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The recovery for display of a 1,600-year-old roasting pit feature from Head-Smashed-In Buffalo Jump

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ABSTRACT

Dozens of pre-contact pit features have been recorded during excavations of the processing area at Head-Smashed-In Buffalo Jump, in Alberta, Canada. In 1990 a largely intact 1,600-year-old roasting pit feature was located and left *in situ* as it was considered a good candidate for future display, should an opportunity present itself. In 2016 that opportunity was realized with the planned development of the new Royal Alberta Museum in Edmonton. The feature was relocated, excavated, and enclosed in a plaster jacket using a technique commonly used by paleontologists for fossil recovery. After removal and transport, the final excavation of the feature was accomplished in the museum, allowing optimal excavation conditions that produced some unusual results. This methodology allows the preservation and long-term interpretation of archaeological material, providing an alternative to dismantling these features under standard archaeological research conditions.

KEYWORDS

Roasting pit feature, earth oven, Head-Smashed-In Buffalo Jump, plaster jacket, museum studies, canid

1. Introduction

In 2018 the Alberta Government opened the new Royal Alberta Museum building in Edmonton. As part of this effort, all of the curatorial programs designed new exhibits to help interpret the province's natural and human history. The archaeology program proposed that a feature that had been partly excavated in 1990 at Head-Smashed-In Buffalo Jump (HSI) would be a desirable and informative exhibit. The feature is a largely intact example of an Indigenous earth oven used for roasting food. In September of 2016 staff from the Royal Alberta Museum, the Head-Smashed-In Interpretive Centre, the Royal Tyrrell Museum of Palaeontology, and a horde of volunteers spent a month exposing the feature and encapsulating it in a plaster jacket, after which it was removed and transported to Edmonton. For the next year Archaeology, Exhibit, and Conservation staff prepared the feature for display where it can now be observed in the Ancestral Lands Gallery in the Human History Hall at the Royal Alberta Museum.

2. Study area

Head-Smashed-In Buffalo Jump, DkPj-1, is a multi-component precontact site situated on the southeast edge of the Porcupine Hills in southwestern Alberta (Reeves 1978, 1983; Brink 2008) (Figure 1). A long north-south trending sandstone escarpment (Figure 2) has been used as a communal bison kill site by Indigenous people for at least 6000 years and probably much longer.

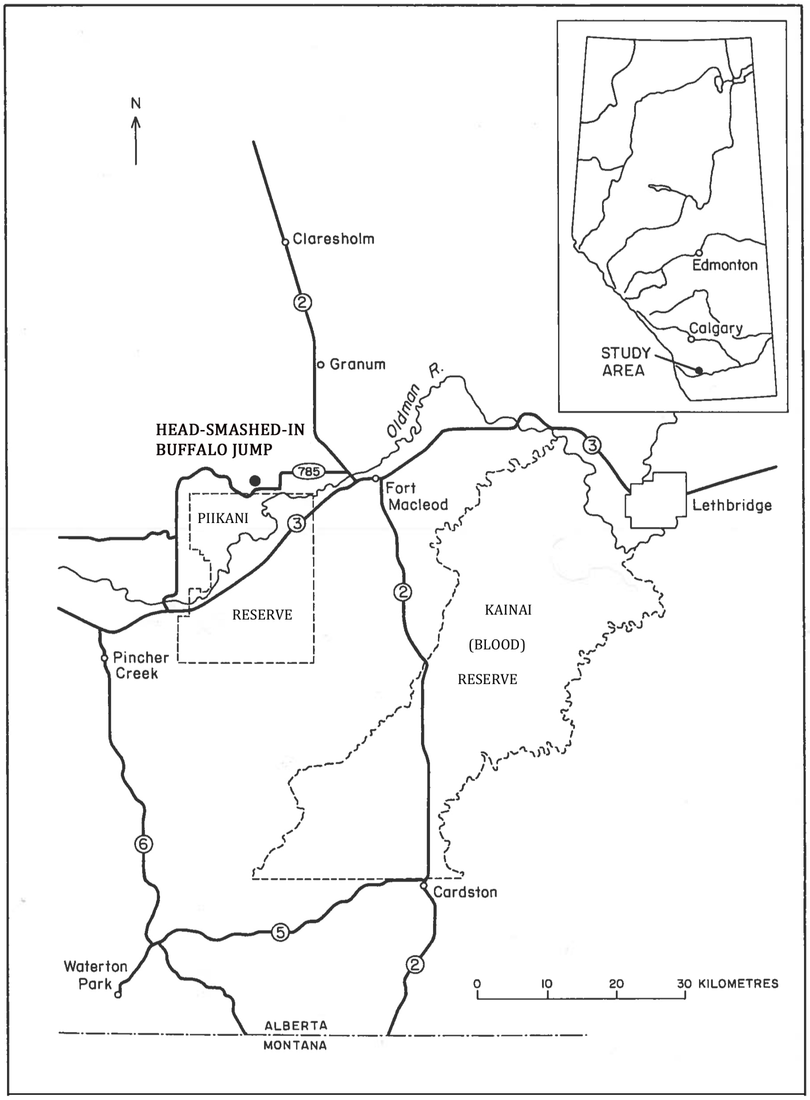

Figure 1. Study area map.

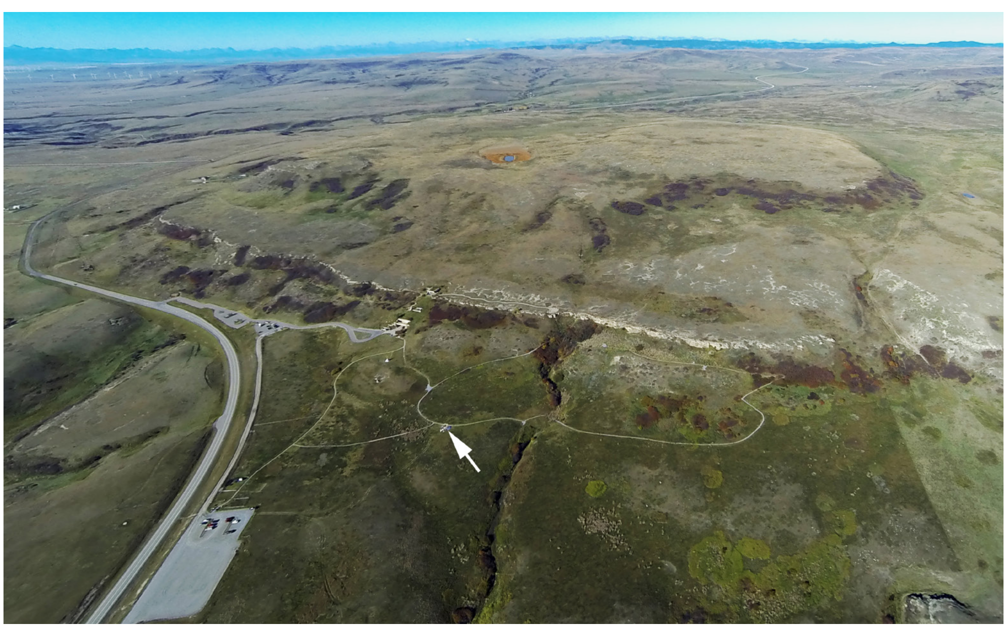

Figure 2. Aerial view of project location looking southwest. The Rocky Mountains can be seen on the horizon.

Excavations by various researchers starting in the late 1930s mostly focused on the cliff side deposits – the kill site where tens of thousands of bison were killed and butchered, leaving a deep stratified record attesting to countless episodes of use and reuse of this effective bison trap. The bias of targeting the excavation of kill site deposits that featured considerable numbers of diagnostic artifacts such as thousands of arrowheads and atlatl dart tips in stratified deposits, was a common feature of bison jump research, not just at Head-Smashed-In, but generally across the plains.

Between 1983 and 1990, in a departure from the allure of kill site deposits, the Archaeological Survey of Alberta conducted excavations that concentrated on the processing area below the kill site (Brink et al. 1985; Brink et al. 1986; Brink and Dawe 1988; Brink and Dawe 1989; Dawe and Brink 1991). The processing area is a vast distribution of cultural material that parallels the cliff for about a kilometre and extends several hundred metres onto the prairie level east of the cliff. More than one hundred acres bear the residue from butchering and processing bison, and the remains of campsite activity including cooking, food preparation, tool manufacturing, maintenance, and retooling. The continued reuse of this area over thousands of years has resulted in the accumulation of a dense pavement of butchered bone, rock used to process the bison, and artifacts in a veritable midden. This midden is about a half a metre thick in the core area near the cliff, and gradually thins out to the edge of the slope on the prairie level below. Amongst this debris hundreds of features have been identified, principally boiling pits, hearths, and roasting pits. From 1987 to 1990 the processing area excavations concentrated on a four-metre wide and eleven-metre-long block excavation, oriented north-south, parallel to the cliff, which is approximately 200 metres to the west. In the last week of the four-year project investigating this area, the lens shaped edge of a pit feature was identified just under the pavement of processing debris, extending out from the excavation's west wall (Figures 3 and 4).

As the excavation proceeded the feature was observed in profile to have the characteristics of an earth oven-style roasting pit. (Figure 5). At HSI these can be discriminated from other types of hearth and pit features by the exclusive use of sandstone lining the floor of the pit and the presence of charcoal indicative of an *in situ* wood fire. The typical components of earth oven construction are: a heating element in a basin that can be comprised of rocks heated in a fire and/or hot coals; a green vegetal packing in which food is wrapped; and, an earthen cover (Thoms 2009; Koenig 2023).

Figure 3. Plan view of Feature 90-2 at 65 centimetres below datum (BD) in 1990 excavation. Note canid phalanges in lower center.

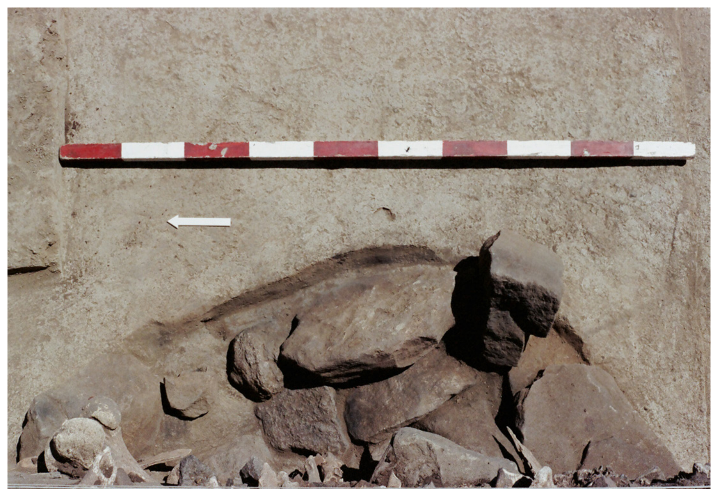

Figure 4. Plan view of Feature 90-2 at 70 centimetres BD in 1990 excavation.

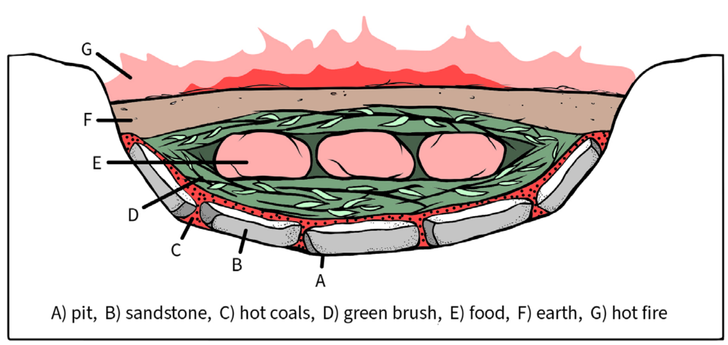

Figure 5. Schematic profile of earth oven showing presumed construction of HSI feature 90-2 (figure by Emily Moffat).

Earth ovens are widespread worldwide and they have been observed to have been in use throughout the Holocene in North America (Wandsnider 1997; Dering 1999; Thoms 2009; Black and Thoms 2014; Koenig 2023). Wissler provides a description of this practice amongst the Blackfoot:

> "A method of cooking in a hole was sometimes used for meats. At the time of the buffalo drive, a hole might be dug in the ground, many hot stones placed in the bottom and over these a layer of willow branches and grass. Next, a layer or two of foetal and newly born calves over which again were spread branches, grass and finally earth. This was spoken of as a dry cook. The hole was usually filled in the evening and by the following day it would be ready to uncover. A variation of this was similar to the mode of roasting camas. A hole was dug to the depth of four spans of the thumb and fore finger and lined with hot stones and brush as before. Dressed calves were wrapped in fresh hides, two hides spread over the brush, water poured in, the calves quickly placed and the whole covered with two more fresh hides. The upper hide was stretched and staked. Then the earth was heaped over all and a fire kindled on top" (Wissler 1910:25,26).

The feature we recovered varied from these descriptions only in that it appears the stones were heated *in situ*, as the considerable amount of wood charcoal found amongst the large sandstone slabs on the floor of the pit would attest. Heating rock within the pit used for an earth oven was most typical (Thoms 2009; Koenig 2023). In the profile of this pit not only are the heated rocks and faunal remains evident, but apparently also what appeared to be a capping layer of earth and evidence of a superior wood fire on top. Just above the stone basin, the articulated bones of two adjacent canid feet and the sacrum and presumed articulated lumbar vertebrae of a juvenile bison were observed sticking out of the profile. Both sets of faunal remains extended west into the profile of the adjacent unexcavated pit. This feature occurred beneath the midden and other than some superficial rodent disturbance, there was no apparent intrusive disturbance.

Given the articulated nature of the post cranial remains of each of a canid and an immature bison we suspected further excavation would reveal perhaps largely complete skeletal remains, and further, that perhaps this represented a prepared roasting pit containing an uneaten meal. In our experience of the recovery of numerous pit features, finding articulated faunal elements of any kind was extremely rare. To find the articulated remains of two animals in the same pit fueled the interpretation that this feature was intact. As this feature had all the hallmarks of a possibly unopened intact pit, we regarded this as an excellent candidate for future display material, perhaps as an *in situ* display at the site. The totally exposed faunal remains were recovered, but otherwise the feature was left intact. All the sandstone blocks and any other component parts of the feature including partly imbedded bone and charcoal were left in situ. Despite our desire to create an on-site display of this unique feature at Head-Smashed-In, no solution for a practical display was deemed feasible in 1990.

3. Field and laboratory methods

3.1 Excavation

Twenty-five years after roasting pit feature 90-2 was identified, the Alberta Government announced the Royal Alberta Museum was going to be moved to a new location in downtown Edmonton. As new exhibits were required, an opportunity to retrieve the roasting pit for display presented itself. It was proposed that by using a plaster jacket technique the feature could be picked up intact and transported to Edmonton for display. Plaster jackets have long been used as a method of recovering archaeological objects (White 1955), but in our experience this method has not been used to remove an archaeological object of this size intact from the ground for display, at least in Alberta. Paleontologists on the other hand regularly recover quite large and heavy dinosaur fossils using a plaster and burlap jacket technique (Auffenberg 1967; Greenwald 1989; Brown 1994; Hone 2009). For this reason, we consulted our sister organization, the Royal Tyrrell Museum of Palaeontology in Drumheller, which provided the services of Darren Tanke for assistance. In Darren's experience this was an ambitious, very large object recovery, but despite the archaeological nature of the material, there seemed no reason why this plaster jacket method should not work.

In September of 2016 with the support of the staff of the Head-Smashed-In Interpretive Centre and the approval of the Blackfoot elders advisory committee, we undertook the retrieval of this cultural feature.

The roasting pit feature as left in 1990 was relocated by removing backfill from a one metre by three-metre area in the southwest edge of the 1987-1990 block excavation. It was determined that by extending the southwest margin of the block excavation two metres westward and extending the southern boundary of this unit three metres north, a new six square metre area would be sufficient to completely expose the feature and enough of the surrounding matrix to facilitate removal (Figure 6). This expectation was satisfied, and no further excavation was necessary.

To identify the feature limits we stripped off the processing area debris using the same methodology in 1990, excavation by a variety of small hand tools and screening through a ¼ inch mesh. In this 30 centimetre deep by six square metre area, less than two cubic meters, we recovered more than 20,000 pieces of bone, mostly bison longbone fragments, over 14,000 pieces of principally non-sandstone FBR weighing over 300 kilograms, and approximately 5,000 pieces of lithic debitage and stone tools. The sub ¼ inch sized cultural material that passed through the screen is likely considerable, but for the purposes of this project, was not practical to recover. The profile on the east edge of the feature excavated in 1990 was found unchanged by any disturbance in 26 years and was left intact for the plaster jacket (Figure 7).

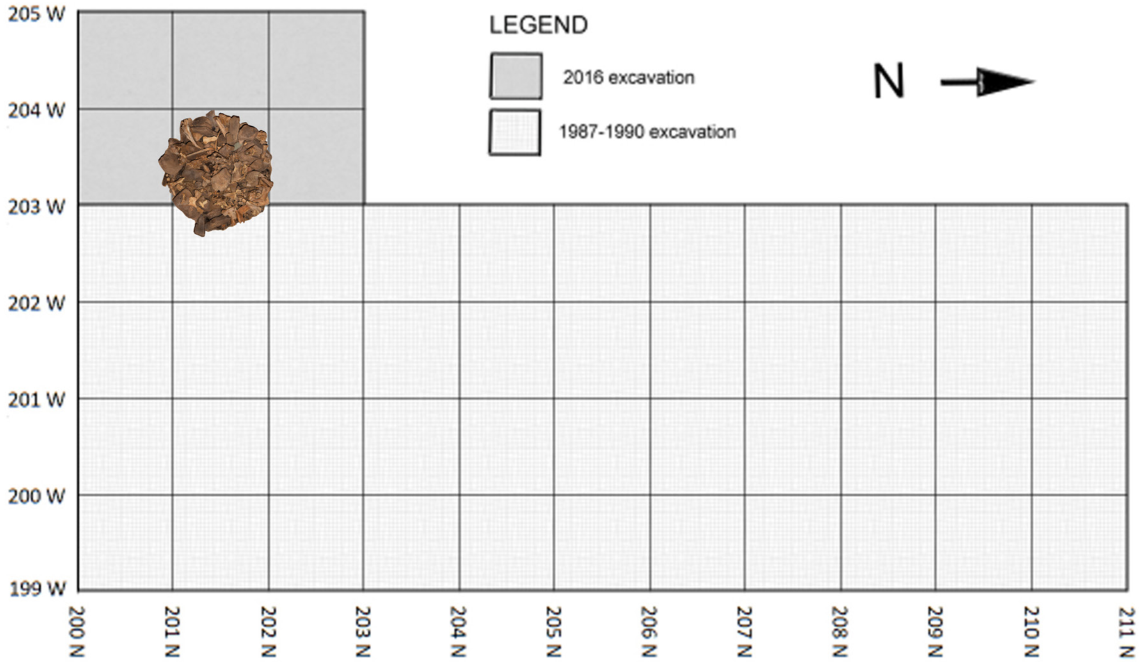

Figure 6. Plan view of location of roasting pit feature 90-2 in processing area excavation showing extent of 1987-1990 excavations and the extension to retrieve the feature in 2016.

Figure 7. 2016 excavation after uncovering the profile excavation in 1990 and removing the processing area midden from around the feature with the new excavation in 2016. The basin in the back right is another excavated roasting pit.

3.2 Consolidation

We had trouble determining the upper limit of the feature contents as the processing midden laid directly on top of the feature. At this stage, when in doubt, anything at the correct elevation based on the profile was left *in situ* for later excavation in the lab. Excavation of the feature stopped as soon as bone started to show up. The partially exposed faunal remains were treated with a consolidant where needed and were re-covered for protection; the excavation focused on delimiting the extent of the perimeter of the feature. The horizontal extent of the feature was much easier to discriminate than the vertical limit as the feature had intruded into a largely sterile sediment.

Once the limit of the feature was identified, it was pedestalled by excavating down about 20 centimetres outside from what was perceived as this horizontal limit and the process of jacketing began. The Head of Conservation of the Royal Alberta Museum, Carmen Li, joined us to provide conservation measures and consolidate the feature, and Darren Tanke, Senior Museum Technician from the Royal Tyrrell Museum of Palaeontology, came to direct the plastering process.

As we excavated, where bone was exposed and observed to be fragile or friable, it was treated with a dilute solution of consolidant (Figure 8), and this bone was then covered with tinfoil when dry. The consolidant used for bone was Butvar B-76, which we diluted with ethanol. A protective layer of fill mixed with a water-based consolidant was applied and smoothened to cover any overhanging edges of rock or faunal material. Even bone that didn't require consolidation was covered with tinfoil and covered with the consolidated earth mixture for protection during transport. At this stage it was necessary to smooth the surface because the plaster when applied later finds its way into nooks and crannies where allowed, and the removal of the plaster when dry would pull on any imbedded projections, damaging the feature. The consolidant used for the sediment was a water soluble acrylic emulsion, Acrysol WS-24. Utilizing different consolidants that used different solvents, ethanol and water for each of the faunal remains and the sediment respectively, provided the benefit of being able to work on one material without affecting the other. For example, soil could be removed from close proximity to a fragmentary bone by spraying the area with water and removing the loosened sediment without affecting the integrity of the consolidated bone. Where faunal material had been exposed and was now covered with a protective layer of earth, some flagging tape was affixed in the sediment cap at that location to alert future excavators of the position of near-surface bone (Figure 9). Once all projecting elements were capped with fill and the surface smoothened over, the entire surface of the feature was sprayed with Acrysol -WS-24. In preparation for plastering, we laid a layer of tin foil over the exposed sediment cap (Figure 10). This is to prevent plaster from leaching into the surface when applied and makes for easy separation of the plaster jacket at the time of removal.

Figure 8. Carmen Li applying consolidant to large canid skull during excavation.

Figure 9. Isolated feature. Flagging indicates near surface bone.

Figure 10. Application of tinfoil to feature cap prior to plaster application. The overlapping tin foil seams were sealed with masking tape so wet plaster did not leak into the feature.

3.3 Plaster jacket

We use the term "plaster" in the generic sense, as palaeontologists use a variety of different plaster and plaster-like substances to make plaster field jackets for fossils. In our case, the plaster we used, Hydrocal® FGR-95, should not be confused with plaster of Paris. Hydrocal® FGR-95 is a fibreglass reinforced gypsum cement. This product was selected because of its strength characteristics which, compared to plaster of Paris, only requires about a third of the jacketing to achieve the same strength of jacket.

The "plaster" was prepared by mixing a slurry of water and FGR into a creamy consistency. Long and narrow strips of coarse woven burlap, roughly a metre long by 15 to 20 centimetres wide, were soaked in this solution and lightly squeezed of excess, then applied to all exposed areas in several layers and in alternating orientations (Figure 11).

Figure 11. Plastering of feature.

After the top of the feature was entirely encased in plaster, we continued to excavate down around the sides using trowels, shovels, and a pickaxe to pedestal the feature and facilitate excavation beneath it. We then started to undercut the edges of the feature, working plaster and burlap strips under the overhang as soon as it was exposed, wrapping the loose ends of the burlap up over the top of the jacket to hold them in place (Figures 12 and 13). After jacketing the undercut portions, we carefully dug through the sediment forming the jacket pedestal resulting in a series of narrow, parallel tunnels. After each tunnel was done, extra long, wet FGR and burlap bandages were passed through them, pulled up and tight by people on either side and pressed and smoothed onto the sides and top of the jacket. Four or five layers were used. Once set, wood shoring was inserted and also used around the circumference of the jacket. Stacks of shoring were removed one at a time to do more plastering work, then replaced as this process was repeated. This way the jacket was always supported despite removal of most of the supporting matrix. Once the FGR bandages in the tunnels had set, the remaining matrix pillars on the bottom were removed and FGR bandages applied again. Once those set the wood shoring was added and the entire block was supported by wood shoring and still *in situ* (Figure 14).

Figure 12. Plastering the underside of the feature as it was being exposed.

Figure 13. Undercutting detail.

Figure 14. Detail of shoring during excavation and plastering under the feature.

The plaster thickness for the most part was between 5 to 10 centimetres and a bit thicker around the bottom. When dry, this plaster is extremely hard and strong: a nail cannot be pounded into it. This plaster process took several days.

Without knowing its lower limit, we ensured the bottom of the plaster jacket was deeper than the feature as we did not want to take the risk of excavating too close to the feature bottom and having the fill collapse and drop out. Despite careful shoring a brace was integrated onto the jacket to support the southeast corner as the jacket was perceived to have a bit of a lean (Figure 15). When the plaster was complete, the finished product looked like an alien spaceship.

Figure 15. Feature jacket completed.

3.4 Transport and delivery.

A flatbed truck with a cherry picker and cargo straps were brought the site and the object lifted and placed on a bed of large truck tires to cushion the load (Figures 16 and 17). At this point our plaster jacket feature weighed 1,370 kilograms and was two metres in diameter. After transport to Edmonton the object was temporarily placed on a custom-built wood frame to facilitate further work (Figure 18), and supportive legs were integrated onto the object bottom using lumber and plaster.

Once the object was fitted with supportive legs, the temporary stand was removed and the plaster jacket top was cut off in one piece by cutting around the perimeter of the top edge using an angle grinder and multitool saw (Figure 19). This was a very dusty job for which several vacuum and Hepa filter options were employed to reduce the dust. Face masks were also employed. The plaster top of the object came off very neatly in one large piece with the tinfoil still adhering on the underside of the plaster. We were relieved to see the contents of the feature had not been disturbed by the removal and transport (Figures 20 and 21).

Figure 16. Lifting the jacketed feature using a cherry picker.

Figure 17. Jacketed feature supported on bed of tires for transport to Edmonton.

Figure 18. Positioning jacketed feature on temporary custom-built stand to facilitate construction of permanent legged base.

Figure 19. Cutting open the plaster jacket.

Figure 20. Jacketed feature after removal of tinfoil-lined plaster cap. Flagging, labels, and tinfoil clad objects were all intact and none of the jacketed contents were dislodged or otherwise affected during transport.

Figure 21. Side view of legged feature jacket and feature prior to excavation.

3.5 Final excavation

We then had the luxury of finishing the excavation of the roasting pit indoors in a lab. Excavation was conducted with trowels, grapefruit knives, dental picks, bamboo skewers, paint brushes and whisk brooms (Figure 22). All matrix was vacuumed and retained for fine screening.

Once the superior layer of consolidated matrix was removed the contents of the feature were fairly easy to discriminate from the remnants of the overlying processing midden – there was a notable contrast in the colour, consistency, and content of the overburden. Probably the most obvious distinction between the feature fill and processing midden overburden is that the latter was a veritable pavement of fragmented bone and boiling stones with almost no sandstone and few intact faunal element portions. Although we were confident that the original feature contents were intact, some clearly later materials, particularly bone, had evidently found its way into the pit at some point after the pit was used. Any of the faunal remains in the pit feature, including the oven contents and materials that found their way into the pit depression shortly after the feature was used, retained better integrity than the midden bone presumably because it was not exposed on the surface as long.

After we exposed the feature contents and objects we wished to retain as part of the exhibit, it was often necessary to apply consolidant to supportive underlying matrix and pedestals. This ensured each object would have enough support long-term and the feature wouldn't deteriorate and crumble over time as the sediment dried out.

With a couple of exceptions noted below, all the stone comprising the feature was Porcupine Hills sandstone. This contrast between the feature rock and that in the midden is quite distinct and was observed during excavation. One factor that introduced some overburden into the feature was an observed rodent burrow, presumably ground squirrel, that entered one side of the feature and exited the opposite side, at a level just above the floor of the feature basin. The offending rodent took time to disassemble what had been apparently one articulated canid foot and chewed through part of a bison maxilla. At some point in time the burrow collapsed, dropping a few pieces of FBR and bison bone scrap into this burrow. Some of these were left in the contents of the displayed feature for interpretive value. Amongst this collapsed burrow fill a heavily worn and flattened distal end of an apparent conical pestle was observed and left *in situ*.

Figure 22. Conservation team excavating in the lab. Finger is pointing at stake void observed during excavation.

Excavating in the lab yielded results that probably would not have been possible had the feature been excavated in the field. During the excavation in the lab, a circular ¾ inch diameter hole was observed extending down into the matrix (Figures 22 and 23). We poured plaster into it, and as the fill was removed around it, we found we had cast a void left behind by a previous project where someone had apparently unsuccessfully tried to hammer a steel stake vertically into the ground and had hit a large flattish quartzite cobble core that was, at that time, about 20 centimetres under the surface, and coincidentally, above our feature (Figures 24 and 25).

The large cobble core would have been invisible to whoever was trying to establish perhaps a datum or pit corner using a steel stake. Impact marks on the cobble show four failed attempts at pounding the stake into the ground before the last blow deflected the stake downward off the edge of the cobble at an angle, penetrating through an underlying bison legbone shaft. Apparently at that point the stake was removed, as it would have been at an angle, leaving the hole where the stake had been, and the telltale evidence of frustration chipped into the upper surface of the quartzite cobble. Although not part of the feature, this component of the assemblage, both the large cobble and stake cast, was retained for interpretation.

Figure 23. Stake void when first exposed. Plaster was poured in before further excavation to see if we could determine the source of the hole.

Figure 24. Roasting pit excavation near completion. Plaster stake cast (white) can be observed just right of center. Note the area on the east (right) side of the feature was excavated down to the rock basin in 1990 and all bone not partly imbedded in the profile was removed at that time.

Figure 25. Detail of post occupation disturbance. Dark gray painted plaster cast of stake hole. Note adjacent chips off the cobble core from failed attempts at driving stake. The stake split a deeper bison longbone after deflecting off the buried cobble. Note distal canid tibia adjacent to a canid foot that was disarticulated by rodent disturbance. FBR in lower right dropped into rodent burrow from midden above feature.

The plaster cast of the stake was painted dark gray to look more like the color of the spike that would have occupied this void, however briefly, at some point in the past. Clearly had the large cobble core and stake cast been removed, more of the primary contents of the roasting pit would have been exposed in this area. The cobble core is certainly intrusive – it is lying on top of some of the faunal remains in the feature.

3.6 Exhibit preparation

Much of the remaining work in making this a display involved stabilizing and leveling the object and fitting it into a display case. A square plywood case was constructed to house the feature in which the plaster footed feature was positioned (Figure 26). To stabilize the feature and support it in the case, expanding foam was injected under the bottom and around the sides of the feature (Figure 27). The foam used was a slow rise pour-in-place low pressure polyurethane foam. The object now looked like a round patch of bone and rock in sediment surrounded by white foam in a square box. The foam was then covered with a plywood layer onto which was affixed a layer of plankfoam.

Retained sediment was mixed into a paste with adhesive and applied over the plankfoam, and then carved to resemble the appearance of the original excavation unit when in the ground. Some screened matrix had been retained from an adjacent excavation unit at the site for this purpose. When this matrix was applied to the apron around the feature, the colour did not match, despite the fact the fill had been recovered from elsewhere in the same excavation at the same depth. On closer inspection, the sediment around the feature was observed to have a slight pinkish cast that was unlike the grey-brown colour of the natural silt we had retained. We realized this pinkish cast must have been due to the heat generated by the roasting pit operation which had oxidized the adjacent matrix.

To more closley match the colour, the retained sterile sediment was heated in a barbeque until the same oxidized color was achieved at 600 degrees Fahrenheit. Such "thermally oxidized sediment" is a characteristic of the intense heat achieved by the heating element in an earth oven (Black and Thoms 2014:215). It is clear that the fire that heated the rocks (and accounts for the charcoal) was prepared *in situ* rather than a construction involving hot rocks and coals added to a prepared pit. Initially the roasting pit must have been extremely hot, to achieve a temperature of at least 600 degrees Fahrenheit as far as 30 to 40 centimetres through the sterile sediment that surrounded the feature.

Once the apron around the feature was completed, and a few of the tools used in the excavation were placed to add interpretive value (Figures 28 and 29), a glass case was installed, and the feature went on display in the Ancestral Lands gallery at the Royal Alberta Museum (Figure 29).

Figure 26. Detail of fabrication of display case assembly. Upright boards are supports for plywood apron.

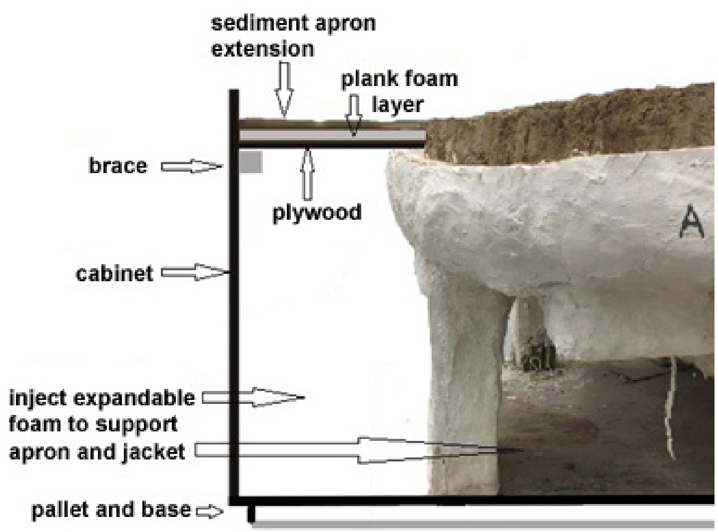

Figure 27. Detail of cabinet and apron support. Note expandable foam location on the bottom and sides.

Figure 28. Plan view of finished roasting pit feature prior to installation.

Figure 29. Finished roasting pit display in the Royal Alberta Museum.

4. Results of excavation

4.1 What we expected

The roasting pit feature was identified at the end of the 1990 field season at HSI. At an approximate depth of 30 centimetres below the original ground surface the first indications of an unusual feature were encountered. At the base of the midden a distinct film of charcoal representing a wood fuelled hearth was encountered (Figure 30).

Charcoal in the processing area is uncommon as the fuel encountered in hearths at Head-Smashed-In is usually bison chips which burn down to a clean white ash. As the excavation continued down, we observed a concentration of bone, sandstone blocks and charcoal typical of a roasting pit separated from the hearth by a thin, largely sterile layer of sediment. Given the observed superimposition of the charcoal distribution in the hearth above the feature apparently matching the distribution of the roasting pit below, we assumed we had uncovered a complex feature with the hearth being an integral component part. At that time we believed this upper charcoal hearth represented the superior wood fire used over an intact roasting pit in the type of earth oven construction observed by Wissler (1910). Below this hearth was a thin sterile layer of sediment that we thought corresponded to the superior insulating layer of earth described in Wissler (1910). Both the charcoal and the sterile layer of sediment found in the 1990 excavation can be observed in the profile image taken at that time (Figure 30). The first indications of the contents of the roasting pit were encountered immediately below this thin sterile layer of sediment. The 2016 excavations corroborated the corresponding matrix distributions observed 26 years earlier and fueled our conviction that we had found an intact assembly.

Figure 30. Profile of roasting pit feature 90-2 during 1990 excavation. Note the largely sterile layer of sediment occupied by a single large block of sandstone, separating the midden underlain by a black charcoal lens from the feature contents showing up below.

As we were excavating in 2016, by coincidence, a second roasting pit was recovered a half a meter away. This second roasting pit was similar in that it was a shallow basin lined with rock with considerable wood charcoal interspersed, but it differed in that the chunks of sandstone were smaller and there was a comparative lack of faunal remains.

In the feature we were targeting, the upper portion of a cranium of a large canid (Figure 31), a segment of articulated thoracic vertebrae, and an articulated canid foot were encountered and left *in situ* (Figure 32). This was a different canid foot than the ones recovered in 1990, in a slightly different location. The location of these canid remains recovered in 2016 corresponded to the anatomical position expected of a fully articulated canid skeleton of an animal lying on its side, with the front paws in the 1990 profile and the 2016 recovery in an area that would correspond to the position of a back foot, further confirming our interpretation of an intact articulated canid in this pit.

To find an unopened roasting pit at a communal bison kill, although certainly unusual, was not unprecedented. George Frison reported a prepared but unopened roasting pit at the Wardell Buffalo Trap (Frison 1973:54, 57). In that feature there were various butchering units of bison represented including a section of articulated vertebral column.

Figure 31. Detail of canid skull.

Figure 32. Detail of articulated canid foot.

4.2 What we found

4.2.1 Failed expectation

We resumed the excavation of the feature in a lab at the Royal Alberta Museum. As the sediment was removed from the upper layer of the roasting pit it became clear that the interpretation of the roasting pit being intact and the contents uneaten, was wrong. None of the articulated segments of the canid remains were connected. All of these remains were limited to the areas in which they were initially exposed and were otherwise discontinuous. Further, it became obvious very early that the skull of the very large canid recovered near the center of the feature did not belong to some of the canid bones that came from a clearly much smaller animal. There were partial but considerable representations of at least two canids of different size, both adult animals, including different sized sets of vertebrae and feet, and a scapula and articulated rear leg from a canid smaller than the one that the skull came from.

The initial associations and distribution of faunal elements that appeared so promising proved nothing more than a remarkable and, needless to say, disappointing coincidence. Other than an unfused distal femur, the unfused sacrum found in 1990 was the only bison calf representation, so any hope of finding anything like an intact calf was also dashed.

4.2.2 Stratigraphy

The sterile layer of sandy sediment observed capping the feature, as it turns out, is not limited to the feature but is an extension of a widespread sedimentary lens that was fortuitously well defined in proximity to the feature. Even more curious was the coincidental presence of the charcoal hearth immediately above the roasting pit, one of only three or four charcoal hearths found in eight years of research here, and it just so happened to be a cruel coincidence that it was neatly overlying our unrelated earlier feature. So, the interpretation of an intact unopened roasting pit went down in flames in rapid fashion. Despite this, the results uncovered were perhaps more interesting.

Where the charcoal hearth just above the feature was an incredible coincidence, the sterile sand lens below this hearth appears to be a more or less continuous sedimentary layer extending across much of this terrace, and now seems like it should have been expected. Brink and Dawe (1989:23-24) observed what has to be an expression of this sand lens at approximately the same depth in the processing area excavations in 1985 and 1986 that would be a little more than 100 metres south of the roasting pit. Brink and Dawe estimated the age of the largely sterile sand layer in that 1985/6 excavation to be about 1,100 ^{14}C yr BP (1989:23) which would fit conformably with what we know about the dates obtained in the 1987 through 1990 excavations. We don't know the length of time this lens represents, or its origin, but in both excavations cultural material was densely concentrated just above it, and slightly less densely, below it as well.

4.2.3 Faunal remains

Of the identified faunal remains in the feature, 118 were identified as bison (*Bison bison*), 94 as canid (*Canis lupus*, *Canis familiaris*, or *Canis latrans*), and one each of mule deer (*Odocoileus hemionus*), rabbit, and small rodent, this latter probably Richardson's ground squirrel (*Urocitellus richardsonii*). In addition to these were hundreds of small, unidentifiable, principally large mammal bone fragments. Most of this latter appears to be intrusive bone scrap derived from the ubiquitous scrap in the midden overburden. Of the identified bone, the MNI (Minimum Number of Individuals) of the faunal remains indicates more individual bison are represented than canids, but number of bones derived from like individual animals is better expressed by the canid remains. The canid limb bones and vertebrae are distinctly two different sizes and are limited to the number of elements that would account for one of each sized individual. The bison MNI, based on distal femora, is three, including two adult animals and one subadult, but there is not much to indicate any of the bison bones were derived from a like animal.

Unfortunately, there was no discontinuity in the use of the site that we can identify that clearly separates the faunal material that was cooked in the feature from that which was not - clearly many, perhaps all, of the bison bones were intrusive. Both the deer rib fragment and rodent limb bone we believe are intrusive and will not be considered further here.

Although the count would seem to indicate a predominance of bison, it should be pointed out of those 118 bones identified as bison only five are complete elements: two astragali, and one each of a calcaneum, phalanx, and a sesamoid. The calcaneum was slightly disarticulated from one of the astragali and was probably articulated at the time of deposition. The bison remains are mostly appendicular fragments, otherwise nineteen rib fragments, three maxilla fragments, eight teeth, five vertebral fragments and a sacrum round out the axial content. As mentioned above, there doesn't seem to be much representation of any one animal. With the exception of four scapula fragments, oddly of the few bison limb bones represented, no element was represented by both sides. There were at least three complete or partial right astragali but no left astragali. Two right calcanei. The three left femora were not matched by any right femur. Two left distal humeri but no rights. Two each of proximal right metacarpals and metatarsals but no left side of either. We believe most if not all of the bison teeth, maxilla fragments, rib fragments, vertebral fragments, phalanges and two innominate fragments found in the pit were intrusive, as may be the case with some of the limb bones and fragments. One innominate fragment, which was lying directly on one of the sandstone blocks, has evidence of having been gnawed which would support a later intrusive origin as it is unlikely anyone would want to roast a bone that had been chewed on by a carnivore already (Figure 33). The opposing tooth marks include a puncture and an opposing impression trough that suggest the innominate was torqued in the mouth of the carnivore while firmly anchored at the point of the puncture. Apparently, a carnivore chewed on this bone shortly after the cooking event, and it found its way onto the feature before the feature would have been substantially covered by sediment derived from natural environmental processes. This type of gnawing may be an indication of heavy carcass utilization by a carnivore that was scavenging bone in the absence of soft tissues. Scavengers "prefer to eat meat, hide, viscera, or cartilage before finally gnawing bones" (Haynes 1983:106). Finding this gnawed bone directly on what would have been a briefly exposed heating element supports an interpretation that a successful bison jump had not occurred recently.

The lack of any considerable butchering elements or articulated sections of bison bones could simply be explained by the removal of a whole or partial carcass after cooking. The adjacent roasting pit for example, assuming it was used for cooking meat, was devoid of bone. It is unknown if any of the bison bone recovered in feature 90-2 was cooked in the pit as opposed to finding its way in later. Some of the bison bone, particularly two of the distal femurs, are lying tightly on the rocks in the floor of the basin, many of the other bones are jumbled together and may simply relate to discard from a slightly later date. It would be hard to discriminate, for example, a bone that slumped in or got kicked into the feature depression a month after the pit was used from one that was discarded the day of use. The several bison teeth, maxilla, mandible, astragali and calcanei do not represent meat-bearing portions, and their presence in the feature we presume is fortuitous. The impression of the bison representation is that the parts that actually could relate to the roasting pit, if any, are limb bones broken open for marrow extraction. Of the fifteen long bone shaft fragments some or all might have been part of the limb elements otherwise only represented by articular ends. Most of the large fractured limb bones showed no evidence of spiral fracture. It may be that some of the bone in the pit is simply a case of house cleaning – someone cleaned up a campsite area by dumping garbage from close proximity to the feature into this handy depression.

In contrast to the bison remains, the canid remains present a different picture. A skull, detached maxilla, and several short, articulated segments of canid axial elements including four sets of articulated canid vertebrae from two animals, some articulated limbs including a hind leg and four complete feet, as well as some isolated phalanges, a scapula, and a few mostly fragmentary ribs, were recovered. The canid skeletal remains represent two adult animals, but of considerably different size. It appears the larger of the two specimens is either a large wolf or perhaps dog-wolf hybrid, whereas the smaller canid is closer in size to a coyote or smaller dog.

Figure 33. Gnawed bison innominate fragment found lying directly on a sandstone slab lining the oven basin. Note the opposing tooth puncture (left) and tooth drag impression (right).

The one canid skull is from the larger canid with the length of the zygomatic arch exceeding 140 millimetres and the frontal bone about 100 millimetres wide. This is either a very big wolf or perhaps a large wolf-dog hybrid. A canid maxilla portion bearing heavily worn incisors appears to have been detached from the large canid skull. Two sections of articulated vertebrae, one of which includes the sacrum, some phalanges and at least two ribs, also appear to be from this same larger canid.

A smaller canid is represented by all four articulated feet, a scapula, two sets of articulated vertebrae of which one including the distal caudal vertebrae, some rib fragments, and a slightly disarticulated femur. The size of the smaller canid, an adult animal, is in the size range of a coyote.

Most of the canid remains were in the floor of the pit, in some cases with sandstone blocks partly tipped over on top of them. This may partly be a function of smaller bones being able to filter down between the rocks, but the fact that there are several different sets of articulated faunal elements suggests they were thrown into the pit at a common time while still somewhat fresh.

That the feet were articulated (i.e., Figure 32) suggests they were detached from the larger meat bearing elements and discarded into the feature during the course of a meal. Canid feet could be eaten (Mandelbaum 1940:280) but the articulated feet found in the feature, all apparently from the smaller canid, do not seem to have been big enough to be very meaty, and hence were discarded intact. The few isolated larger canid foot bones found are not articulated, other than a single toe, suggesting that the feet of the larger animal had enough meat to attract consumption, and were pulled apart while eaten.

The large canid skull found in the pit appears to have broken apart somewhat after it was deposited. The few other disassociated vestiges of this animal in the pit, including two articulated vertebral sections and some disarticulated phalanges, may represent post consumption discard of meat bearing portions, with the cranium the exception to that rule. Whether there may be any other significance to the presence of the skull sitting somewhat upright near the middle of the feature would be speculative. It should be noted that Swanson (1972:79,80) found it curious that canid cranial remains were found in the earth ovens at Birch Creek, Idaho. He notes crania of both dogs and wolves were represented, the dogs being in some case of "exceptional size" (1972:80).

So, we can with confidence say two canids were cooked here, and possibly some butchered bison portions, perhaps just some marrow bones rather than prime meat-bearing butchering units. We have not been able to find any archaeological or ethnographic documentation of cooking canids and bison together however, and there may be some practical consideration to not cook such different sized animals together. Wandsnider (1997:22) observed that the amount of food cooked was not the only factor in determining cooking times in earth ovens, but the data she presents suggests that variable observed cooking times were used for different animals partly as a response to their relative lipid content.

Bison was universally highly regarded as a foodstuff, whereas the indigenous consumption of canids was variable and was more often, but not always, occasioned by necessity rather than by preference. It is possible that only canids were cooked in feature 90-2. It is doubtful that if ample fresh bison meat was available, anyone would have bothered adding these two canids to the menu. The larger canid is not just large, but also very old. A canid maxilla portion (Figure 25), presumed to be from this larger canid, has several worn incisors – one can be seen worn flat through to the pulp cavity. It is extremely doubtful a very old canid would have been a dietary preference should bison be available. Perhaps an earth oven was the best way to make this option palatable. The predilection of Plains Indigenous people for bison meat if available would argue against the necessity of adding an old canid to the meal. Although Catlin doesn't include wolves or dogs in this description, it does paint a picture of how the other meats stacked up: "…so much is it [buffalo] preferred to all other, that the deer, the elk, and the antelope sport upon the prairies in herds in the greatest security; as the Indians seldom kill them, unless they want their skins for a dress" (Catlin in 1832, reprinted in Catlin 1973, Vol.1:24).

What has to be one of the most interesting things recovered, and again not likely something that would have been found had the excavation been conducted in the field, was the recovery of some apparent canid digesta in the floor of the pit. This was manifest as a thin linear distribution about 15 centimetres long of fine highly fragmented small mammal bone. The contents of what we will refer to as scat included a very small complete bone, originally thought to be the tooth of a very small mammal, but an absence of occlusal surfaces and enamel prompted closer inspection. This has been identified as an inner ear bone, an incus, of a rabbit (Figure 34).

The inner ear is usually integrated with the skull and is normally only dislodged by a bone crushing carnivore, in this case apparently by one of our canids. There were no other observed intact elements, and indeed the bone scrap in the scat was all very fine bits of small mammal bone, consistent with the remains of small bones assumed to be from the

Figure 34. Rabbit incus recovered *in situ* in roasting pit feature 90-2.

same rabbit. Nothing in the scat appeared to be derived from large or even medium sized mammal bone. It is our interpretation that the canids were cooked whole and at least one was disemboweled on the spot. Swanson does (1972:79) interpret that dogs and wolves were cooked whole in the earth ovens found at the Birch Creek sites in Idaho.

Canids have one of the most efficient digestive systems of any mammal, able to ingest, digest, and pass food between 6 to 8 hours. This compares to 20 to 30 hours for people. The remarkable question for us is what is this big canid doing with a gut full of rabbit? Had the bison jump been successful, no canid in the vicinity would bother wasting its time hunting rabbits. It can also be speculated that it is unlikely anyone would have cooked these remains in this roasting pit in preparation for a jump, as the woodsmoke would potentially scare away a herd – this would have been strictly prohibited. If this roasting pit had been assembled for the purpose of cooking fresh bison at the successful conclusion of a bison jump, a canid consumed in the mix might be expected to have evidence of bison bone somewhere in its tract. It might be argued should a canid have the opportunity to gorge on bison meat after a hunt perhaps it didn't need to resort to chewing on bones, and as indicated above (Haynes 1983:106), soft tissues would be preferred. So even if a canid gobbled its fill of soft tissues, it still doesn't answer where the rabbit came from, or why the rabbit skull would have been chewed up. The most probable explanation is that the roasting pit was built well before a hunt, or long after, when ample bison meat and other soft tissues were not available for neither man nor beast.

What seems to be the best explanation to account for the peculiar contents recovered in this pit was that it was prepared in anticipation of a jump that didn't transpire, leaving a fallback position of consuming something available, in this case a pair of dissimilar sized canids and an unknown component of partial bison butchering units, principally marrow bones possibly scavenged from a previous jump episode. Alternatively, the earth oven was constructed at a location where it was well known that bison bone that could be predictably scavenged would be plentiful, and two canids found in the proximity were added to the mix. Either way, there is no evidence the HSI pit was reused more than once – there was no burned bone recovered.

Scavenging in times of need at Head-Smashed-In might be hard to detect archaeologically but given the regular use of the site, especially in the last few thousand years, this practice should be a consideration. In times of scarcity, harvesting bones from former jump episodes was probably commonplace: "They do collect old bones if they have the least appearance of marrow or fat in them and boil them to get the fat out of them" (Schoolcraft 1856:68, observing Sioux). Greiser et. al. (1983:5-12) have interpreted a series of features used for marrow and grease extraction at Sun River, Montana. Heating up marrow bones was interpreted as being beneficial for marrow extraction. Marrow and bone grease can be rendered from bones for many months after the demise of a bison, especially if buried or retained in cool conditions. It might be speculated that if our HSI roasting pit was not coincident with a buffalo jump event, perhaps marrow bones from previous events were collected and roasted to mobilize marrow or grease. The three distal femurs would support an interpretation of marrow extraction. If marrow bones were scavenged, femora might be a preferred target of such endeavor, as James observed of the Omawhaws [sic]:

> "The bones of the thighs, to which a small quantity of flesh is left adhering, are placed before the fire until the meat is sufficiently roasted, when they are broken, and the meat and marrow afford a most delicious repast. These, together with the tongue and hump, are esteemed the best parts of the animals" (James 1823 vol.1:212).

Some of the other bison anatomical elements are harder to understand with such an interpretation of scavenging, such as maxilla fragments and a single largely complete mandible, but again, clearly the presence of some of the bison bone is fortuitous.

One documented example of an unopened prepared earth oven at the Wardell site (Frison 1973) provides an unusual assortment of bison remains. The assemblage of faunal elements represented was described as potentially meat bearing but included "some marginal and possibly some more-preferred units of butchered bison" (1973:57). Frison does not seem to be speaking with much conviction about how preferred these choices were when he mentions "possibly". The list of butchering units in that feature included:

> "…a skull with maxillaries removed; a section of a vertical column containing number 2 through number 11 thoracics with the proximal ends articulated and rib and dorsal spines chopped off close to the bases; a scapula with the proximal parts dropped off; a right maxillary; the proximal end of a radius; ribs, including the distal ends of numbers 10, 11, 12, and 13, that were apparently part of a butchered rib unit; several fragments of the medial section of a humerus and the dorsal spines of numbers 6, 7, 8 and 9 thoracics" (Frison 1973:54,57).

This may be a case of scrounging left-overs. Fire fractured stones in the Wardell pit indicate that the prospective meal was indeed cooked and adds to the mystery of why contents were not retrieved. Perhaps this feature was abandoned before consumption because a better offering came along.

4.2.4 Sandstone basin lining

With the objective of keeping the feature together for display, it was impossible to record all the constituent rocks that made the rock basin that formed the heating element base of the earth oven. Based on those visible and the outliers that could be analyzed and reinserted, we estimate 50 sandstone slabs and chunks comprised the pit lining. These ranged in size from one to over ten kilograms with the average piece about five kilograms, with a total weight of sandstone approximately 250 kilograms. This sandstone was the Paleocene-aged Porcupine Hills Formation type outcropping at the site. The natural distribution of rock of any other lithology is rare at Head-Smashed-In and any cobbles from the thin local gravel distribution would have been too valuable for use to boil water rather than wasting them in a roasting pit for which the ample supply of local sandstone was better suited (Brink and Dawe 2003).

4.2.5 Lithic artifacts

We did not expect to find much in the way of lithic artifacts relating to the use of the roasting pit and were hence not surprised by a lack thereof. There were a few pieces of debitage that filtered into the feature from the above midden. None were observed in the floor of the feature. Two tools and a core were conspicuous but only one of the two tools was apparently part of the feature assemblage, and the core was certainly not contemporary with the feature. This latter core was the obstacle impacted by the attempted insertion of a stake into the ground described previously. This core is a large quartzite cobble with a few large spalls removed from both faces. It clearly overlies some of the feature contents, hence is not a part of the earth oven.

One of the tools was the distal end of what appears to have been a hand-held conical quartzite pestle broken transversely five centimetres from the working end. The blunt working end, seven centimetres in diameter, is well used. This pestle portion looks identical to the end of a complete specimen recovered nearby (Brink and Dawe 1989:241 figure 101a). The pestle fragment was found on top of a rodent (ground squirrel?) burrow into which several bone scraps and boiling stones have slumped, so it is quite clear the pestle fragment was intrusive and incorporated at a somewhat later date. The rounded cross section of this artifact can be seen in the center right of Figure 28. We left this artifact *in situ* in the display because it was only one of two lithic tools found in the feature and it was desirable for interpretive purposes.

The other lithic tool however was found lying on the floor of the feature basin (in the bottom left of Figure 28), quite possibly an expedient tool used for butchering some of the animals represented by the faunal remains in the pit. This artifact is a green argillite spall knife with marginal use retouch nibbled onto the cortex face. It has a wedge-shaped cross section and measures 124.4 millimetres long, 64.4 millimetres wide and 15.2 millimetres thick (Figure 35). This argillite artifact is still light green in colour – a lack of discoloration due to oxidation indicates this artifact was not in the feature at the time of cooking as the local green argillite changes colour readily to a reddish-brown colour at a fairly low temperature (Brink and Dawe 1989:195). Thus, if used for butchering the contents of this pit, this flake knife would have been used to cut cooked meat.

Figure 35. Argillite spall knife.

4.2.6 Dating

During the 1990 excavation of feature 90-2 a large chunk of wood charcoal recovered from the bottom of the roasting pit was submitted for a standard ^{14}C date. The result obtained of 1,640 ± 100 ^{14}C yr BP (AECV-14444C) was accordant with our expectations based on the stratigraphic position and relationship to diagnostic lithic materials, hence we regard this as a good date for when this feature was utilized. What we did not expect was significantly earlier material, in what had been assumed to be sterile sediment well beneath the feature.

In order to plaster jacket the roasting pit feature, we had to excavate below the presumed base of the feature to work plaster underneath it (Figures 13 and 14). The resulting excavation extended almost a half metre deeper than the 1990 excavation. It had been our experience elsewhere in the processing area that the vast amount of cultural material was limited to the top 40 centimeters, and very rarely, with the exception of the occasional intrusive pit feature, was anything found deeper than 50 centimeters. Reeves (1978:154) describes the major part of the processing area, in the vicinity of our excavation, as a midden up to two feet thick. Any excavations we conducted in this area appeared to be culturally sterile below this conspicuous "midden". We typically excavated a half metre deeper that the lowest extent of the processing debris just to make sure we weren't missing anything. By this depth the sediment becomes a uniform indurated silty clay that is extremely hard to excavate. Based on our previous experience, and that of other archaeology projects at the site, we believed we had bottomed out and

Figure 36. Quartzite core recovered approximately a half metre deeper than the bottom extent of Feature 90-2.

had no expectation that cultural material could be deeper. It was therefore with some surprise that we recovered cultural material between 125 and 140 centimetres BD (below datum), near the floor of the 2016 excavation. At a depth of 140 centimetres BD a large (~10-15 kilogram) apparently quartzite boulder was observed. This was left *in situ*. Three small pieces of FBR (fire broken rock) were collected from approximately 134 centimetres BD, a large quartzite amorphous core at 125 centimetres BD (Figure 36), and three large mammal bone fragments were recovered between 134 and 135 centimetres BD.

One piece of the largest bone fragment, which appeared to be a portion of an articular end of a bison limb bone (Figure 37), was submitted for a ^{14}C AMS date (Beta-517304).

Figure 37. Bison bone from which radiocarbon sample Beta-517304 was derived.

This resulting date of 6710 ± 30 ^{14}C yr BP was met with some surprise, as it predated any previous dates attributed to cultural activity at the site. To corroborate this result, a second bone scrap, a large mammal long bone splinter, was submitted to a different lab. This bone produced an even earlier result (7039 ± 36 ^{14}C yr BP: UOC-9752) and apparently from yet another older component. Clearly more research of this earlier and repeated use of the site is warranted. The surprising results seen here exceed the previously oldest dated use of the jump of 5,780±30 ^{14}C yr BP or 6,581 cal yrs BP (Brink 2016) – by more than a thousand years and fit in a presumed gap of using the site between Mummy Cave and Cody materials found elsewhere on the site.

The sobering realization that our previous excavations in the processing area were apparently not deep enough was tempered with the fact we were in good company, as decades of previous research by other archaeologists similarly failed to explore this deeper, intractable realm. In 1983 a backhoe test did recover some unmodified lower limb bones of a bison at an approximate depth of 1.3 metres, in the area of what is now the main parking lot, well away from the heart of the processing area. A ^{14}C date on this bone yielded the earliest date obtained from Head-Smashed-In, of 7,065 ± 175 ^{14}C yr BP (S-2500, Brink et. al. 1985:45-46). Given there was no associated cultural material nor indications of butchering, it was thought at that time this bone could be of natural origin. It is remarkable that that date on bone, at the same depth relative to the surface, and 400 metres away, conforms so nearly to the bone date we have from below the feature 90-2 excavation. That these depositional conditions are manifest similarly across such a broad expanse of the prairie level below the escarpment gives us hope that there is some inherent comparable stratigraphy of these earlier components in a fairly broad area all along the processing and campsite area. This observation is borne out by the observation of the sterile sand lens described above observed in the 1986 and 1990 excavations.

The earliest date previously obtained from the kill site was from the lowest Mummy Cave Component in the "north kill" excavated by Reeves. This date, 5,780±30 ^{14}C yr BP or 6581 cal yr BP (Beta-396502), was obtained by Brink (2016), who considered this to represent the earliest use of the jump. It should be noted that the deepest dated material in both the north and south kills came from the top of a rotational slump. There was no deeper bone found in either of those areas –this bone was right on top of, and bottomed out on, the sandstone capping the slump block. In that location, much earlier material could not be expected as this sandstone cap would have been part of the cliff top prior to the slump, an episode thought to have occurred about 6,000 years ago. In 1966 during the project by Reeves, a geological team put a deep trench through this slump block. Reeves (1983:121-122) reported that cultural material and bone was observed in outwash derived from beneath this slump. Apparently there was not enough bone to date from this pre-slump deposit, but Reeves went on to speculate that perhaps this material related to a Cody Component projectile point found in this outwash area in an earlier project by Boyd Wettlaufer (Reeves 1983:122). The projectile point discussed by Reeves was a Scottsbluff point of Knife River Flint. A further examination of material recovered by Wettlaufer (1949) indicates there are several other Cody artifacts in this assemblage including at least one obsidian Alberta point and a probable chert Eden point that have been recovered here, representing possibly three or more Cody components (Dawe 2013:151). The material recovered by Wettlaufer was from the fill pulled out of a spring channel to dam the spring water for cattle. This dugout was situated at the foot of the slump, about 100 metres north of feature 90-2.

Deeper excavation was beyond the scope of this project, and at the time, before we submitted our samples for dating, it was assumed that these deeper materials we recovered represented a previously recognized cultural occupation of the site, so no deeper nor more extensive testing was deemed necessary. A small hand auger test was punched down to a maximum depth of 247 centimetres BD after the roasting pit had been removed to evaluate if there were any deeper conspicuous paleosols or cultural material, but none was observed. The sediment, which at 150 centimetres BD is a compact silty clay, appeared unchanged until a depth of approximately 220 centimetres BD where it turned sandy until we reached the limit of our hand auger and discontinued the test at the 247 centimetres BD depth.

Table 1. Radiocarbon and calendar dates obtained from within (AECV-14444C) and below (Beta-517304 and UOC-9752) Feature 90-2.

Lab number	Material	^{14}C date	Calibrated date
AECV-14444C	Charcoal	1,640 ± 100 ^{14}C yr BP	1730 – 1344 (94.8%) cal yr BP (OxCal 4.4)
Beta-517304	Bone DkPj-1:179623	6,710 ± 30 ^{14}C yr BP (δ13C –18.5‰)	7624 – 7555 (75.6%) cal yr BP (BetaCal 3.21)
UOC-9752	Bone DkPj1:160000	7,039 ± 36 ^{14}C yr BP	7949 – 7794 (95.4%) cal yr BP (OxCal 4.3)

5. Discussion

The best evidence for the function of feature 90-2 was that it was an earth oven used primarily, and perhaps exclusively, to cook canids for consumption. Given the popularity of using earth ovens to roast meat, if canids were consumed, the use of earth ovens for roasting them was probably a common practice. At the Bison and Veratic rockshelters in Idaho (Swanson 1972) there is a 3,500-year record of the practice of not only using earth ovens, but of using earth ovens to specifically cook canids including in some instances cooking different canid species in an earth oven at the same time. In some instances, it is documented that canids were only resorted to in lean times. For example, canids – foxes, wolves, and dogs, were consumed in times of famine by the Northern Paiute and Shoshone (Stewart 1941).

At this time, we do not know which canid species are represented in the earth oven at HSI, other than that one is a large wolf-sized specimen, and that the other is smaller, and approximately coyote-sized. So these may simply represent a wolf and a coyote. In the alternative, one or both of these could be dogs. There are several ethnographic observations of indigenous dogs being of two distinct sizes or breeds which were used for different functions (Harmon in Wissler 1924:230; Welker and Byers 2019). In the aftermath of a bison jump, it probable that both scavenging wolves and coyotes would have been easy to obtain. In the absence of a successful jump, it may have been more expedient to cook a couple of dogs. Ethnographic and archaeological observations citing the practice of using canids as a food source do tend to have a bias in the literature of the canid most often associated with human activity – dogs. There was certainly some reluctance by some groups to eat dogs specifically, but generally all canids were potentially food. In the case of dogs, as much as dog lovers are uncomfortable with the reality, the fact that something like 30 million dogs are consumed worldwide each year suggests canids are universally a potential food resource that is not ignored. In precontact times dogs presented if not a primary food source certainly one of the more accessible ones.

According to Wissler, the Blackfoot, the most recent Indigenous group that used the jump, did not regularly eat dogs: "While many tribes eat the flesh of the dog, the Blackfoot show a special antipathy toward it" (Wissler 1910:44). But even among the Blackfoot there were exceptions: "Dogs were not eaten, though the modern intrusive society of the Hair-parters, makes some pretense of serving them at ceremonies" (Wissler 1910:20,21). The Cree similarly did not regularly eat dog. "Eating dog meat marked an occasion as extraordinary. Thus, a dog might be killed to provide food for an honored guest or to be served during a bundle transfer. In general, however, dogs were eaten in those rituals particularly associated with the Woodlands" (Mandelbaum 1940:197). Mandelbaum cites an example of the Cree specifically eating dog paws along with the head and breast during the *mitewiwin* ceremony (1940:280).

On the upper Missouri, Catlin echoes the eating of dogs as an honorific choice, although clearly not his favorite: "…this is truly the land of Epicures; we are invited by the savages to feasts of *dog's meat*, as the most honourable food that can be presented to a stranger, and glutted with the more delicious food of beavers' tails, and buffaloes' tongues" (Catlin in 1832, italics his, reprinted in Catlin 1973, Vol.1: 14).

The Hidatsa ate dog: "The Indians frequently eat the flesh of the dog;… These dogs are small; and in shape, very much resemble the wolf. The large dogs are of a different breed, and their flesh always has a rank taste; but this is never the case with the small kind" (Harmon p.281 in Wilson 1924). Buffalo Bird woman may have presented an explanation for the "rank" taste: "Ordinarily, dogs were not eaten, partly because the dog was a sacred animal, and again because the flesh is not good; for dogs fed on carrion and human ordure" (Wilson 1924:230).

Where consumption of dogs was acceptable, there has been an observed benefit by filling a dietary seasonal niche. Snyder (1991) makes a good case for utilizing dogs as a preferred food resource in the late winter and early spring when other animal resources such as bison, deer, beaver, and racoon, are comparatively fat depleted. The accounts of numbers of dogs cited by Snyder of 6,000 dogs in one Pawnee village and 4,000 in another (Snyder 1991:360) do seem to exceed the beast of burden needs.

Finding two canids in an earth oven at arguably the largest bison jump on the Plains is certainly curious. That at least those two animals were cooked seems certain. Whether there was a bison component to the meal is less certain. The fact that one of these animals, as a very old specimen, would probably not be a coveted meal choice might argue this was a meal dictated by necessity rather than choice. If the rationale is valid that the rabbit incus recovered from the canid digesta is a clue that fresh bison meat was not available, the timing of the meal would most likely have been other than at the conclusion of a successful hunt, as having such a meal during the preparation of a hunt would not have been prudent. Even if it could somehow be argued that such a feast may have been ceremonial, it would apparently have to have been after an unsuccessful hunt for the reasons described above. It doesn't seem likely that the preparation of a roasting pit to cook canids would occur at Head-Smashed-In in an event unrelated to the buffalo jump – the nearby Oldman River valley would offer better resources for undertaking an earth oven if someone simply wanted to roast some meat should a source of meat be available. Unlike the Oldman valley, firewood at HSI is limited to a few shrubs. Experiments undertaken by Dering (1999:665) indicate the quantity of fuel wood to heat the rock element in an earth oven was considerable: "Cooking the food for 24 to 48 hours in a 1.5-m pit requires about 224 kg of fuel wood to heat a rock element weighing about 250 kg" The dimensions of the pit and weight of the rock element example provided by Dering is coincidentally the same as our feature 90-2. Such a quantity of wood would be hard to find at Head-Smashed-In, and we presume must have been hauled in from some distance.

It has to be considered that the activity represented by the roasting pit is a consequence of necessity precipitated by a lack of fresh bison, hence two canids, one particularly old one, were consumed. If the case can be made that there was some element of desperation necessitating the eating of an old canid perhaps scavenging some old marrow bones to add to the mix could reasonably account for the conspicuous presence of large bison leg bone ends in the feature. Clearly the interpretation of earth oven feature 90-2 recovered at Head-Smashed-In would have been easier to understand had this event occurred in a single component site, or at least in an area of the site where there was a demonstrable separation in activity areas. There is probably no other kill site on the Plains that presents less of a single component aspect than Head-Smashed-In Buffalo Jump.

6. Conclusion

Were the purpose of this project to be the understanding of the mechanics of earth oven use our needs may have been better served elsewhere but as the purpose of this undertaking was to retrieve an earth oven from Head-Smashed-In Buffalo Jump for display, in that regard this project was a success. Museum exhibits depicting the practice of the use of earth ovens or other pit features are most typically illustrated, or sometimes depicted by means of artificially contrived replicas, or displayed in section using a sediment peel. To our knowledge this was the first time, at least in North America, one has been retrieved intact for display. Apart from being intrinsically interesting, the process demonstrates it is possible to recover largely unconsolidated materials intact for future display and/or analysis. Again, the ability to excavate this feature in a lab facilitated uncovering, *in situ*, an intact assemblage of bone that would have been improbable to accomplish in the field.

The one caveat to the beneficial aspects of this procedure was the necessity of utilizing various consolidants, which, though physically reversible, introduced contaminants to compromise other types of analyses. Further, without completely dismantling the whole assembly of rock, bone, and matrix, there are surely some smaller objects that eluded our scrutiny and would not factor into the final analysis. Despite these concerns, the continued ability to study an intact feature such as this offers benefits no longer available in the assemblages of totally dismantled, and, often in large part, discarded feature matrices. As a last benefit, should it be desirable, such an intact feature can potentially be restored to its place of origin as it was found when its utility as a display and research item is no longer required.

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