# Human bones in the destruction layer

(From this section of the article online here→ https://www.nature.com/articles/s41598-021-97778-3#Sec60 )

## Upper Tall

If the MB II destruction event at TeH was of sufficient magnitude and abruptness to be fatal for human inhabitants, as the evidence indicates, human remains should exist in the MB II layer. Indeed, human skeletal remains of sufficient size to be positively identified were found on the upper ring road that encircled the upper tall between the MB II defensive fortification wall and the outer wall of the MB II palace. Two human skulls were found about 20 cm apart (Fig. 44a, b), adjacent to a portion of a pelvis and a likely arm bone fragment. One skull was missing the mandible, and the right orbit was crushed about 50%. The second skull fragment consisted only of the upper dentition and lower half of the right orbit. Only two or three rib fragments were found and no other long bones were recovered. The forensic evidence suggests that the two bodies may have been decapitated, dismembered, and disarticulated. The record indicates that most of the bones had been shattered into small pieces and mixed into a matrix of pulverized mudbricks. Currently, it is not possible to determine if the small bones are from humans or small mammals, but their proximity to identifiable human bones makes it most likely that they are human. If so, only ~ 10% of the combined original bone mass of both humans is present as observable fragments within a 75-cm radius from the skulls. The remaining 90% of the two skeletons are missing and assumed to have been destroyed and/or located further away in the sediment matrix.

These skeletons were found on the roadway around the upper tall, where the road was 3–4 m wide. The top of the nearby rampart was several meters wide. The remains were found at a depth of about four meters below the modern surface, well-sealed and undisturbed beneath archaeological sterile strata. The bodies had been rapidly entombed by pulverized mudbrick containing abundant ash and charcoal. No weapons were found associated with the skeletons or evidence of damage by weapons, and neither body showed any indication of exposure to scavengers. Although humans can be mortally affected by earthquakes, volcanism, and warfare, these bone characteristics, both individually and collectively, show no evidence that these human deaths were caused by such events. Furthermore, even though these bones were found in close association with large charcoal fragments, the bones lack evidence of direct exposure to fire, except for the extreme upper ends. Radiocarbon ages of the surrounding charcoal (~ 1650 BCE) are contemporary with those elsewhere in the destruction event.

We also searched and found human bone fragments in palace bulk sediments, ~ 15 m away from the skeletons on the ring road. We quantified bone abundance in the fraction using a > 1.2 mm screen (#12 ASTM sieve). The destruction layer was found to contain ~ 19 bone fragments per kilogram, weighing 3.2 g/kg. The largest bone was ~ 2.1 cm long × 0.8 cm wide (average size of bones = 0.6 × 0.2 cm). In nine other samples, three above the destruction layer and six below, no other bone fragments were observed. After excavating nearly 100 squares (0.36 ha or ~ 1% of the site), researchers have found ~ 10 partial human skeletons, out of an estimated city population of ~ 8000 people2. However, dozens to hundreds of broken and disarticulated bone fragments have been found in each of the 100 squares but these were too small to be conclusively identified as human or animal.

## Lower Tall

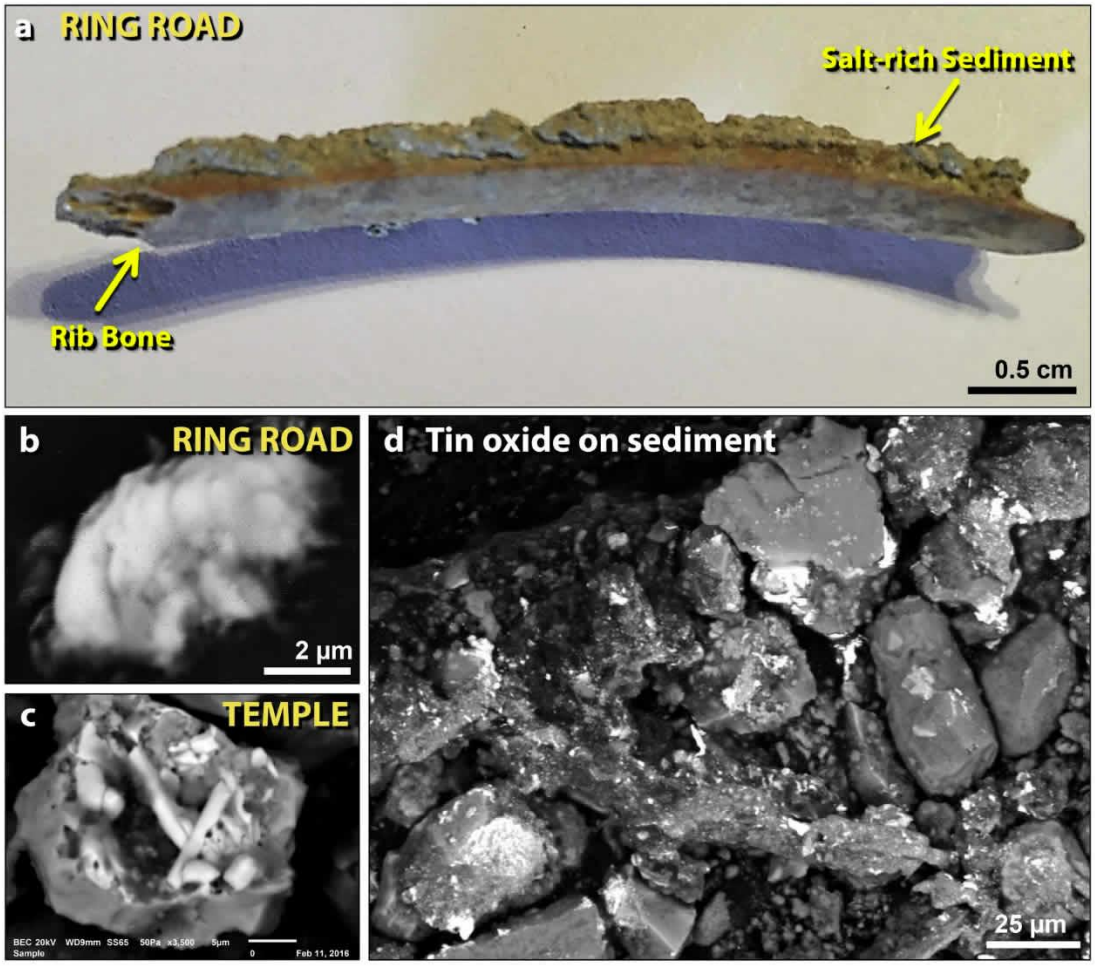
During Season 6139, excavations were conducted in two 6-by-6-m squares along the ring road of the lower tall. Both squares revealed a significant abundance of disarticulated and fragmented human skeletal remains in the MB II destruction layer139 (Fig. 44c). In one square, three partially intact skeletons were found. All bones observed were embedded in a loose debris matrix composed of pulverized mudbrick, ash, and charcoal (Fig. 44c). There are no indications of intentional burial, scavenging, accidental death, violence, or battle damage.

Two osteologists examined the bones of two adults and one child139. Disarticulation of the skeletons was generally severe, and for the adult skeletons, only leg bones were preserved. For one skeleton, ~ 10 cm of the ends of both femurs showed evidence of charring. The remaining skeleton was represented by many fragmented bones found in the surrounding matrix. Metatarsal bones were abnormally hyper-extended (i.e., joints were over-stretched) and the proximal phalanges were hyper-flexed at almost 90 degrees to the metatarsals. The right knee joint of one skeleton also was hyper-extended139. In a nearby child's skeleton, the legs were hyper-flexed backward and the knee joints were disarticulated. Another skeleton was found buried in a crouching position with the hands raised to the face, a posture commonly adopted for protecting the head, as occurred during the volcanic eruption at Pompeii140.

Bones were also found in another square, ~ 6 m south of the square containing the skeletons. This square contained ~ 100 bones/kg with average length of 5.0 mm (range 0.5 mm–4.7 cm) and average width of 1.0 mm (range 0.5–5.0 mm). The largest was a small rib bone (4 by 47 mm), either from a human infant or a small mammal. The bone fragments weighed ~ 6.0 g/kg.

We also observed a 3.5-mm-long charred bone that had been splashed with meltglass (Fig. 45). In one case molten sediment had partially melted and mixed with the bone, flowed, and cooled in place. Previous experiments by Moore et al.17 suggest that such melting occurs at ≥ 1500 °C.

These bones also were associated with geochemical anomalies. The rib bone is visibly salt-encrusted, measured by SEM–EDS at ~ 46 wt.% NaCl, and the NaCl content of the attached sediment was very high at ~ 54 wt.% (Fig. 46a). Anomalously high concentrations of salt were found only associated with the bones and sediment in the destruction layer at 1650 BCE, and not in strata above or below, indicating an unusual influx of salt at that time. The rib bone also exhibits several nuggets of silver and tin oxide ($SnO_2$) (Fig. 46b) with morphologies suggesting that they splashed onto the bone and sediment while molten. Ag melts at ≥ 961 °C and $SnO_2$ at ≥ 1630 °C, although elemental Sn melts at ~ 232 °C. The tin and silver nuggets are also similar to those observed in the surface of melted mudbricks in the palace that were found fused to meltglass in the temple complex (Fig. 46c) and observed splashed across loose sediment (Fig. 46d).




Bone associated with salt and melted tin oxide ($SnO_2$). (**a**) Photomicrograph of 4.7-cm-long human or mammal rib bone from the ring road on the lower tall. NaCl is present at high concentrations in the sediment (~ 54 wt.%) and on the bone (~ 46 wt.%). (**b**) Tin oxide particle ($SnO_2$) appears to have collided with sediment on the bone while it was molten, possibly as unoxidized tin. The melting point of $SnO_2$ is ~ 1630 °C, but unoxidized tin melts at ~ 232 °C. (**c**) A similar tin oxide particle from the temple, ~ 150 m away from the lower ring road sampling site. Particles are fused into meltglass. (**d**) Tin oxide splashed onto sediment around the bone in panel '**a**'.

## Discussion of human bones

A medical doctor (co-author T.W.) inspected the human bones and concluded that the injuries occurred perimortem, including damage to the eye socket of one skull. We propose that the individuals represented by the bones were violently torn apart by a powerful airburst/impact, leaving only a few hand and foot bones still articulated and unbroken. It would not be possible to duplicate these injuries and disperse the bones as found in this layer by warfare or by accidental falls from a great height, e.g., off the adjacent rampart. Although tornadoes (max winds of ~ 512 km/h or ~ 318 mph) can cause bone breakage, organ damage, and disarticulation (Supporting Information, Text S3), they are exceedingly rare in Jordan or Israel and typically of low intensity. In any event, no known tornado has been shown to burn bones and break them into small fragments.

The most severe known injuries to human bodies result from the impact of airborne high-velocity objects, such as during explosions and tornadoes (Supporting Information, Text S3). In addition, the

ground-hugging blast wave from an airburst/impact would be laden with high-velocity missiles, including sand, gravel, pulverized mudbrick, plaster fragments, potsherds, broken branches, and shattered timbers. At tornado-force wind velocities and extremely high ambient temperatures, these missiles would be capable of incinerating/stripping flesh and crushing bones. Current evidence suggests that the human mortality rate at TeH was very high, so that most likely none of the ~ 8000 inhabitants survived.

Based on the distribution of human bones on the upper and lower tall, we propose that the force of a high-temperature, debris-laden, high-velocity blast wave from an airburst/impact (i) incinerated and flayed their exposed flesh, (ii) decapitated and dismembered some individuals, (iii) shattered many bones into mostly cm-sized fragments, (iv) scattered their bones across several meters, (v) buried the bones in the destruction layer, and (vi) charred or disintegrated any bones that were still exposed.

In summary, although man-made explosives and atomic bombs can account for an extreme range of damage to humans, they can be ruled out because of the age of the site. In addition, warfare, accidents, and tornadoes can be eliminated because they are incapable of causing the observed severe skeletal damage at TeH. The circumstances and condition of the human bones and fragments suggest that at the moment of death, these individuals were going about normal activities inside the palace, on the upper ring road, and/or on the rampart above the road, where they were struck by a high-temperature thermal pulse, followed by a hyper-velocity blast wave from a catastrophic cosmic airburst. This event was most likely larger than the airburst at Tunguska, Siberia in 1908, where ~ 500 reindeer and several herders within the blast radius suffered severe burns and were killed, but suffered no disarticulation.

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Full article here → https://www.nature.com/articles/s41598-021-97778-3 entitled:
“A Tunguska sized airburst destroyed Tall el-Hammam a Middle Bronze Age city in the Jordan Valley near the Dead Sea” by Dr. Phillip J. Silvia

## **Other details from this article linked above**:

1. Provides detailed forensic evidence that a cosmic airburst obliterated Tall el-Hammam.
2. Excavation team documented a massive 4.5-foot-thick (1.5 meter) destruction layer beneath the surface of the artifact-filled, half-mile long mound.
    a. Usually these remaining mounds (or, tel, or, tall) indicated the remains of a deliberate burning from military conquest or accidental burning due to human negligence or natural events such as earthquakes. These causes are easy to identify
    b. This mound (tel, tall) was caused by something other than the normal events
3. In 2014, after fifteen field seasons of excavation and archaeology, the Comet Research Group (CRG) made of 20 scientists visited the site at Tall el-Hammam to investigate.
4. The 40-foot tall, four to five story palace had been demolished.
5. The 13-foot-thick mud brick defensive wall of the city had been blasted away.

6. Human skeletal remains showed fragmentation and extreme disarticulation indicating the bodies had been violently ripped apart by the blast.
    a. Dr. Allen West, CRG: “Among more technical evidence, we discovered human bones that had been splattered by molten glass from the event. The glass is indistinguishable from that found at ground zero after atomic explosions. These people were killed by the heat and pressure of an atomic-like explosion but without the radiation.”
7. Heat experiments indicate the temperatures would have instantly exceeded 3,600-degree F (2,000 degree C) which is hot enough to turn a truck into a molten pool of iron.
8. Key finds:
    a. Evidence for high-temperature burning of the city.
    b. Melted construction materials
    c. Minerals and materials subjected to extremely high pressure and temperatures.
    d. Human bone fragments in the destruction layer
    e. High salt content of the soil associated with the destruction and its implications for agriculture in the region
9. The city could possibly have been destroyed by ten different destructive methods including:
    a. Warfare
    b. Fire
    c. Earthquakes
    d. Volcanism
    e. Lightning
    f. Only one option explains all the features found in the destruction layer: a cosmic airburst, caused by a nearby comet or meteor explosion that exploded near the northern end of the Dead Sea a few miles southwest of Tall el-Hammam.
        i. Only plausible formation mechanism that can account for the entire range of evidence is a crater forming impact OR a cosmic airburst, most likely somewhat larger than the 22-megaton airburst at Tunguska, Siberia in 1908.
10. A cosmic airburst over the north end of the Dead Sea brought some level of destruction across the Jordan Valley north/northeast of the Dead Sea destroying 15 other cities and 100 small villages making them uninhabitable for 300-600 years.
11. They found broken clay pottery (potsherds) that had been subjected to such high temperatures that it had melted and formed bubbles, with no clear evidence of what could have produced such extremely high temperatures.
12. The debris in the destruction layer was unusual not only for its having been subjected to extremely high temperatures, but also because it was thrown down in a specific direction – from the southwest to the northeast, indicating the destructive force originated in the air southwest of the city near the northern end of the Dead Sea.
13. Pottery and construction materials that had melted at temperatures of over 2700 degrees F
14. Inexplicably high salt content in the soil.
15. The airburst would have caused in rapid succession a high-temperature thermal pulse from the fireball that melted exposed materials (clay roofing, mudbricks, pottery). This was followed by a high-temperature, hypervelocity blast wave that demolished and pulverized mudbrick walls leveling the city.