Abstract:
This study sought to estimate the cremation temperature for a single burial from the Bronze Age (1600–1200 BC) site Béla 103 Jégvármért-Kart, as part of the BAKOTA project. The primary focus of our research was the estimation of cremation temperatures and the conditions of the body prior to cremation. Using a Munsell Soil Color Book, we were able to qualitatively measure the color of cremated remains in order to estimate burning temperature. Determining whether or not the body was cremated with flesh relied on two methodologies: the analysis of color patterns across the body and the identification of specific bone fractures. With the majority of bones being a shade of white, it was estimated that the crematory fires likely exceeded 800°C. Thumblemill fractures along long bones and the prevalence of noncalcined bone fragments on specific areas of the body, such as where two bones articulate, both suggest that the body was cremated while flesh was on the body. Together, these two conclusions indicate that the people of this region during the Middle Bronze Age took care to cremate the dead soon after death and then carefully tended to the pyres, allowing them to reach such high temperatures.

Results:
Of 1,473 observable fragments, 835.6% had curved transverse fractures. When only taking into account tubular bones, 61 of 790 fragments (77.2%) had curved transverse fractures. Warping occurred on over 10% of bones for both tubular bones only and for all examined bones.

Frequency of Color on all Bone Fragments

Discussion:
The presence of curved transverse fractures in numerous bones indicates that the body being examined for this study was cremated while flesh was still attached (Herrmann and Bennett 1999).

Areas with greater tissue depth are usually subject to burning after areas of lesser tissue depth, meaning that exposure time to heat is reduced for heavily fleshed areas of the body (Symes et al. 2015). This was demonstrated in this sample through analysis which suggests that bone calcination is related to anatomical location.

The majority of bones (79.4%) displayed signs of calcination. Therefore, it is probable that the heat source used during cremation exceeded 800°C (Walker et al. 2008). The notion that the body was fleshed at the time of cremation helps explain the lack of uniform coloration, while also providing support that the body was not exposed to its heat source long enough for all bones to become white.

To produce the level of calcination that is seen in this individual, the heat source would likely have been kept at a relatively high heat (McKinley 1989). During this time, a wood fire would not have been constantly refueling in order to keep the temperature above the 800°C needed to initiate the chemical changes that cause calcined bone to form (McKinley 1989).

The different patterns of the cremated remains in concert with the fracture patterns detected helped to surmise that the body being examined was cremated while flesh was still present. From this, it was concluded that the body was likely exposed to the cremation fires of approximately 850°C. These results suggest that the processes of the dead carefully tended to wood fires in order to complete the cremation process for the deceased.

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References:

Materials and Methods:
Ums excavated at the Hungarian site Béla 103 Jégvármért-Kart were microexcavated off-site, each producing fragmented human bones. The specific aim examined in this analysis, designated HB 54, contained thousands of fragments ranging in size from less than a millimeter to over 100 mm.

Remains were separated on gridded paper into categories based on size and location in the body (cranial, postcranial, or indeterminate). Sizes included hypermicron (0-5mm), mosaic (5-10mm), macro (11-50mm), and hypermicron (50-1000mm) (Nemeskéri and Handl 1968) (see Accuf et al. 2016). Bone color was identified specifically using a Munsell Soil Color Chart (Shipman et al. 1984). On bones exhibiting a pattern of temperature, the color indicator of highest temperature was recorded (Walker et al. 2008; Shipman et al. 1984).

A chart detailing the number of calcined and noncalcined bones from the body (Symes et al. 2015).

Figure 1: Orientation of cremated remains in the clay pit. (Shiptman et al. 1984).
Figure 2: Cremated bone fractures on the shaft of a long bone (Photo: László Paja).
Figure 3: Cremated bone fracture on the shaft of a long bone (Photo: László Paja).
Figure 4: Fragments of the Past: An Analysis of Cremated Remains.
Figure 5: Frequency of fracture types on all bone examined.
Figure 6: Frequency of Color on all Bone Fragments.
Figure 7: Frequency of fracture types on all bone examined.