of excavations. The remains of mammoths trapped in the sinkhole about 26,000 years ago, are represented by over 1,200 in situ identifiable bones and fragments, and over 2,000 identifiable bones and fragments placed in the collections. The trapped animals accumulated in a very short geological time (about 200-700 years) representing result of selective (behavioral) deaths, and can be characterized by parameters of a single "population". The Mammoth Site collection is complete, and with the exception of the microfauna (the screen washing of the sediments began in 1990), none of the identified specimen was discarded.

The assemblage represents a thanatocoenosis of mammoth in unique circumstance of an untransported, or minimally transported accumulation in springfed pond within a karst depression (Agenbroad and Mead, 1994). Most of the bones (about 90%) in situ are not associated (or in articulated position with each other), and concentrated within three-six meters of the northeast, east, south and southwest edges of the former sinkhole.

Based on the cranial material retaining molars revealed age range of the trapped mammoths between 10 and 54 AEY (African Elephant Years), dominated by 10-19 and 20-29 AEY young adult animals (Agenbroad and Mead, 1987), with a mean age of 25 AEY (Agenbroad, 1994). Scarcity of juveniles and senile individuals, as well as predominance of males in the assemblage argues against a catastrophic event or a mass accumulation of a single heard (Agenbroad and Mead, 1994; Agenbroad and Lister, 1994).

The most complete specimens belong to Columbian mammoths and include 90% complete skeleton of the 49 AEY years old mammoth nicknamed "Napoleon", adult male mammoth nicknamed "Murray", the largest specimen so far found at the site (Agenbroad, 1994), and partial skeleton of two adult male mammoths, nicknamed "Swimmer" and "Dutchman". None of the mentioned above specimens revealed bone abnormalities.

Very few bones (0.01%) of the entire collection accumulated in 1974-2013 field seasons display signs of possible development of abnormal or excessive growth of bony tissues. The bones were not associated with any skeletons, and mammoth individual ages that yielded these specimens remain unknown.

The bones represent mostly stylohyoideum, sternum, vertebrae and rib. Among highly variable stylohyoidea observed among the specimens in the collection, two out of approximately two dozen of specimens in the collection, have extensions in the shelf area (Fig. 1).

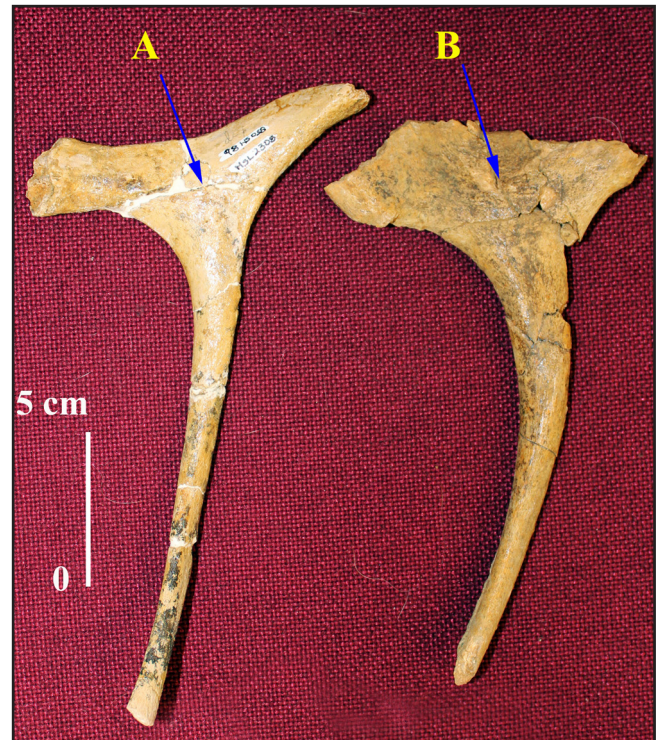


Fig. 1. The Columbian mammoth, *Mammuthus columbi* stylohyoids. A, normal shape (dex; MSL 2308); B, extended shelf area (dex; MSL 938).

A single isolated mammoth presternum (MSL 725) displays a significant growth around the articulation facets of first pair of ribs, with some of the growth expanding towards the tip of the bone. The growth might have been stimulated by dislocation of the ribs from the sternum.

Originally identified as pathology (Mol & Agenbroad, 1994), we cannot over rule the possibility of interpreting this growth as a healed fracture caused by bull fighting. The sternum is in the anatomical position to be vulnerable to tusks damage, as in fighting between bulls.

Few frontal thoracic vertebrae display overdeveloped (or deep) cavities (not penetrating foramens) at the base of the neural arch with spinal process. Based on their rarity, we opt considering it as a morphological variation, or most likely, ontological changes due to aging. Whether this feature (cavity) corresponds to extreme cases of development of further penetrating through the bone foramens observed in woolly mammoth, *Mammuthus primigenius* recorded in few cases in European sites and southwestern Siberia (Krezminska, 1980; Musil 1983; Leschinsky, 2009), is unknown.

Although the hyoid apparatus is highly functional system on Proboscidea associated with feeding, sound production and water storage in pharyngeal pouch, the other bones, as vertebrae, ribs, and foot bones are cited as having most

of the pathological changes (osteoblastoma, spondylosis, cancer, etc.) in mammoth skeleton (Krezminska, 2008), as in other mammals. It is obviously not a case at the Mammoth Site collection.

Within the entire collection, no specimens (except the presternum) revealed cases displaying healed fractures, malformations of the skeletal elements (furrows in the molar's cement, holes in bones due to abscess), vertebrae fusion, or additional molars in rami.

The Columbian mammoths from the Mammoth Site are represented by healthy individuals, with animals displaying a very small percentage of bones with unusual morphology, characterizing normal condition of a natural population.

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