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EXCAVATION AT THE HOT SPRINGS MAMMOTH SITE: A LATE PLEISTOCENE ANIMAL TRAP

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INTRODUCTION

Construction work on a housing development in southern Hot Springs, South Dakota, during July 1974 exposed teeth, tusks, skulls, and post-cranial elements of mammoth. These were located in a small deposit of sand within the Spearfish Formation, a red shale of Permian-Triassic age.

The deposit was originally a topographic depression. Prior to construction, it stood as a ridge, the sand and gravel armoring the adjacent shale. It is currently a sandy knob left by the construction work.

Initial excavation during 1974 and 1975 (Agenbroad and Jones, 1975) was salvage and exploratory in nature. The abundant faunal remains from such efforts resulted in a field season from June 13 to July 19, 1976.

GEOLOGIC SETTING

A study of the deposit, its lithology, size, shape, and attitude of the units, suggests a Karst sinkhole caused by solution in the underlying Minnekahta Limestone (Permian). This was reflected upward through the overlying Spearfish (Permian-Triassic) and then filled with sand, silt, and clay of Late Pleistocene age.

The attitude of the beds varies throughout the deposit, as does the lithology. Thin-bedded, laminated sands, silts, and clays varying from a thickness of less than one centimeter to a thickness of several centimeters, suggest varves, which occupy the western portion of the deposit. Sands and gravels predominate in the northeastern portion. A backhoe pit sunk sixteen feet in the center of the unit reveals laminated silt and clay impregnated with gypsum crystals to the maximum depth encountered.

Beds vary in dip up to 40° and indicate a depression of the central units by compaction and/or differential movement, after deposition. Some faulting is apparent on the eastern side of the deposit, with a relative depression of the Quaternary unit. Bank caving is also to be noted in this area, with blocks of Spearfish material depressing and contorting the sand.

The present model of sedimentation for the karst-fill suggests subaqueous deposition in a spring-fed pool within the sinkhole. The well-sorted sands of the northeast portion of the deposit give the impression of a spring conduit, at least a high energy environment. The west and southwest deposits, comprised of laminated silts and clays, reflect a low-energy environment suggestive of a quiet water pool, opposite the spring. Gravels are concentrated in a peripheral position and may reflect material falling into the sinkhole.

METHODOLOGY

Excavation of the site followed standard archaeological and paleontological techniques as applied at the Murray Springs, Lehner Ranch, Boney Springs, and Hudson-Meng sites. Bones were mapped *in situ*, both vertically and horizontally, as encountered in the fill. Horizontal provenience was done with a string grid and transferred to metric graph paper. A vertical datum gave levels on individual bones. A level was taken on the central portion of the bone except in instances when one end was vertically much higher or lower (Dutrow, 1977).

Remains were mapped, field-numbered, removed, and

taken to the laboratory for further stabilization, reconstruction, and identification. Area A and a portion of Area B (Fig. 1) remains were left *in situ* after excavation for subsequent development of the site.

1976 SEASON

Work was concentrated on the northeast edge of the locality. A total of 126 square meters was opened (with as much as three meters depth of excavation) in this major portion of the excavation efforts. In addition, as the field period advanced, an additional 25 square meters were opened in a series of test pits on the periphery of the Pleistocene deposits.

The faunal remains proved the existence of at least fifteen mammoth at the site, with the probability of numerous individuals to be recovered with further excavation. In addition to mammoth, we also recovered camel remains. Invertebrate remains (pelecypods, ostracodes, and gastropods) were recovered by the field party and a party from the South Dakota School of Mines. A total of 431 faunal (vertebrate) specimens were excavated, mapped, and recorded. Most of the specimens were cast and removed to the laboratory. The exception to casting and removal were those specimens housed in a 46 x 20-foot temporary structure, placed over a portion of the bone bed to preserve an *in situ* exhibit.

Five skulls, 13 tusks, 7 pelvi, and 5 scapula were recovered in addition to numerous ribs, vertebra, and long bones. Several isolated teeth plus three mandibles containing teeth were recovered. Three maxilla (or fragments) with teeth were also excavated. Two articulated feet were found, indicating the elements were incorporated in the deposits while enough flesh, tendons, skin, etc. adhered to keep the small bones in place until incorporated as a part of the sedimentary units. Two partly articulated spinal columns were also recovered.

Concentration and orientation of the bone in the northeast excavation promoted the theory that the majority of bone would be in the six meters adjacent to the contact of the Permian-Triassic Spearfish shale and the Pleistocene sand, silt, and clay of the karst fill. That theory was tested by a series of test pits along the contact. Each test pit produced numerous faunal remains, tentatively validating the model. Final validation awaits the 1977 season.

Map compilation is in progress for the 1976 season as well as for the 1974, 1975 test efforts. Bone preservation and restoration is in progress in the research laboratory. Faunal metric analysis will be continued as soon as the bone is prepared.

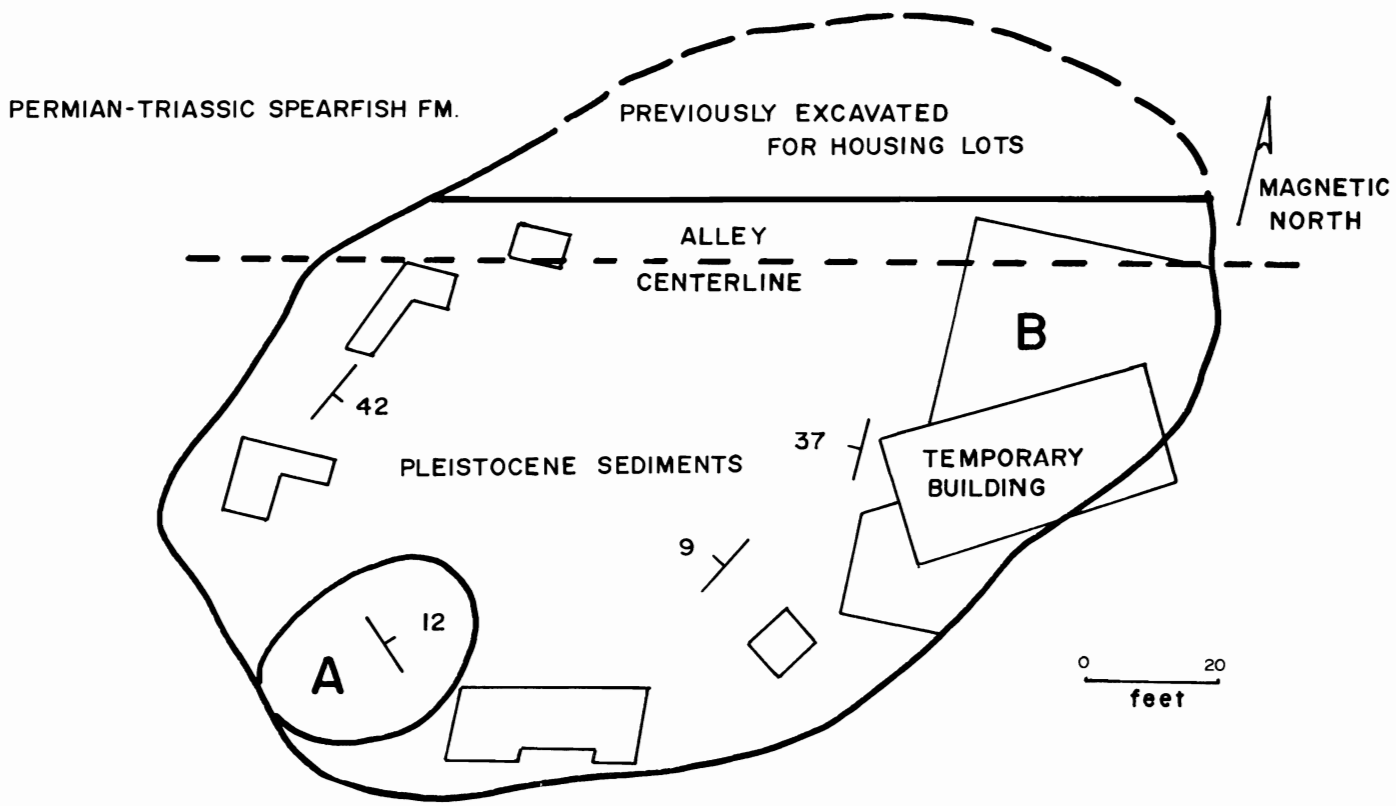

Figure 1. Hot Springs Mammoth Locality: 1976 Excavations.

FAUNA

The vertebrate remains represent a local death assemblage (thanatocenosis) of mammoth and associated fauna. We have, as associated fauna, peccary *(Platygonus),* bear *(Ursus arctos),* coyote *(Canis latrans),* camel *(Camelops),* rodents and an unidentified raptorial bird. A total of 698 vertebrate specimens (excluding rodents) have been excavated, recorded, and mapped. This total represents at least fifteen mammoth, varying from 3 to +50 years in age. Test pits indicate abundant remains in areas to be excavated, suggesting a mammoth population of 30-50 animals represented in the deposit.

Mammoth remains were considered to be *Mammuthus columbi.* This was validated by a graph of the Index of Hyposodonty (Whitmore, et al., 1967) to the Length-Lamella ratio of the M1's (Dutrow, 1977).

No meaningful studies have yet been completed on the associated fauna, other than identification. Most of the specimens are represented by teeth, with occasional fragmentary remains.

MODE OF ACCUMULATION

Current evidence proposes a karst sinkhole-trap model for the Hot Springs Mammoth site. Abundant sinkholes are present in the local drainage system. A pair of twin giants occur on the ridge south of the site, with depths and diameters up to 200 feet.

It is postulated that the mammoth entered a steep, walled karst sink, either for water or for the vegetation at and near the water's edge. Once inside the sinkhole, they were unable to scale the submoistened Spearfish shale banks to extricate themselves. Thus trapped, they simply awaited death by starvation and/or drowning. Assuming the former mode of death, carcasses decomposing along the bank of the pond would gradually yield bones to the sedimentation of the karst fill. That at least part of these elements were articulated is evidenced by the two feet found in the 1976 field season.

A model of the lagoon and associated vegetation, surrounded by Spearfish shale is available at Mirror Lake, northwest of Spearfish, South Dakota.

CHRONOLOGY

An estimated age of +20,000 years has been postulated on geologic evidence for the site. Two bone collagen samples have not yielded enough collagen for a C^{14} date.

RESULTS

At the Hot Springs site we have a large sample of a local mammoth population. The individuals range widely in age and may represent one or more family units added to the deposits over a time period, or they may represent accumulation of single individuals through time.

In either case, they provide a statistical sample of local mammoth and allow a series of post-cranial metric studies to be performed. This data, plus an ultimate age analysis should provide a reference set of post-cranial (and cranial) attributes for a group of South Dakota mammoth, plus give added information to the Late Pleistocene paleoenvironmental/paleoclimatic data based on these and associated fauna.

Studies of the sedimentation, invertebrates, palynology, etc. will add considerable knowledge to the conclusions from vertebrate analysis.

ACKNOWLEDGMENTS

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Excavations in 1974 and 1975 were done with volunteer crews. The 1975 field season was supported by a Geological Society of America Penrose Research Grant.

The 1976 field season at the Hot Springs Mammoth Locality was initiated July 13 and terminated July 19. A field crew of six persons, supported by National Geographic Society and EEI/Earthwatch and Chadron State College Research Institute were on site for the duration of the field period and were joined by two teams of Earthwatch participants.

Excavation was undertaken by a composite NGS crew and two EEI crews including the following persons: James Mead, foreman; Barb Dutrow, foreperson/cartographer; Marty McCafferty, Karin Olssen, Cynde Adcock, George Allen, Fred Edinger, Jim Jensen, Ralph Jones, Jon Marget, John Outler, Carolyn Brook, Hanna Nekvasil, Janet Smith, Susan Marshall, Ron Caruso, Anne Chapman, Csilla Duneszky, Rachael Lipson, Stephanie Hutter, William Maybaum, Virginia Schroeder, Edward Vaughn, Dale Wilson, Melissa Pelletier, Andrea Zuckerman, and Richard Dumas.

Laboratory preparation and analysis are being done by Barb Dutrow, Marty McCafferty, Matt Rohde, and Phil Watt.

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