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MAMMAL FOOTPRINTS FROM THE UPPER PLEISTOCENE OF THE TULAROSA BASIN, DOÑA ANA COUNTY, NEW MEXICO

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ABSTRACT.—Fossil footprints from a locality in the Pleistocene Otero Formation on the White Sands Missile Range were made by proboscidean (mammoth) and camelid trackmakers. Oriented trackways suggest these large ungulates walked to and from the waters of Lake Otero, probably to drink. Although human artifacts (chipped stone) have been found at the tracksite, there are no human tracks, and there is no demonstrable human association.

INTRODUCTION

New Mexico's Cenozoic strata contain an extensive body-fossil record of mammals, but only a handful of fossil mammal footprint localities. These localities are of Eocene, Oligocene, Miocene and Pliocene age (Walters, 1969; Ferguson, 1986; Lozinsky and Tedford, 1991; Lucas and Williamson, 1993; Williamson and Lucas, 1996; Morgan and Williamson, 2000). Here, we add to this record late Pleistocene mammal footprints from the White Sands Missile Range in Doña Ana County (Fig. 1). These footprints have been known for about 70 years, but this article represents their first scientific documentation. Here, NMMNH = New Mexico Museum of Natural History and Science.

HISTORY

Ellis Wright, a government trapper, discovered the footprints on the Alkali Flat in Doña Ana County in 1932 (Gross, 1981, 1982). Wright believed them to be those of a giant human; and Gross (1981, p. 11) quotes a 1938 pamphlet titled "Story of the Great White Sands:"

"GIANT'S TRACKS—In the fall of 1932 Ellis Wright, a government trapper, reported that he had found human tracks of unbelievable size, imprinted in the gypsum rock on the west side of White Sands. At his suggestion a party was made up to investigate. Mr. Wright served as a guide. O. Fred Arthur, Supervisor of the Lincoln National Forest, Edgar Cadwallader and one of his sons from Mountain Park and the writer made up the party. As Mr. Wright had reported, there were 13 human tracks crossing a narrow swag, pretty well out between the mountains and the sands. Each track was approximately 22 inches long and from 8 to 10 inches wide. It was the consensus of opinion that the tracks were made by a human being for the print was perfect and even the instep plainly marked. However there was not one in the group who cared to venture a guess as to when the tracks were made or how they became of their tremendous size. It is one of the unsolved mysteries of the Great White Sands."

As far as we can determine, no study or other documentation of the footprints took place until 1981. At that time, a group including Love, Hawley and Donald Wolberg, then paleontologist at the NM Bureau of Mines and Mineral Resources, examined the footprints at the request of archaeologist Peter Eidenbach (Hawley, 1983, p. 28). Wolberg (in Gross, 1981, 1982) identified the tracks as those of an elephant (mammoth), artiodactyl (camel) and an undetermined mammal. Some photographs taken of the footprints at that time are reproduced here (Fig. 2). On a 9 June 1984 tour of the area by the N.M. Archaeological Council, a large mammoth-molar fragment was observed by Hawley, Love and others in a small gully within 250 m of the tracksite. Unfortunately, there is no record that this fossil was ever recovered. In 2001, Lucas, Morgan and Myers re-examined the tracksite, tracing representative footprints and collecting metric and stratigraphic data

LOCALITY, STRATIGRAPHY AND AGE

The tracksite is NMMNH locality 4979, located at and around UTM 13, 358368E, 3644477N, NAD 27. Site elevation is 1195 to 1200 m. The footprints are exposed over an area of about 75,000 m^2, and include 25 tracks of proboscideans and 64 camel tracks.

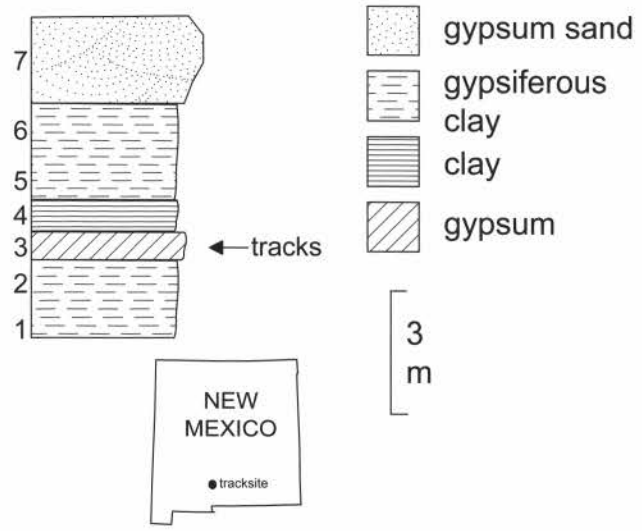

FIGURE 1. Location map and stratigraphic section at NMMNH locality 4979, the Pleistocene mammal tracks on the White Sands Missile Range.

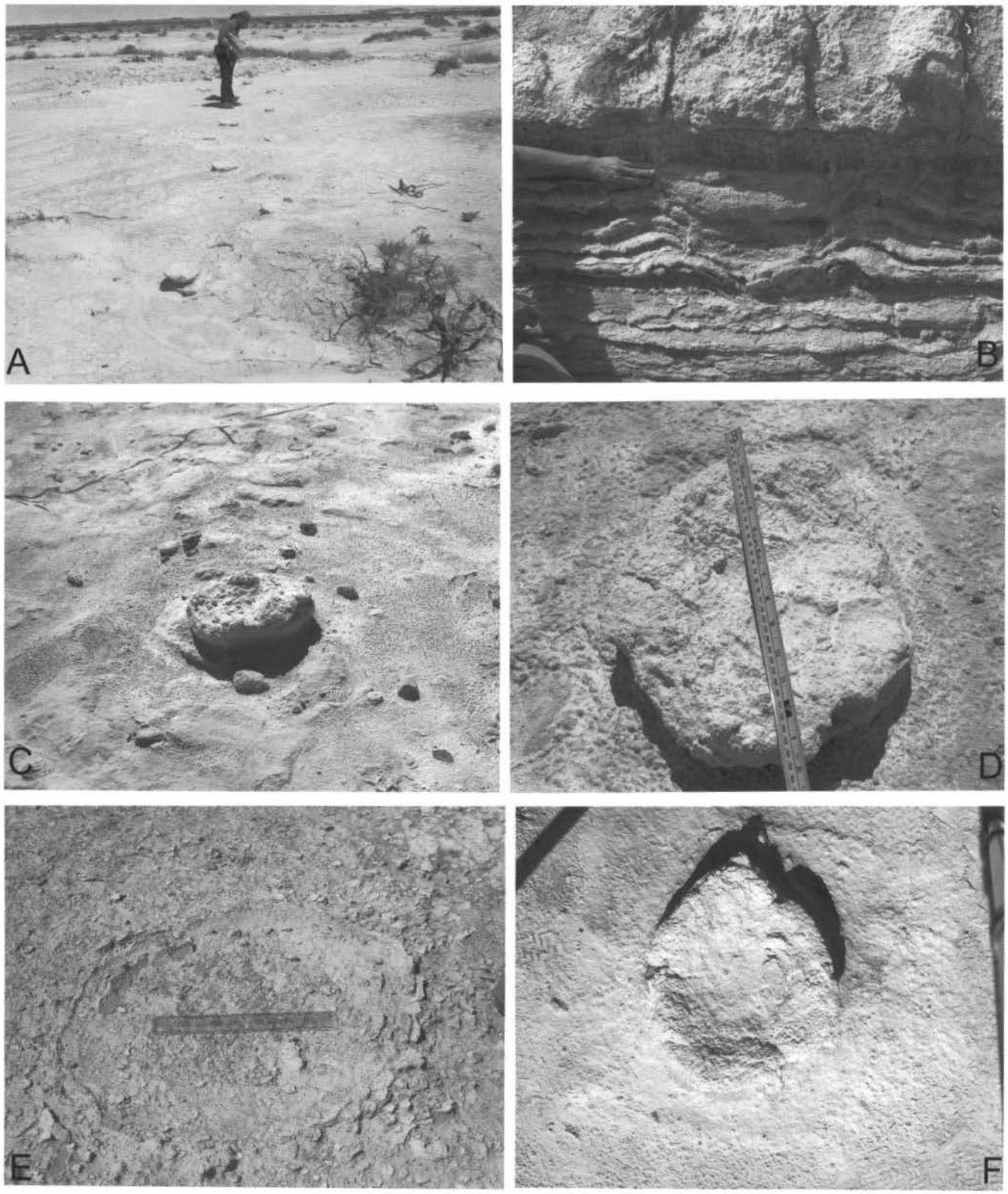

FIGURE 2. Photographs at NMMNH locality 4979, taken in 1981 by Robert A. Corley, U. S. Army. A, Overview of mammoth trackway. B, Track of mammoth in cross section. C-D, Characteristic pedestalled mammoth tracks. E, Very large, "expanded" mammoth track. F, Camelid track.

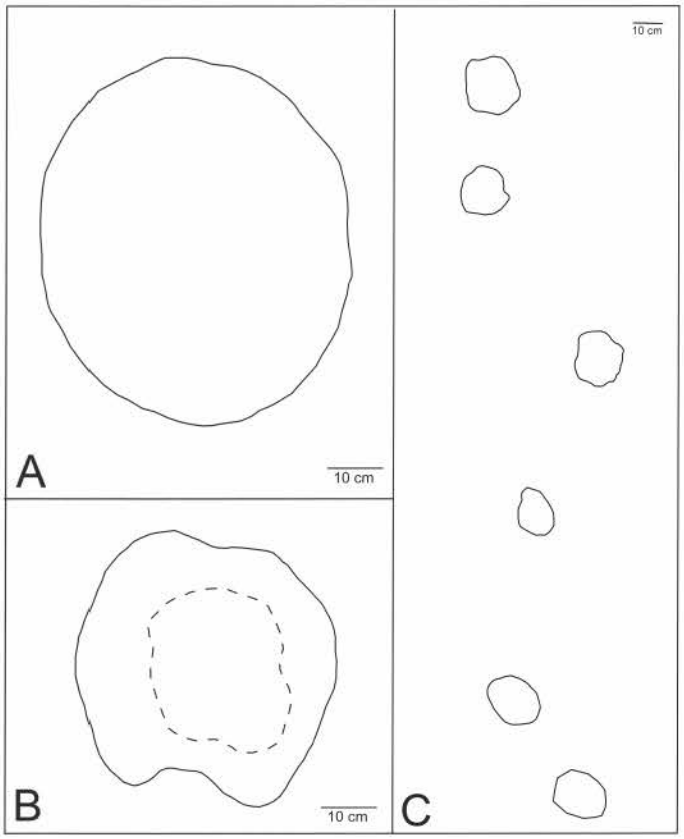

FIGURE 3. Selected tracks from NMMNH locality 4979. A-B, Mammoth tracks. C, Camelid trackway. Anterior is toward top of drawings.

All tracks are preserved in convex relief, and all appear to be undertracks (Fig. 2). In general, the tracks are poorly preserved; their soft gypsite matrix has been deeply eroded. In 1981, cross-sections of some tracks (Fig. 2B) were exposed in an arroyo cut at the site, but this outcrop has eroded away.

The track-bearing layer is a pinkish-gray gypsite (Fig. 1). This layer and surrounding strata are part of the Otero Formation of Herrick (1904), lacustrine deposits of Pleistocene Lake Otero (Lucas and Hawley, this guidebook). Regional mapping of Pliocene-Quaternary basin-fill deposits by Hawley (1983, 1993) and Seager et al. (1987) indicates that the highest stand of the Late Wisconsinan lake was about 1205m (AMSL). Body fossils of mammals from the Otero Formation indicate it is of late Pleistocene (Rancholabrean) age (Morgan and Lucas, this guidebook). About 15 km north of the tracksite, at the northern end of the Tularosa Basin-Alkali Flat area, Hawley (1983, Fig. II-1, p.28-29) also noted the common occurrence of Pleistocene mammalian fossils in fluvial-deltaic facies that are correlative with the highest stage of Lake Otero.

TRACKMAKERS

At NMMNH locality 4979, two kinds of tracks are preserved, those of a large proboscidean, almost certainly a mammoth, and those of a smaller, quadrupedal mammal, a camel.

Mammoth Tracks

At NMMNH locality 4979, there are 25 round to ovoid, large (maximum diameter ranges from 430 to 620 mm) tracks (Figs. 2A, C-E; 3A-B). No separate toe impressions are preserved, and two trackways can be identified, one of four tracks, the other of six tracks. (In 1981, D. W. Love measured a trackway of 12 tracks, but it has mostly eroded away.) Manus and pes imprints overlap, as is typical in proboscidean tracks, and stride length is 2-3 m. These tracks closely resemble previously published tracks identified as proboscidean in being large, round to ovoid impressions (e.g., Johnston, 1937; Brady and Seff, 1959; Scrivner and Bottjer, 1986; Reynolds, 1999; Chandler, 2000).

Given the large size of these tracks and the late Pleistocene age of the Otero Formation (Morgan and Lucas, this guidebook), the tracks are almost certainly those of mammoths. Few metric data on mammoth foot size are available, but an articulated hind foot of a Colombian mammoth from the Hot Springs site in South Dakota has a maximum diameter of ~258 mm (Mol and Agenbroad, 1994). This is much smaller than the tracks described here, but all elephants have fleshy pads around the feet, so foot diameter based on bones is much smaller than actual foot diameter. Indeed, Weber's (1928, fig. 279) illustration of the forefoot of a living elephant indicates that the foot diameter of the fleshy pad is slightly more than twice the foot diameter based on the skeletal elements alone. Also, some of the tracks at NMMNH at locality 4979 appear to have "spread out" (expanded) from the original size because of the viscosity of the substratum walked on (Figs 2E, 3A).

Camel Tracks

One 1981 photograph of a track (Fig. 2F) is characteristically camelid: heart shaped, with two distinct digits and a pointed anterior end. No such clearly preserved tracks remain at the site, but a trackway of six steps (Fig. 3C) shows the pacing gait characteristic of camelids (Webb, 1972; Sarjeant and Reynolds, 1999). These tracks have diameters of 160 to 180 mm, and stride length is about 1.3 m, dimensions compatible with a relatively large camel, such as Pleistocene *Camelops* (Webb, 1965).

DISCUSSION

Tracks of proboscideans and camels are common in the Neogene mammal footprint record. Body fossils of camel (*Camelops* sp.) and mammoth (*Mammuthus columbi*) are found in the Otero Formation (Morgan and Lucas, this guidebook), and these are the probable trackmakers of the mammoth and camel tracks at NMMNH locality 4979.

At the locality, all the preserved trackways are oriented nearly east-west. This suggests the animals walked to and from Lake Otero, most likely to drink. Although human artifacts (chipped stone) have been found near the tracksite, there are no human tracks and no demonstrable human association.

All the tracks at the site are preserved as pedestals; they are in convex relief, standing above the surface of the Alkali Flat (Fig. 2). This is probably because the tracks, upon being impressed in

gypsum, compacted the gypsum and/or allowed water to recrystallize the gypsum disturbed by the tracks and undertracks so that they became more resistant to erosion than the surrounding sediments. Extant oryx are now leaving similar, pedestalled tracks on the Alkali Flat just north of the Pleistocene tracksite.

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APPENDIX-MEASURED SECTION

Section measured at NMMNH locality 4979 (Fig. 1); strata are flat lying. Measurements in meters.

Otero Formation:

7. Gypsiferous sand; yellowish gray (5 Y 7/2); fine to coarse grained; not calcareous. **1.6**
6. Sandy gypsiferous clay; same color as unit 7; calcareous; mollusks; mammal bones. **1.2**
5. Gypsiferous clay; same color as unit 7; calcareous. **0.9**
4. Clay; light olive gray (5 Y 5/2); gastropods. **0.2**
3. Gypsite; pinkish gray (5 YR 8/1); forms an indurated ledge; tracks (NMMNH locality 4979). **0.2**
2. Gypsiferous clay; yellowish gray (5 Y 7/2); calcareous. **0.4**
1. Gypsiferous sandy clay and gypsum; yellowish gray (5 Y 7/2); calcareous. **0.5+**