THE WYOMING ARCHAEOLOGIST

Early Middle Period Type Projectile Points (McKean and Variants)

Late Middle Period Type Projectile Points

MARCH 1972 VOL. XV NO. 1

Late Prehistoric Type Projectile Points

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APPENDIX III

MARCH, 1972 ISSUE CONTENTS

Next Issue: Second Part of the Glenrock Buffalo Jump; Age Determination of Buffalo by Teeth Eruption and Wear; Population Dynamics of the Glenrock Bison bison Population; Geology of the Glenrock Site Area, Wyoming

EDITOR'S NOTES

As you see by a new inclusion that Chapter News items are in the form of a news letter, The Bulletin Board. It is hoped that the membership will vote to accept this new format. I must add that much better support and more timely contributions will be absolutely necessary for its success. Hopefully it can be printed every two or three months or as needed with very little expense. This then will free the Archaeologist of extraneous matters and permits a more informal approach to chapter news.

David Lieuvance, the new Secretary of the Cheyenne Chapter, is full of enthusiasm and raring to go as you can see by the first issue. I would hope we could have some of Mary's excellent poetry, more cross word puzzles, and more reports of findings and hunting trips. Chapter programs that were outstanding should be told about so that they might be shared. Chapter projects should be represented.

Please, on bended knees, send your contributions to Dave Lieuvance, P. O. Box 2102, Cheyenne, Wyoming 82001.

WYOMING ARCHAEOLOGICAL SOCIETY

February 23, 1972

Dear Fellow Members:

The annual State Meeting will be held at the Holiday Inn, Casper, Wyoming, beginning at 9:30 A.M., Saturday, April 8. A very full schedule is planned: Ross Hilman reporting on Hyattville Site; Charles Love on Geology; Michael Wilson on buffalo species; Dr. Frison will summarize activities and talk of summer plans; and Helen Schuster will report on Pictograph Survey. We will also have speakers from B.L.M. and Recreation Commission.

Following a buffet dinner (barron of beef), our guest speaker will be Dr. Dale Henning from the University of Nebraska.

Because of this tight schedule on Saturday, Chapter business requiring a vote by Chapter delegates will have to be largely debated at the informal meeting, open to everyone, Friday evening at 8:00 P.M., also at the Holiday Inn.

Reports of Chapter activities should be concisely written and just the high-lights or new ideas read to membership at large on Saturday. During all this activity, the election committee, composed of all past presidents, and Chairman John Albanese will make the selection of new officers, and a meeting of the Foundation Board will be announced.

Please urge all members to make every effort to attend, and have voting delegates present letter of certification to Credential Committee Chairman Gary Fry. Don't forget to bring artifact displays and make your room reservations early.

Sincerely,

Grant H. Willson
President

Answer to Cross Word Puzzle printed in September Issue, Vol. 14, No. 3; by Bill Barlow

ACROSS

1. Spear thrower
7. And (Latin)
9. Intertile greyish soil
10. Sumerian city
11. Silver (chem.)
12. Small ducks
15. Hole in cliff
17. Wanderer
19. Prefix, "external"
20. Colo. mountain tribe
21. Long time
23. Relating to ancestors
26. Common preposition
28. Senior
29. Gold (Span.)
31. Prejudice
33. Prefix, "dead" or "corpse"
35. Blackthorn fruit
36. And elsewhere (Latin)

DOWN

1. Fierce S. W. Tribe
2. Roman garment
3. Low Dutch (Abb.)
4. Kingdom Cortez defeated
5. Foot digit
6. Clovis
7. Prefix, "good" or "well"
8. Commerce
13. "Look!"
14. Sooty matter
16. Underneath or belly side
18. Common preposition
22. A spring
24. Charged atom
25. Canadian Indian tribe
27. Implement
30. October
32. South
34. Egyptian sun god

1. a	2. t	3. l	4. a	5. t	6. l			7. e	8. t
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THE GLENROCK BUFFALO JUMP, 48CO304: LATE PREHISTORIC PERIOD BUFFALO PROCUREMENT AND BUTCHERING *

By George Frison

The Glenrock Buffalo Jump, 48CO304 is part of a Late Prehistoric period buffalo procurement complex in central Wyoming along the south side of the North Platte River. Operation of the jump required controlled movements of buffalo herds for as far as one to three miles before they were finally stampeded over a bluff 40 feet high. The effective width of the bluff was small and as a result the herd had to be under control during the final stampede as well as the initial drive.

Good bone preservation in much of the site allowed recovery of large samples for analysis and in addition large numbers of simple but functional tools were found in context. Marks that reflected a number of butchering operations appeared repeatedly suggesting stylized methods, and from this a model of Late Prehistoric butchering is postulated which needs further testing in other mass butchering contexts.

INTRODUCTION

Site Location and Environment

The Glenrock Buffalo Jump is located two and one half miles west and one mile south of the town by the same name in Converse County, Wyoming. Location on the U.S.G.S. Parkerton Quadrangle map is T33N, R76W, Sec. 11, ne1/4. The site is one and one half miles south of the North Platte River. The latter stream originates on the Wyoming-Colorado border between the Medicine Bow and Sierra Madre ranges, flows directly north a distance of about 100 miles, then turns and flows directly east at the site area. A short distance further on it flows southeasterly for about 90 miles, where it then enters the state of Nebraska.

At present, the average yearly precipitation in the site area is about 13.5 inches and the greatest probability of occurrence is during the months of April, May and June. Much of the area composed of rolling grassland with excellent cover of buffalo and grama grass, along with sagebrush. Bottoms and sides of arroyos support heavy stands of grass and some shrubbery such as buffalo berry, chokecherry, and willow. South of the site, a distance of about five miles, the foothills of the Laramie Mountains begin. These are rough and deeply dissected and covered with different species of foothills scrub such as mountain mahogany, juniper, and large sagebrush, while the streams are lined with cottonwood, willow, boxelder, chokecherry, service berry, and buffalo berry. In the higher elevations of the Laramie Range are stands of yellow pine, fir, and lodgepole pine. The flood plain of the North Platte River is lined with groves of cottonwood and heavy stands

*Previously printed in Plains Anthropologist, Memoir 7, No. 50, Part 2, November 1970

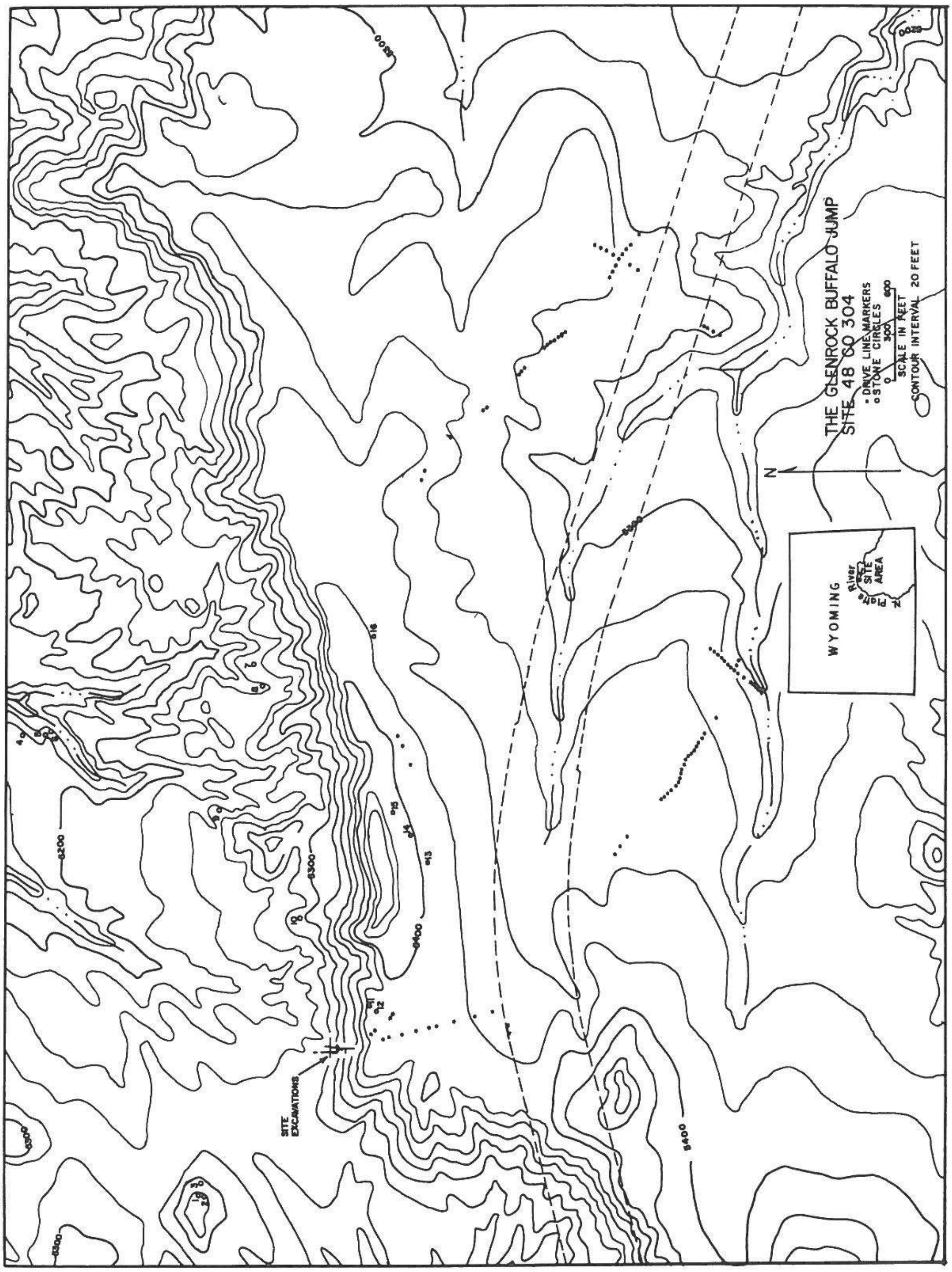

Figure 1 - Topographic and location map for the Glenrock Buffalo Jump. Dotted lines mark location of Interstate highway.

of willow. Abandoned oxbow meanders are often swampy. Directly north of the Platte River open grassland extends into Montana. To the northwest, a distance of 75 miles, is the Bighorn Mountain range and the Black Hills are to the northeast, a distance of 115 miles.

The site of the Glenrock Buffalo Jump was determined by the position of a long meandering scarp extending for a distance of about six miles, essentially parallel and from one to three miles south of the North Platte River. In some places, the sandstones comprising the upper portion of the scarp are solid enough to support perpendicular bluffs with as much as 35 to 40 feet of drop (Fig 2a). There are extensive areas of flat and rolling grassland extending from the edge of the scarp southward, providing approach for buffalo herds that were stampeded over a perpendicular section of the bluff. The 5300 foot contour level runs through the bone deposits, with the jump-off itself at an elevation of 5390 feet (Fig. 3). At least one other buffalo jump and possibly others utilized the same geological feature. Two miles south of the jump-off is Deer Creek, which along with the rolling grassland country, provided water which resulted in optimum conditions for attracting buffalo herds.

The Glenrock Buffalo Jump provided above all, evidence of prehistoric bison skinning and butchering techniques and to a lesser extent revealed information on bison handling, time of year of operation, and composition of herds. It is assumed that somewhere in the vicinity is a processing area or a combined processing and camp area. Unfortunately, this was never found. It may be buried or more likely has been lost through processes of erosion.

Operation of the Jump

The operation of the Glenrock Buffalo Jump required movements of herds of buffalo from distances of at least a mile, and possibly two to three miles. Some of the markers for this in the form of stone piles are still visible (Fig. 1), but a good share have been removed as a result of highway construction. The function of these markers are interpreted by the writer, as indicating to the drivers, the limits within which a buffalo herd must have been contained in driving them toward the jump-off. If the herd was allowed to drift outside of these boundaries, they would not have been in the optimum location for a final stampede over the jump-off. The jump-off is located so that close control over the herd during the final stampede was also necessary. If the herd verred a few feet right or left, they could have avoided the more lethal parts of the jump-off entirely. Another jump was located about 1/2 mile from the one investigated and was found by following another line of stone piles that cross the ones leading to the jump that was investigated.

At various locations in the area of the two jumps are at least 15 stone circles 8.5 to 11 feet inside diameter (Fig. 1). The stone circles are composed of single circular rows of smoothed boulders where these are available. Other similar circles are made of angular pieces of hard sandstone where this material was available and boulders were not. These

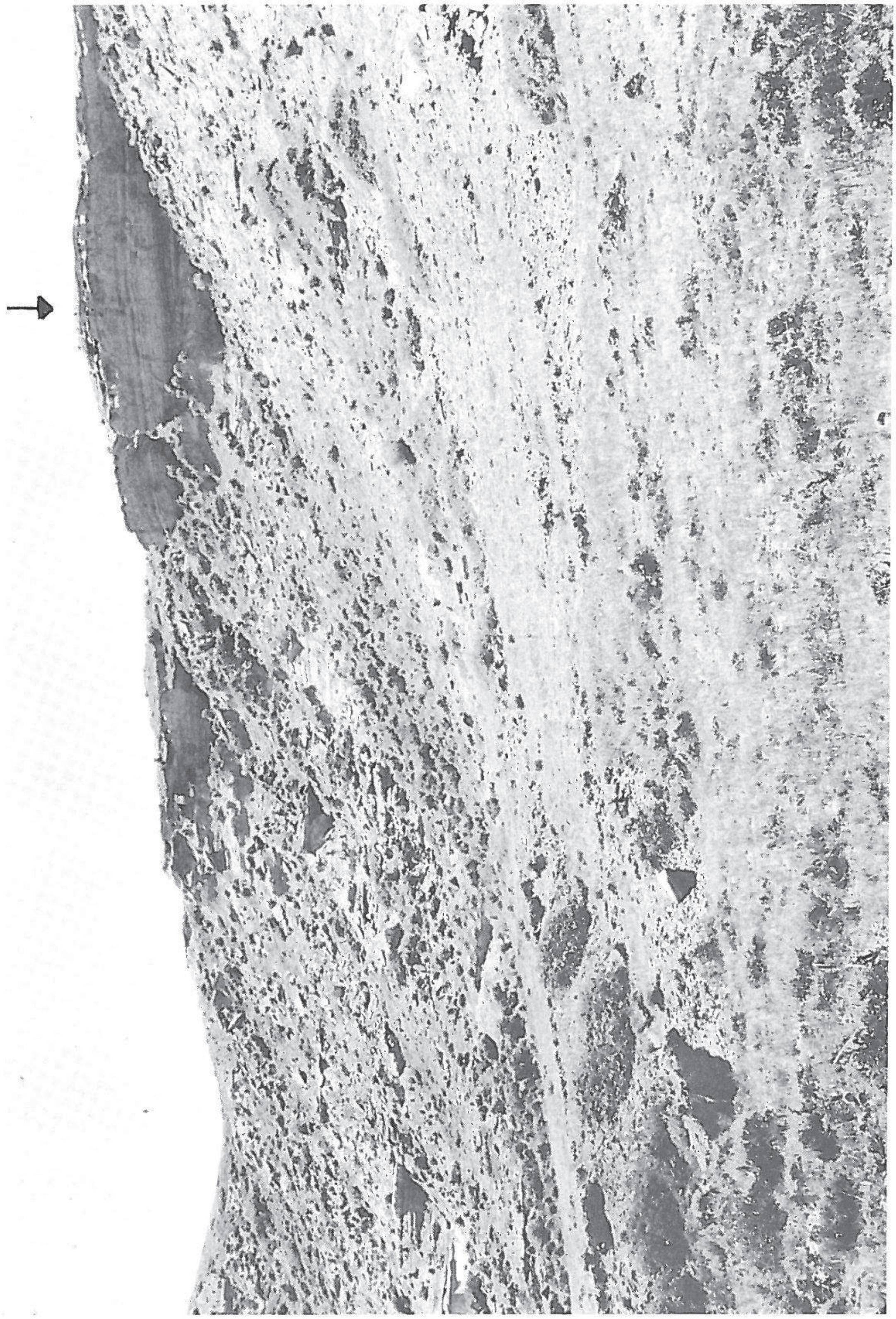

Figure 2 - View of Glenrock Buffalo Jump from Bottom. Arrow Marks Center of Jump Area.

Figure 2b - View of Bone Profile, Glenrock, Wyoming.

Figure 2c - View of Intersection of Trenches with Old Arroyo.

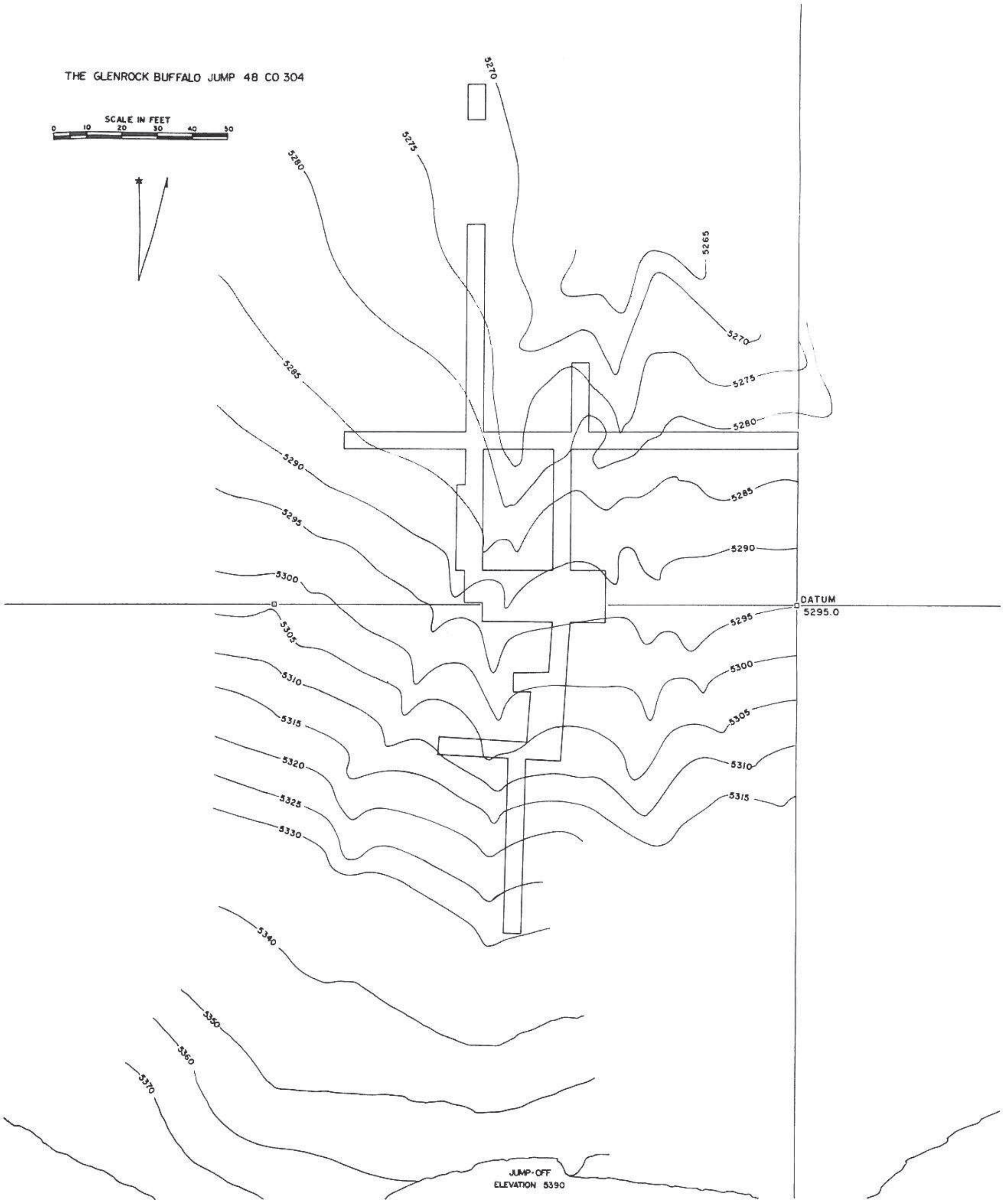

Figure 3 - Topographic map and excavated area of the Glenrock Buffalo Jump Site.

do not have the appearance of typical tipi rings nor are they located in a pattern suggesting living sites. In addition, none contain any evidence of fire inside or out nor is there any sign of debitage common to habitation sites. These are postulated to be evidence of shamanistic activity that accompanied communal buffalo procurement activities, and which has been well documented in a number of contexts (Medicine Crow 1962; Shaeffer 1962, Mandelbaum 1940). Two of the stone circles have large boulders in the center reminiscent of a situation described by Gilmore at an old Assiniboine drive (1924), which he considered as representing religious activity.

The nature of the entire site reveals a procurement situation of considerable complexity. It was not an incidental operation, but one that required careful planning and execution. The bison herd had to be gathered and moved by driving or decoying, and probably both, to an area that is away from routes used in the normal course of buffalo movements from the river bottoms to the grasslands flanking the mountains. There is no way that the operation can be viewed as waiting for herds to drift into a favorable position and then stampeding them. Small groups of animals had to be consolidated into a large herd and then carefully moved to a position where they could be stampeded over the jump. In terms of the terrain, it would seem most logical to persons unfamiliar with handling buffalo, to bring the herd straight toward the jump-off from the gathering areas. However, the actual movement of the herd was a circuitous route that near the end of the drive was more or less parallel to the jump-off. For the final stampede, the herd made nearly a right angle turn toward the jump-off. In terms of buffalo handling, this was deliberate as the animals handle easier in this manner rather than in a continuous straight-line course. This was a common method of approach in other sites investigated by the writer (Frison 1970).

Drive lane markers for the final stampede converge at the jump-off (Fig. 1), which presented nearly a 40' vertical drop to a steep talus slope below (Fig. 2a). The width of its effective part allowed little deviation of the herd in an east-west direction. This indicates the drivers were able not only to move a herd long distances, but could also control them quite well in a stampeding situation. Animal population studies indicate a fall period of buffalo jumping (see Appendix II). There are many reasons for driving buffalo at this time of year and for not driving them at other times. The animals themselves are in better condition at this time and they could be handled much easier, especially without horses. Like most wild animals, buffalo are in poor condition in early spring after the winter. With green grass which appears around the last of April or the first of May, the animals' condition begins to improve. They begin dropping calves during this period, which for all practical purposes makes the herds difficult for driving. A buffalo cow with a calf up to a week or two old is disagreeable, unpredictable, and disruptive of any driving endeavor.

About the time the calving season is over and the calves are beginning to grow, the rutting season begins and lasts into the late summer. The behavior of both the cows and bulls at this time makes driving impossible. A single cow in rut in a herd is sufficient cause to disrupt any attempt toward controlled herd movements.

On the other hand, during the spring and summer, the human group dispersed into single or small multi-family groups in order to better exploit the environment, and it was not economically advantageous to convene a group of people large enough for communal driving when the probability of success was lowered because of buffalo behavior. In addition, large quantities of meat were not desirable during the hot summer days considering the speed with which meat spoils and, besides, individual hunting techniques provided them with sufficient meat during this period.

With the approach of late summer the grass begins to dry and harden and the animals now take on their best condition. The contents of the paunch contain less gasses that cause rapid bloating and spoilage. The weather is cooler, but days are hot and dry and favorable for curing the meat. The calves are mature enough that the cows do not regard the approach of a strange object as an immediate danger to their offspring. The older bulls leave the herd after the rutting season and may be found singly or in separate groups and although they mix back and forth, they are easily separated at this time. It was a distinct advantage to get the bulls out of the herd as much as possible since they drop out continually when moved and others tend to follow, which is disruptive to the driving process.

This resulted in a group of people consolidating in the fall at one of several predetermined locations. The nature of buffalo behavior is such that there was no guarantee of sufficient numbers of buffalo present in any given locality in this part of the Plains from year to year, so alternative locations were ncessary. There is also a question whether a jump could be used from year to year. A mass of butchered animals such as that remaining after a successful jump season created an unbelievably foul situation that required several years to dissipate through natural means. From experience, even after two years or more exposure, a single carcass of a mature buffalo is still in a stage of decay so that collecting skeletal material from such an animal is almost unbearable. Even the contents of the paunches alone, from 100 buffalo, comprise a large mass which takes a long time to become rotted sufficiently so that use of such a location would be possible. Burning of buffalo jumps was common and this was quite likely done deliberately to improve the conditions. There was, however, no evidence of burning at the Glenrock Jump, fortunately for purposes of bone preservation, and it is difficult to interpret use of the site from year to year without burning of the accumulated bone deposits. This might also explain the presence of another jump site or sites nearby. Hind (1860:354) mentions that a group of Plains Cree abandoned a pound because the stench was too bad. It seems likely that jumping the animals into a kill area that was too badly fouled would probably have spoiled the fresh meat. It is impossible to see how any group, regardless of their insensitivity to such a stench could have butchered animals in this kind of situation. Use of the Glenrock Buffalo Jump was probably not from year to year, but was alternated with other nearby sites to allow for alleviation of foul conditions.

It is postulated that in this area of the Northwestern Plains, communal bison procurement in the fall of the year was mostly to obtain large quantities of meat for drying and subsequent storage. There were many periods of time of a week or more, during the winter on the Northwestern Plains, when weather conditions made hunting difficult if not impossible and some sort of storage was necessary to provide food during these times. This was obviously more true before the horse was introduced, when buffalo could not be moved for long distances under as well controlled conditions.

Method of Investigation

Buffalo jumps often present unique problems to the investigator. Their location is determined by special topographical features that excluded most other forms of cultural activity. At Glenrock, the initial butchering occurred on a steep talus slope dissected by a number of narrow, steep-walled arroyos. The bone deposits were contained in slope wash deposits that have been recently dissected by gullying, exposing some of the bone levels in profile. In places, the bone deposits rested on bedded sandstone containing alternating hard and soft strata. Differential erosion caused by one of these hard strata through the main part of the bone deposits resulted in a relatively flat ledge of stone, with nearly an eight foot perpendicular drop below, that contained bone to the bottom and was subsequently covered over by slope wash. Exploratory trenches to the north and south revealed profiles of the bone deposits (Fig. 4). An east-west profile revealed gullying of these strata, subsequent filling with more bone (Fig. 5), and later covering of the entire area with colluvium. The limits of the site were determined by extending the trenches in all directions until there was no further evidence of bone in the profiles. On the west side of the site area extensive deposits filled an old arroyo (Figs. 2c,6), but beyond this, only an occasional bone appeared. It was anticipated that a processing area would be adjacent to the kill area, but such was not the case.

A trench, extended up the steep talus slope toward the jump-off, revealed only a thin level of bone resting almost directly on bedded sandstones and shales. Only in the lower parts of the site did the bone deposits separate into two distinct levels with a sterile level between. A third level near the top of the deposits is believed to be the result of bone washing out of the deposits near the base of the jump-off and being redeposited below. At various places in the bone deposits away from the base of the jump-off, the two main bone levels occasionally separate or merge together with often a foot or more of sterile deposits appearing between the different components of a single unit (Fig. 4). This would suggest rapid deposition of colluvium, probably during thunderstorms or spring runoff.

It would be difficult to estimate the total number of animals killed at the site. At present, due to accelerated arroyo cutting, bones have washed for nearly a half mile below the site and they disintegrate rapidly upon exposure. Althrough there were good samples of well-preserved bone recovered, a large share was badly decomposed. There were some interesting circumstances of preservation in that in some areas of badly decomposed bones were large concentrations of perfectly preserved maggot cases. A level of maggot cases nearly one inch thick in places can be traced over parts of the site at a depth of as much as six feet.

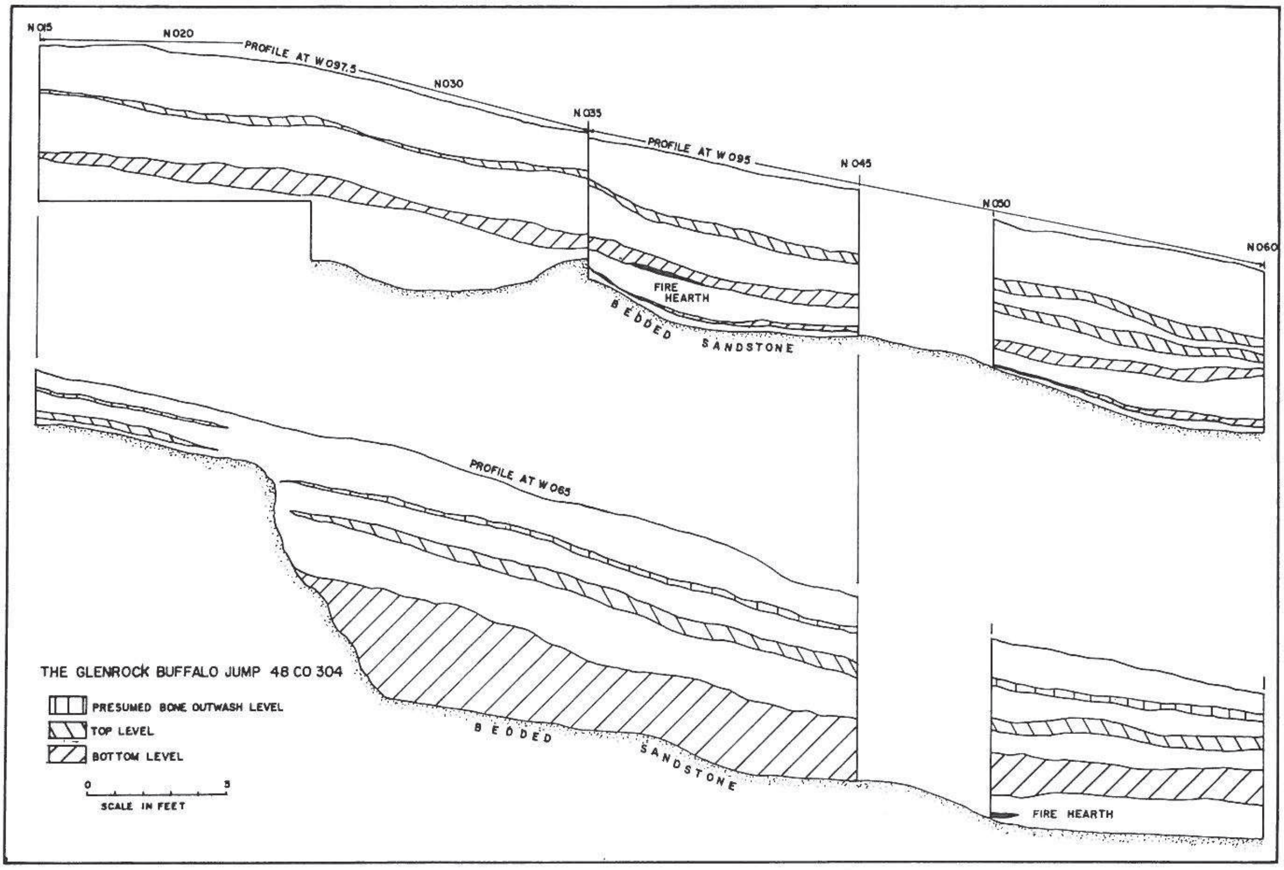

Figure 4 - Profiles from trenches at the Glenrock Buffalo Jump.

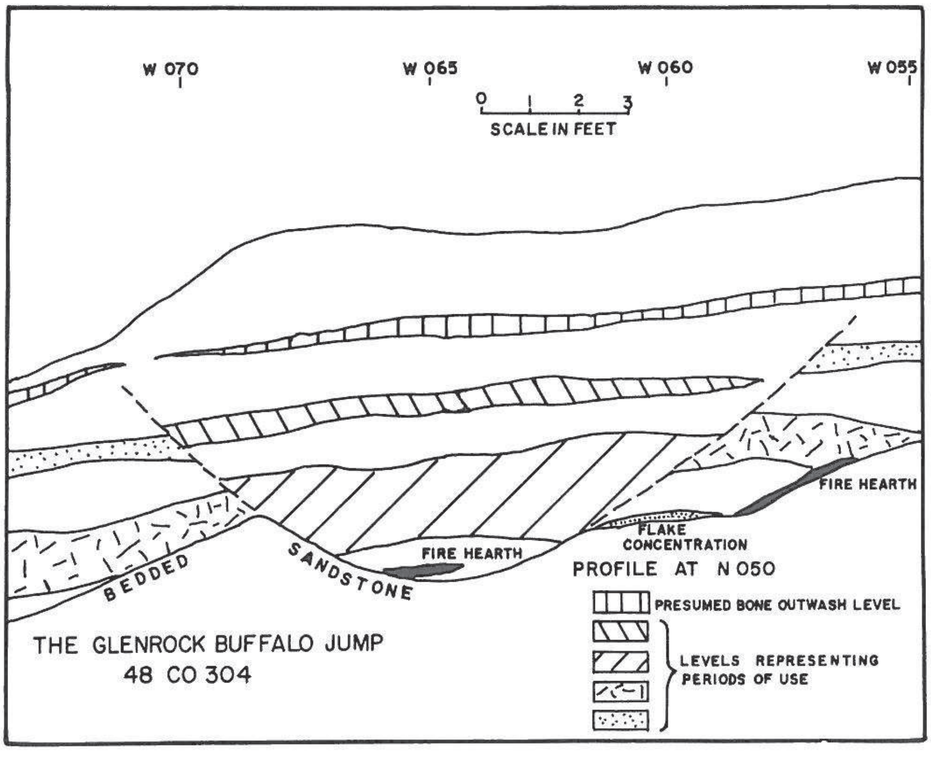

Figure 5 - Simplified profile showing a bone filled arroyo incised into older bone layers at the Glenrock Buffalo Jump.

There was no evidence of burning of the site deposits as was often the case in other jump sites, but there were four small fire hearths in the excavated area, three in the bottom level and one in the top. These were all surface fires with no prepared pits or basins although one was ringed by small angular pieces of sandstone. Charcoal recovered from these hearths is sagebrush (Artemisia spp.) and cottonwood (Populus spp.). At present, the nearest cottonwood is almost a mile distant and it is doubtful that it grew any closer at the time the site was in use. Chenopodium spp. (lambsquarter) seeds were abundant in the deposits and probably appeared as the result of human activity. This plant does not grow at the site at present.

Dating of the Site

The Glenrock Buffalo Jump is a Late Prehistoric Period manifestation and was probably used up until the beginning of the historic period. This is suggested by two radiocarbon dates of 210$\pm$ 100 or A.D. 1740 (M 2350) and 280$\pm$ 100 or A.D. 1670 (M 2349). The latest date is from a fire hearth in the bottom of the bone-filled arroyo (Fig. 5) and the earlier one is from the lower part of the top level. This leaves the possibility that the bottom level could extend back several years further since it is by far the most extensive of the two main levels. Typologically, there is some suggestion of change since base-notched projectile points are confined exclusively to the top level. No changes could be determined in the other tool categories.

Although the site was probably used up until the historic period, there are suggestions that the entire buffalo procurement complex in the area has a long history of use before this. Geologically, the deposits are suggested as being much older. The possibility is also present that earlier deposits may have eroded out completely. These problems are discussed in the geological report.

BUTCHERING PROCESSES

Theoretical Considerations

Although the deposits at the Glenrock Buffalo Jump fall into two separate levels, the bottom level is the thickest and contained by far the greatest amount of bone (Tables 1 and 2). Gullies present at the time of use contained much of the bone deposits. Obviously, once the gullies were filled with bone, they trapped alluvium from the steep slopes and the gully would fill and be forced to move to a different location. As already mentioned, one profile shows this exceptionally well (Fig. 5) and demonstrates a gully filled with bone that was cut into an older bone deposit. These changes are quite rapid as evidenced by one thunderstorm during the summer excavation which deepened one gully several feet in some places and completely filled several trenches. All this considering these gullies head only a few hundred feet away from the site deposits. Although erosion and deposition was often quite rapid, it is believed that the site was in use over a considerable period of time. There is, however, no evidence of any change in butchering techniques that can be seen in the marks on the bones so the butchering interpretations cover both levels of the bone deposits.

Figure 6a - View of Main North-South Trench with Bones in an Old Arroyo.

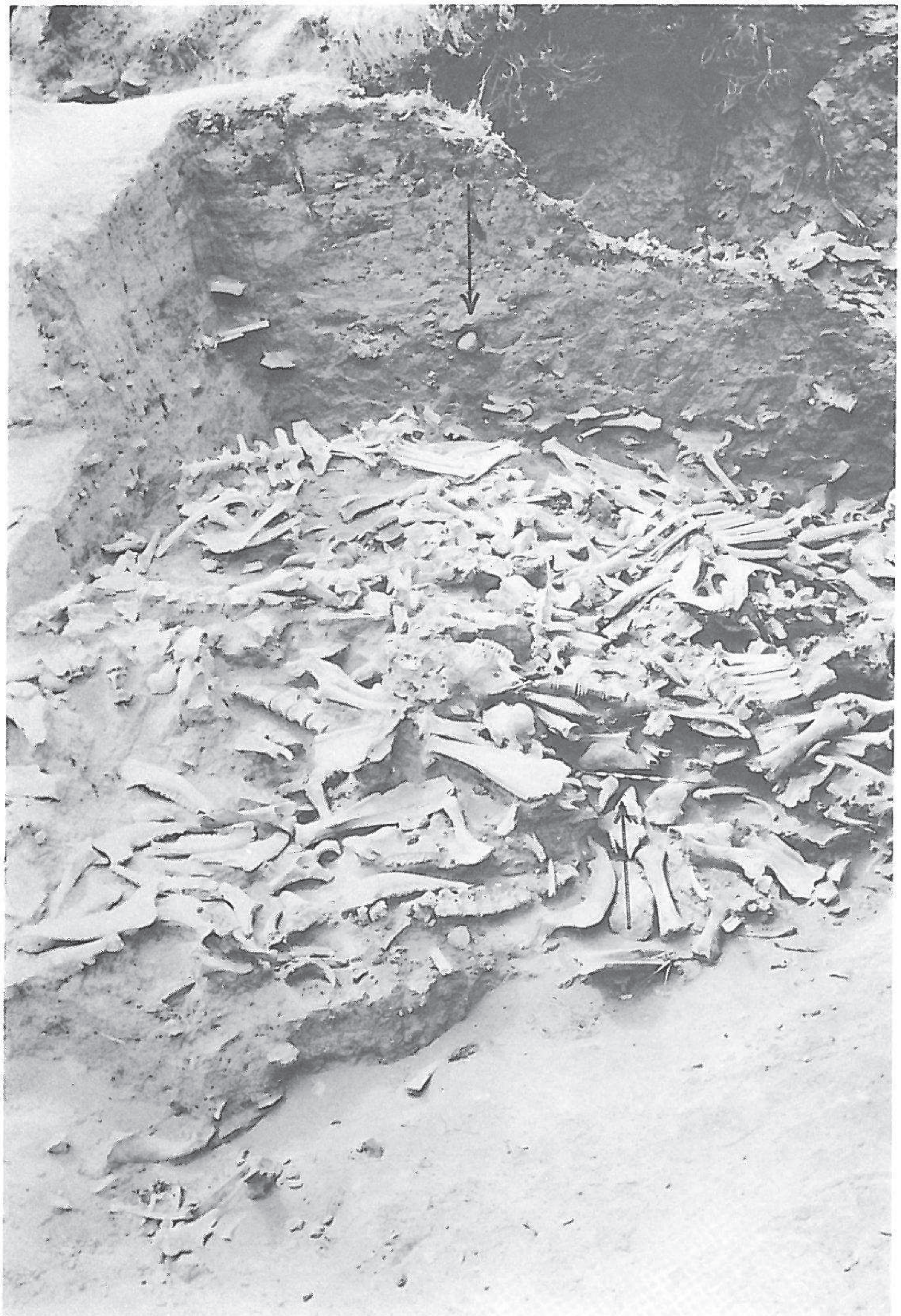

Figure 6b - Same Bone Deposit with Arrows Indicating Stone Choppers in Situ.

TABLE 1. BONE COUNT – TOP LEVEL	Complete		Proximal End		Distal End	
	right	left	right	left	right	left
Skull	27		–		–	
Mandible	25	28	–		–	
Maxillary	15	12	–		–	
Atlas	25		–		–	
Axis	27		–		–	
Cervicals	88		–		–	
Thoracics	99		–		–	
Lumbars	69		–		–	
Scapula	50		–		–	
Humerus	3	2	5	0	9	5
Radius	10	2	12	3	14	9
Ulna	3	3	8	3	8	11
Os Inominatum	14	17	–	–	–	–
Sacrum	17		–		–	
Femur	8	3	3	4	4	3
Tibia	2	9	2	4	9	6
Ribs	164		–		–	
Hyoid	13		–		–	
Caudals	7		–		–	
Metatarsal	32		29		24	
Metacarpal	38		31		24	
Astragalus	58		–		–	
Calcaneus	57		–		–	
Phalange	117		–		–	
Hoof Core	37		–		–	

TABLE 2. BONE COUNT – BOTTOM LEVEL	Complete		Proximal End		Distal End	
Bone	right	left	right	left	right	left
Skull	98		–		–	
Mandible	83	76	–		–	
Maxillary	73	69	–		–	
Atlas	110		–		–	
Axis	111		–		–	
Cervicals	380		–		–	
Thoracics	504		–		–	
Lumbars	307		–		–	
Scapula	136		–		–	
Humerus	6	6	12	6	23	16
Radius	16	16	31	23	38	42
Ulna	8	6	20	17	19	23
Os Inominatum	69	58	–		–	
Sacrum	57		–		–	
Femur	4	7	13	10	10	7
Tibia	9	2	11	7	18	21
Ribs	629		–		–	
Hyoid	70		–		–	
Caudals	14		–		–	
Metatarsal	71		90		105	
Metacarpal	70		96		72	
Astragalus	154		–		–	
Calcaneus	162		–		–	
Phalange	578		–		–	
Hoof Core	114		–		–	

Undoubtedly, butchering began immediately after the animals were stampeded over the jump-off since spoilage begins quite rapidly, even on a cool fall day. In addition, animals are more easily butchered before they have had a chance to cool and hides may be removed much more easily from a warm carcass than from a cold one. The evidence suggests stylized butchering techniques with some variation probably from size, age and number of animals obtained. It was obviously not possible for the drivers to select the number desired since a jumping situation might result in fewer numbers than desired or an overkill, either of which would have a definite bearing on the intensity of utilization of a given carcass. There are, however, no indications that any large body of meat was wasted since there were no articulated skeletons or large parts of the carcass in the excavated area of the site that did not demonstrate some butchering.

There were no complete animals or butchering units that can be pointed to with any degree of certainty as making up the remains of a single animal. The bone deposit is believed to represent the parts of the buffalo as they were left after butchering and the relative presence or absence of any given bone or butchering unit was considered significant and required an explanation. Repeated occurrences of similar tool marks and articulated bone units suggested stylized butchering methods.

The reconstruction or model of butchering processes proposed here for the Glenrock Buffalo Jump is based on a number of assumptions and inferences since not all the operations in butchering a buffalo are reflected as cutting, pounding or chopping marks on the bones. It is assumed, however, that the repeated occurrence of similar tool marks in the same locations on bones reflect stylized processes, and the basis for the interpretation of a culturally-accepted way of handling buffalo carcasses under circumstances that required maximization of effort to prevent loss of meat through spoilage. Once a few steps in the butchering process were established, it was assumed a logical sequence could then be inferred.

It was assumed, also, that the butchering was accomplished with the tools recovered at the site. A good share of these tools, both stone and bone, would be disregarded if not found in this particular context, although this does not render them any less functional. It is not believed that there is any significant category of perishable or other tools used in butchering that is not represented at the site.

With the assumptions that the marks on bones were made by the tools recovered in the deposits and represent strategic butchering processes, another consideration was that some tool marks on bones were obviously the by-products of operations on hides, ligaments, etc., and not on the bones upon which the marks appeared. Further interpretation of these marks required a certain level of familiarity with buffalo anatomy acquired by the use of a standard veterinary textbook on the anatomy of the domestic animals in conjunction with the dissection of a number of buffalo in various stages of decomposition. Although quite similar, there are some important differences between buffalo and domestic cattle. As a result, it was found that the recurring marks on bones could be rationally explained as resulting from a logical butchering sequence.

To oversimplify, the butchering process consisted first of removing the hide and then loosening the origin or insertion of muscles so they could be stripped out and removed to another location nearby for processing. Other processes were involved which included the removal of long bones for later recovery of bone grease, separation of parts of the carcass into various butchering units, opening of the body cavity to gain access to the internal organs, and recovery of brains and other contents of the skull. With this as a generalized model, a more detailed reconstruction of the butchering process can be postulated.

Butchering Evidence from the Site

After killing the animals, the first step in butchering was obviously hide removal. Much of the evidence of skinning is scarce and inconclusive, but some reconstructions are possible. The hide was presumably cut around both front and hind legs by an encircling cut made with sawing strokes by a sharp chipped-stone tool. Evidence for this appears as cut marks on both metatarsals and metacarpals. The cutting marks are quite obvious in some cases (Fig. 7 i-n), but in the majority, careful examination with different light conditions and magnification was necessary. The extent and depth of cutting marks were dependent to a large extent on the condition of the tool. A newly-sharpened tool leaves use marks on fresh bone more readily than does a dull one.

There is no indisputable evidence to determine the location of the main cut on the hide. It seems most likely to have been down the top of the back with less likely possibilities of it having been down the side or the belly. The location has some bearing on the position of the cuts on the legs that connect with the main cut down the back or belly but no marks were found that might give this kind of clue. There would be little possibility of the evidence remaining as cut marks on dorsal or sacral spines considering the thickness and extent of the supraspinous ligament if the cut were down the back. If the cut was down the belly, some cutting marks might be expected on the sternum, or the costal cartilage, but this part of the carcass with almost no exceptions was taken from the site and the few remaining bear no such evidence.

Caudal vertebrae were almost completely lacking, and there are no cut marks on the few recovered. On most of the sacral elements, either the fifth or fourth and fifth sacral vertebrae were broken off and were seldom found at the site. This was probably the method of removing the tail and the missing sacral vertebrae were broken loose by pounding or chopping (Fig. 12a) and went with the tail and hide. There are alternative explanations for the lack of caudal vertebrae. Tixier (1940:193), for example, describes the Osage hunter in 1840 as cutting the tail of a bison for a trophy but the best explanation for the Glenrock site is that it was removed with the hide and served as a handhold to pull the hide loose from one side.

There seems little doubt that the skull on most animals was skinned out quite completely. It does not seem possible to have broken a hole in the frontal bones, broken the temporal bones, removed the mandibles, and split the skull otherwise. A few cut marks on the skulls may have resulted from skinning but none appear in a manner that would give

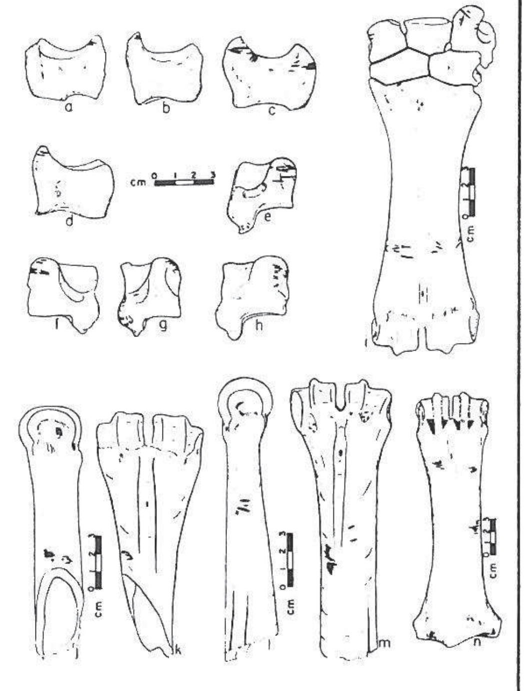

Figure 7. Butchering marks on radial carpals (a-d, i), ulnar carpals (e-i), a front leg unit (i), metatarsals (j-m), and a metacarpal (n).

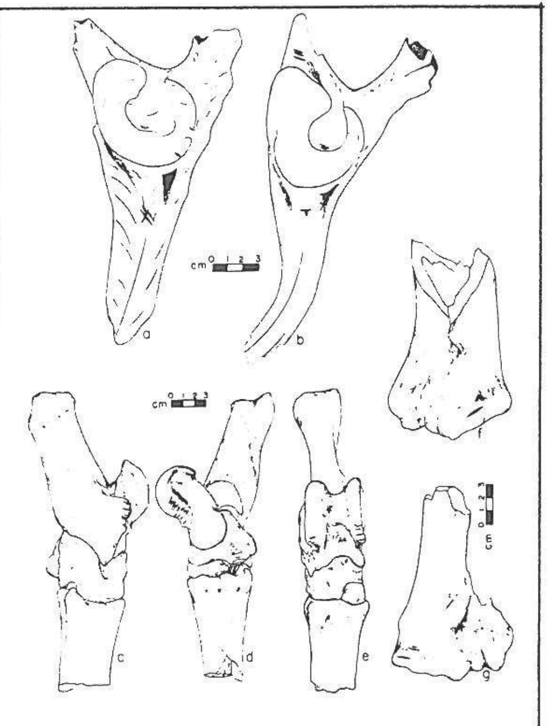

Figure 8. Butchering marks on pelvic units (a-b), rear leg unit (c-e) and radii (f-g).

evidence of the stylized procedures involved. It is possible, however, that the head was removed from the carcass before it was skinned and, if so, it would have been relatively easy to skin enough of it out to complete the processes mentioned above. Significant numbers of mandibles bear sawing marks from a sharp tool on the anterior ventral border at right angles to the long axis, usually slightly forward of or directly below the first or second premolar. This part of the mandible is free of ligaments or muscles and it is believed that these marks were to cut the hide in skinning the skull. Another set of marks regularly appear on the anterior medial side of the mandibles but these are believed to have been for a different purpose, probably to cut the mylohyoideus muscle to aid in removing the tongue. Accounts of Plains butchering (Morgan 1959: 159) mention cutting a slit in the throat and pulling out the tongue and cutting it off, but this was using a steel knife and would hardly apply to the Glenrock site context.

Front and rear foot bones were removed and here the evidence is more straightforward since there is good evidence of stylized cuts to sever certain ligaments. These marks appear on the anterior and medial sides of the tibial tarsal bone (Fig. 8d-e), and could only have been made with the rear leg in its extended position. Otherwise, the posterior side of the distal end of the tibia covers that part of the tibial tarsal which bears the cut marks. It appears most likely that this was done with the animal on its side while holding the rear leg extended. The cut marks appear also on the lateral side of the fibular tarsal bone (Fig. 8c) and the cut then passed directly distal to the lateral malleolus bone. It is postulated that the latter remained on the tibia due to their significant absence in the deposits. These cut marks appear clearly on 52% of tibial tarsals and 46% of fibular tarsals. Gilbert (1969:290) describes a similar mark on a bison tibial tarsal, which he mentions as evidence for skinning. It was more likely the result of cutting the ligament to remove the foot and not a part of the skinning process.

Cut marks appear also on the front leg bones. The best evidence is on the ulnar carpal (Fig. 7e-i) but only rarely (three specimens) does it appear on the styloid process of the ulna, suggesting the front leg as well as the hind leg was also being held in an extreme extended position while the cuts were made. The cut evidently continued around above the accessory carpal. An occasional cut mark appears on the radial carpal toward the posterior side and less rarely on the anterior side (Fig. 7a-d, i). Only rarely (four specimens) do cut marks appear on the posterior side of the ulna. Of the ulnar carpals and radial carpals, 43% of the former and 39% of the latter bear cut marks. This is still a common method of butchering in the field and after cutting in this manner, both front and rear feet may be snapped off. This is best accomplished with the animal on its side. Both front and rear units were left at the site. The hind foot unit usually contained the tibial tarsal, fibular tarsal and the more distal bones and the front foot units contained the radial, intermediate, and ulnar carpal and the more distal bones.

The skinning was probably accomplished by the use of both sharp cutting tools of chipped stone, which were used to make cuts in the hide, and blunt bone tools, which

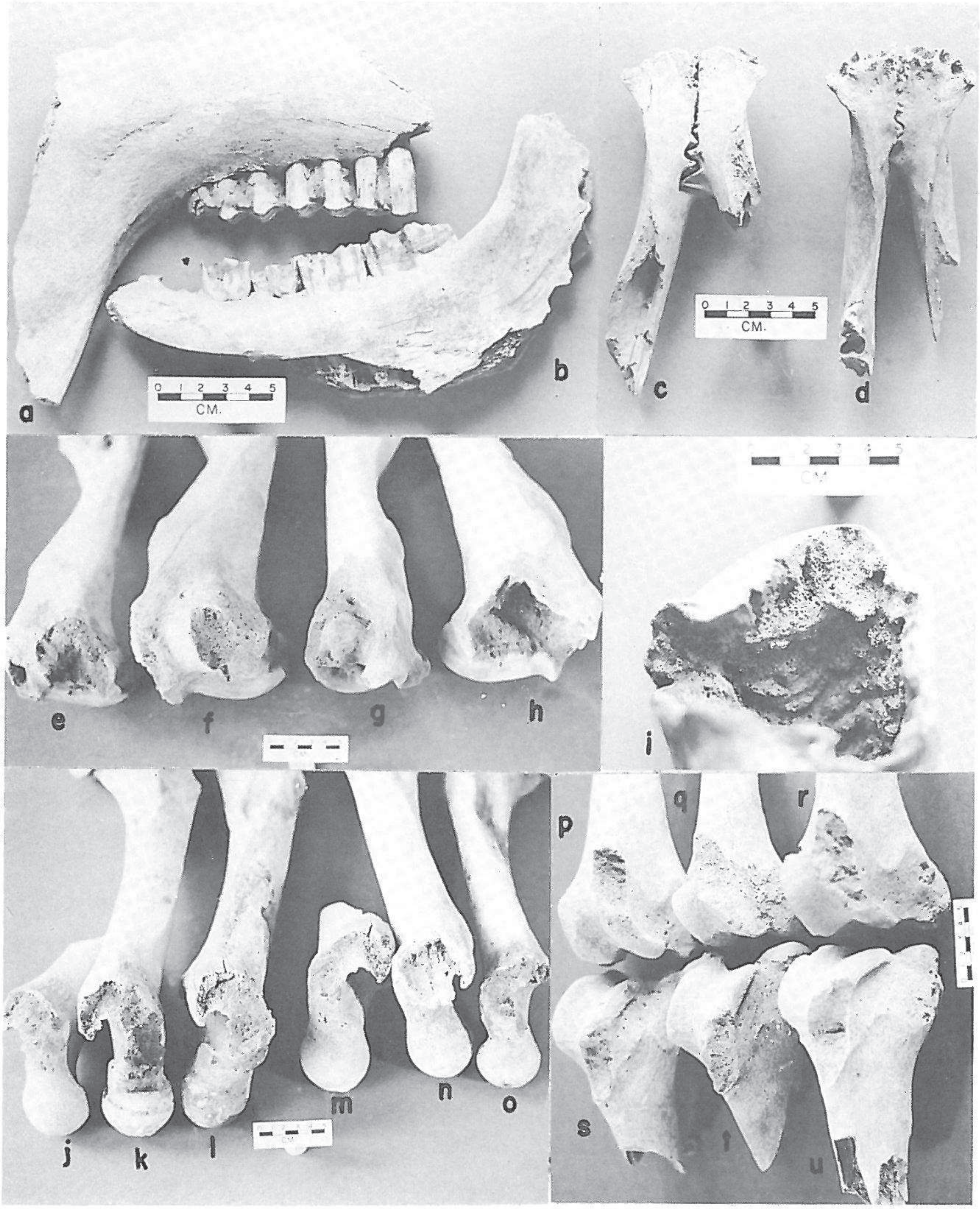

Figure 9 - Butchering Marks on Mandibles (a-d), Humerii (e-l), and Femora (j-u).

were used to loosen the hide. Several bone tools have working edges that would have been functional in separating the hide from the meat and meat from bones. All are largely fortuitous although attempts may have been made to make a predetermined break in order to provide a suitable working edge. Some of these tools consist of more than one articulated bone and bear wear patterns that may be the result of skinning. These are described in the section on tools.

The Front Leg

At this site, the procedure in butchering once the hide was removed is believed to have been to leave the animal on one side and strip the meat and then turn it over and repeat the process for the opposite side. Butchering was accomplished by processes of chopping, crushing, breaking, and cutting muscle origins and insertions and then stripping the muscles. As already mentioned, the process as described here is a reconstruction from the writer's interpretation of the evidence of butchering activity found on the bones and then applying this to the anatomy of the buffalo along with a consideration of the tool assemblage used.

It is believed the butchering process began on the front leg. The first step was to chop loose the lateral tuberosity of the humerus. This was accomplished with either a sharp-pointed or sharp-edged stone tool judging from the marks on the bones (Figs. 9e-h; 15c). The lateral tuberosity is the insertion for the supraspinatus and infraspinatus muscles and once chopped loose, was probably used as a handhold for stripping them. Many of the bone tools were probably used to aid in loosening meat from large areas of bone such as the scapula. Longitudinal marks that appear occasionally in the supraspinous and infraspinous fossae of the scapula suggest this kind of tool use. Most scapulae (64%) demonstrate breaking off the acromion and less frequently part of the spine also. Parts broken or chopped off rarely appeared in the site deposits, suggesting they were carried away with their attached muscles.

There was considerable variation in the treatment of the olecranon which is the insertion for the triceps muscle. Often the olecranon was chopped away (Fig. 10e,f), broken off, or it may bear deep chopping marks (Fig. 10g, h). About half bear no marks at all suggesting the triceps muscle may have been cut loose or as another alternative, if there was an overkill and a surplus of meat it was regarded as of little importance. It was common practice to break the ulna loose from the radius by means of hammerstone blows directed from one side that produced a variety of pounding marks and stylized breaks (Fig. 10j-l). This allowed easier separation of the humerus from the radius-ulna and there are cut marks which appear occasionally on radial tuberosities (Fig. 8f, g) which probably aided also in this separation.

The next step was to raise the front leg and chop loose the medial tuberosity of the humerus in much the same manner as described for the lateral tuberosity and then strip the subscapularis muscle from the scapula. The serratus ventralis muscles, including the serratus cervicis and dorsalis, have their insertion on the costal surface of the

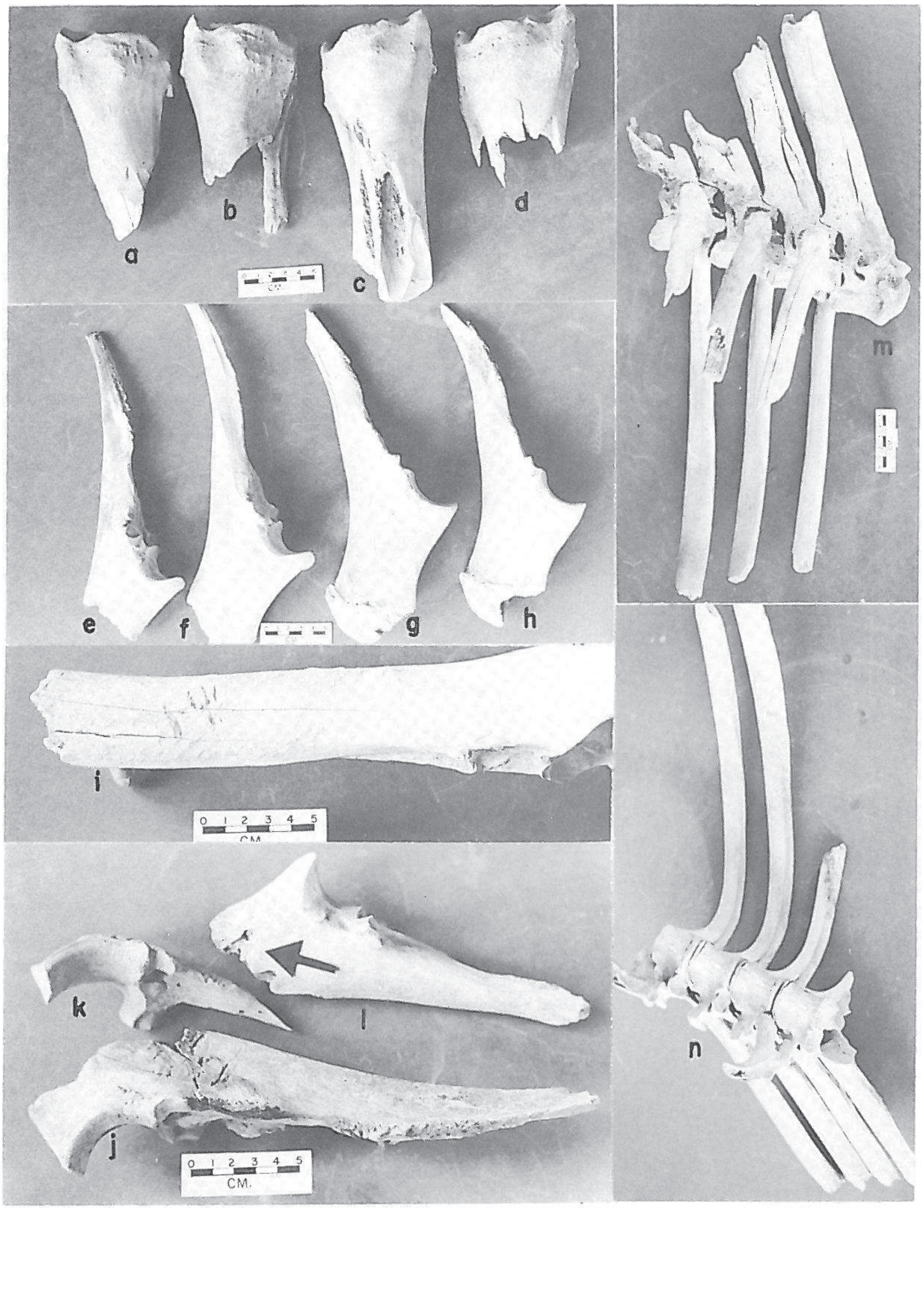

Figure 10 - Butchered radii (a-d) ulnae (e-h); tool marks on dorsal spine (i), and ulnae (j-l); and two articulated thoracic vertebrae and rib units (m-n).

scapula and adjacent part of the cartilage and these insertions were probably stripped loose at this time and the front leg would now have been free of the carcass. These muscles are quite large on a buffalo to support the heavy, low-slung head. The ventral branches of the transverse processes of the fifth and sixth cervicals especially and less frequently the transverse processes of all of the last four or five cervicals were removed which may have been the method of removing the serratus cervicis. The serratus dorsalis could have been removed separately or more likely left attached to the rib butchering unit. The scapulae were then discarded with few exceptions. One was broken transversely at about the center and the resulting edge shows subsequent evidence of use as a scraping tool with the proximal end used as the handle. They would have little value once the flesh was removed since their marrow content is very low.

Often the articular end of the humerus was chopped loose in the kill area and the insides bear gouging marks (Fig. 9i) suggesting the butchers were either collecting or eating marrow while butchering. Several bone tools recovered could have produced the gouge marks. In addition, removal of the proximal articular end was often done in such a manner to leave a toothed edge which was then used as a scraping tool (Fig. 19a-c).

The distal ends of radius-ulnae were usually broken off in a manner suggesting it was probably done by means of a sharp blow over an anvil stone (Fig. 10a-d) and the radius itself split by means of a stylized method of hammerstone blows in the vicinity of the interosseus space presumably to gain access to the marrow cavity. Most humerii and lesser numbers of radii were missing and probably were removed to a processing area to obtain bone grease. About half of the metacarpals and metatarsals present were broken, some of which was undoubtedly the result of the fall from the jump-off and subsequent pile-ups, and some of which was obviously deliberate and probably to obtain marrow since some bear evidence of pounding with heavy, blunt-edge tools. No evidence of either utilization or butchering marks appeared on front or rear phalanges.

The Hind Leg

After removal of the front leg, attention was then directed to the rear leg. The first step here was apparently to gain access to the patella for which evidence appears on nearly every femur. Blows from a sharp tool were directed in such a manner to remove part of the medial ridge of the trochlea (Fig. 9p-u). Patellae were almost entirely lacking in the site deposits (only eight specimens) but two of these bear marks of chopping from a sharp-pointed tool. Tool marks on several femora strongly suggest cutting of the lateral patellar ligament below the insertion of the biceps femoris muscle. It is believed that the medial and middle patellar ligaments were also cut but definite evidence is not present on either the femora or patellae. This is not surprising considering the presence of a large meniscus and the femoro-patellar capsule which would nearly always have received the butchering marks.

It ispostulated that the patella was used as a hand-hold for stripping the biceps femoris and the vastus lateralis muscles. The origin of the vastus lateralis is the trochanter major which was also chopped loose (Fig. 9j-o). The trochanter major is also the insertion of the gluteus medius which could be stripped out at this time.

The next step on 24% of the specimens was to chop loose the tuber calcis (Fig. 11e-h) presumably to strip out the gastrocnemius muscle. There were apparently some variations in this case as most calcaneii do not bear either cutting or chopping marks. The gastrocnemius muscle does not contain much in terms of meat and may have been ignored in many instances when larger numbers of buffalo were killed than needed. However, as already mentioned, it was common to separate the rear leg at the tibia-tibial tarsal joint in which case the tendon was probably cut. In this situation it was possible also that the entire rear foot was used as a hand-hold for stripping the gastrocnemius muscle after which they then cut the tendon. Other muscles along the tibia may have been stripped also, but these are small and of lesser importance.

With the patellar ligaments cut, it was a simple matter to separate the femur and tibia. No evidence of further cutting of ligaments appear but on a few specimens (five) there is evidence of some chopping around the posterior borders of the lateral and medial condyles of the tibia. At least three femora bear marks of chopping on medial and lateral epicondyles and both of these latter operations may have been to complete the separation between femur and tibia. Occasionally, the proximal end of relatively small tibiae were removed presumably to retrieve the marrow concentrated at this point. Occasionally, this was used as a scalloped-edged scraping tool of much the same type as is described for the humerii (Fig. 19a-c).

The Pelvic Area

Variations occurred in the treatment of the pelvic bones and there are a number of areas of muscle attachment that were apparently of importance to remove for purposes of stripping meat. Of greatest significance were the tuber ischii and tuber coxae. Five specimens were complete with both pelves, sacrum and the lumbars intact. On one (Fig. 12a) the fifth sacral vertebra and the spine of the fourth were broken and missing. The tuber ishii and tuber coxae were removed from both pelves and separation was between the fourteenth thoracic and first lumbar, which was accomplished by breaking the articular processes. Much of the spinous and transverse processes of the lumbars were broken and missing. The other four specimens were treated similarly except separation on one was between the thirteenth and fourteenth thoracic and on another it was accomplished by crushing the fourteenth thoracic.

Clear evidence of chopping loose the tuber ischii is present. Depressed fractures indicate the direction of blows on the dorsal side (Fig. 12b). On others, there are depressed fractures both dorsally and ventrally suggesting strongly the animal was on its side and not on its belly and that blows were directed from both a dorsal and ventral direction. The tuber ischii is the origin of the biceps femoris, semitendinosus, and semimembranosus muscles which constitute a major part of the choice meat on the hind leg. This all worked in conjunction with loosening of the patella and tuber calcis. At this

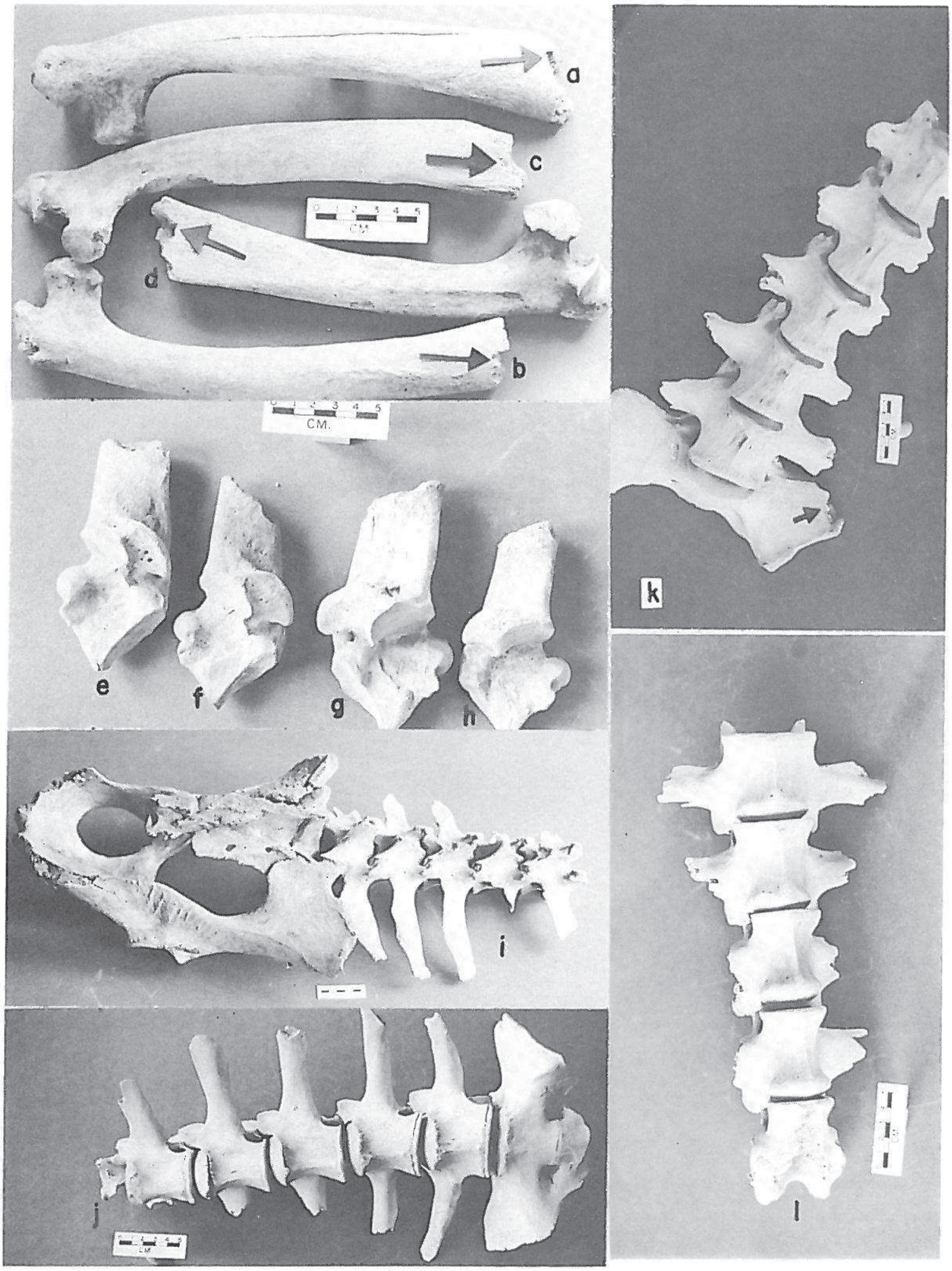

Figure 11 - Tool marks on no. 1 ribs (a-d), and calcaneii with tuber calcis removed (e-h), articulated pelvis and lumbar unit (i), articulated lumbar and sacrum units (j-k), and articulated lumbar unit (i).

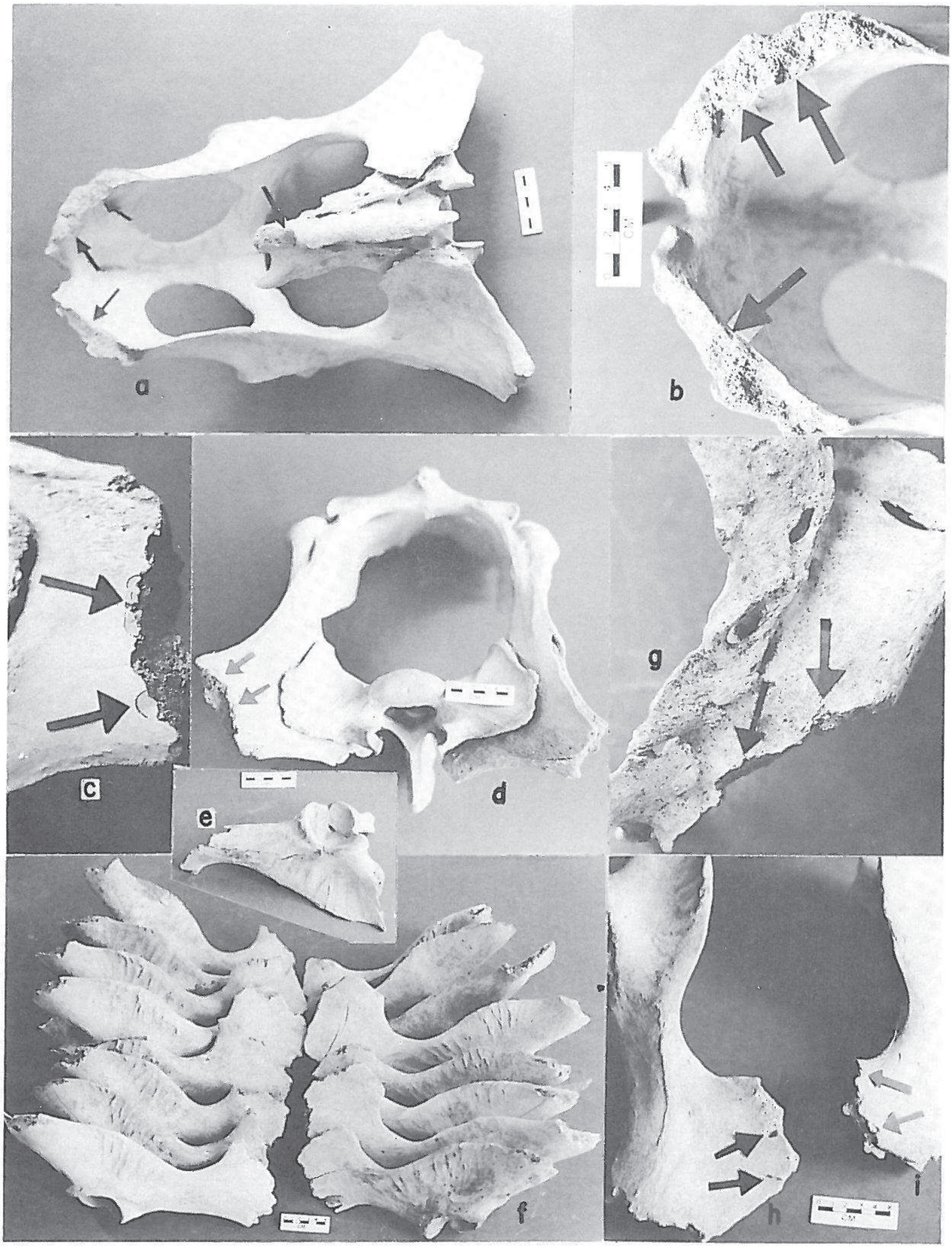

Figure 12 - Complete pelvis with butchering marks (a-d), butchered pelvic units (e-f), and tool marks on sacrum and pelvic units (g-i).

point, the hind leg and pelvis on one side would have been nearly free of meat with the exception of the medial muscles of the thigh which include the gracilis and the adductor which could have been removed with the patella since the gracillis inserts to the medial patellar ligament. On these complete pelves, however, there is no evidence of cutting or chopping loose the area of origin of either the gracillis or adductor on the pelvis symphysis and they may have been removed with other muscles.

The femur was removed from the pelvis and cutting marks occur on a significant number of specimens in the vicinity of the rim of the acetabulum adjacent to the shaft of the ilium and also on the ischium near the acetabular notch (Fig. 8a-b). This was probably to cut the transverse acetabular ligament which would allow exposure of the round ligament to the head of the femur by properly manipulating the femur. Femora were the least frequently occurring long bones at the site and were apparently being taken for their marrow content. Most of those present were broken, apparently as a result of the jumping. Most of the complete femora present were small and from younger, immature animals and this suggests that the marrow content of these was low enough that they were the ones most often ignored. The marrow cavity of an immature animal is quite small compared to a more mature one.

The other part of the pelvis chopped loose was the tuber coxae and this was probably to strip out the longissimus dorsi and other longitudinal muscles between the dorsal spines and the ribs. The spinous and transverse processes of the lumbar vertebrae were broken and missing. The latter probably figured prominently in removal of the sub-lumbar muscles.

Most pelves, however, demonstrate a good deal more breakage with hammer and chopping tools. In 22% of the recovered specimens, breaks were made across the acetabular branches of both the pubis and ischium (Fig. e,f). The body of the ischium usually broke in the vicinity of its symphyseal branch. It is suggested also, from several specimens, that the fused symphyseal branches of the pubis and often part of the adjacent fused symphyseal branches of the ischii commonly formed a unit which was used to remove certain muscles since it was rarely found at the site. A common variation of this was that the pubis was lacking entirely since it often broke away from the ischium and ilium at the acetabulum but was rarely recovered in the bone deposits. There was never an attempt to separate the pelves at the symphysis as in modern butchering since it was obviously easier to break both pubis and ischium across into the obturator foramen.

In 63% of the examples, the ilium was relatively intact except for removal of the area including the tuber coxae and around the anterior border to and sometimes including the tuber sacrale. On 28% the ilium was broken at its narrowest point between the greater sciatic notch and the pelvic inlet. Distal parts of the ilia resulting from this break were almost entirely lacking with the exception of four specimens and these had the tuber coxae chopped loose and in addition bear evidence of use as scraping tools (Fig. 20t-u). Presumably, the distal part of the ilium along with the attached muscles, were removed to the processing area.

The sacrum was separated from the ilium in most cases except in the few (five) examples where the pelvis was intact. On a single example one half of the pelvis, the sacrum, and the five lumbars were articulated. One or both wings of the sacrum often bear chopping or pounding marks (Fig. 11 k) which may have been either to cut ligaments to separate it from the ilium or possibly to loosen the origin of a sublumbar muscle. Sacral spines were chopped loose to varying degrees presumably to aid in loosening part of the origin of the longissimus muscle (Fig. 12g). As already mentioned, the last one or two sacral vertebrae were usually broken loose and missing. Tool marks from sharp-pointed choppers often appear on pelvic units (Fig. 12h-i).

The Ribs and Vertebral Column

The next step was breaking the ribs and interpretation here is not as clear as desired, but some suggestions can be made. The ribs that were recovered fall into general categories that include: (1) ribs broken toward the proximal end but with head and neck usually intact; (2) ribs nearly complete only the sternal ribs are usually chopped off distally; (3) ribs with the proximal ends missing. Breaks vary from those directly adjacent to the articular end to a few placed several inches distally. The interpretation from this is that on one side the ribs were usually broken off close to the vertebral column, probably with a hammerstone or chopper or possibly some other tool such as a bison leg or mandible. Rarely was the first and second rib broken in this manner and often it and the remaining sternal ribs were chopped off close to the distal end close to the costal cartilage. It is suggested by two specimens (Fig. 10m-n) that they were breaking the ribs on one side relatively close to the vertebral column in order to reach the internal contents of the rib cage. There are about equal numbers of ribs that are broken near the distal end as there are complete ones and it is suggested that the ribs from about number 6, 7, 8, or 9 to number 14 constituted a desirable portion of the carcass and that one side was removed by cutting the ribs close to the vertebral column and removing them as a unit. When the carcass was turned over, the ribs on this side were not cut close to the vertebral column but were removed as a unit but still attached to their respective thoracic vertebrae. There was no need to cut the first few ribs near the vertebral column on this side. The desired organs in the rib cage were already taken out from the opposite side and in addition, there was relatively little meat on the first few ribs and what there was could be stripped and included with the posterior ribs. The total sample of both ribs and vertebrae demonstrate a significant absence of about 40% of the last 7 or 8 posterior ribs and thoracic vertebrae over the anterior ones. The two recovered rib cage sections demonstrate proximal breakage of the ribs on one side and distal breakage on the opposite side (Fig. 10m-n).

There is abundant evidence to indicate that the sternum and the costal cartilages were an important cut of meat and were being removed from the kill area. There is ethnographic evidence that this was one of the more desirable parts of the buffalo carcass (Wilson 1924; Fletcher and LaFlesche 1906). With few exceptions, the distal ends of sternal ribs were cut close to their junction with the costal cartilages and these and the sternal parts were rarely found in the site deposits. At first this was considered as the result of differential preservation, but the few sternal elements that were found demonstrate the same preservation as other bones. There are some questionable aspects of chopping the ends of the sternal ribs. The distal end of the first rib is thick and occasionally depressed fractures are still intact, suggesting that some were chopped with blows directed toward the lateral edge (Fig. 11a-b). Experiment proves this difficult unless a stone or other object serving as an anvil is held against the medial side of the rib. In other cases, the number one rib bears depressed fractures on the medial side (Fig. 11c-d) suggesting that the practice was to first cut the ribs on one side and then reach through and cut the opposite ribs from the medial side, probably using the ground beneath as a base for pounding.

A common unit in the site includes usually the first five to six thoracic vertebrae occasionally with the seventh cervical on one end or the seventh and eighth thoracic on the other (Fig. 15f-g). The dorsal spines were chopped off, either distally or sometimes close to the base, presumably to obtain the hump meat. Separation of the vertebral column occurred in five general areas with a variation of one or two vertebrae in either direction. In two cases all the cervical vertebrae, and in one case the cervicals and two thoracic, remained attached to the skull. On one other specimen there were three cervicals, and on two others four cervicals remained articulated to the skull. Usually, however, the skull was removed by separating at the axis and atlas. Evidence for this appears on the anterior part of the wing of the atlas in the form of depressed fractures from pounding with sharp-pointed tools (Fig. 16f). This was usually done from a dorsal direction as interpreted from the nature of the fractures and only in rare cases were the blows directed from the ventral direction. One rather unusual unit consisted of the first three cervicals articulated with the occipital bone, which had been broken out from the base of the skull (Fig. 13a).

The next separation was usually between either the seventh cervical and first thoracic or between the first thoracic and second thoracic, and only rarely as far back as between the second and third thoracic. Next point of common separation was usually at the sixth, seventh or eighth thoracic. There was a good deal of variation in separation beyond this, and with about equal frequency it was between the twelfth and thirteenth thoracic; the thirteenth and fourteenth thoracic; or fourteenth thoracic and first lumbar. Occasionally, the fourth or fifth lumbar was almost completely crushed or chopped in two (Fig. 11l). A frequent occurrence, also, was the sacrum articulated with one or two lumbar vertebrae. Varying amounts of crushing and breaking occurred in separating the vertebral column. The easiest separation was apparently the one between the twelfth and thirteenth thoracic, with others more difficult.

Prominent cutting marks appear regularly at the base of the dorsal spines. These are parallel to the vertebral column and usually appear on both sides (Fig. 14). They are generally confined mostly to thoracics from number eight to twelve and are probably the result of removing the longissimus muscle. This is illustrated by Gilbert (1969:290) for his South Dakota material. Other cutting marks appear quite regularly, but with no definite pattern, on the sides of the dorsal spines from the sixth cervical to the last lumbar but usually are

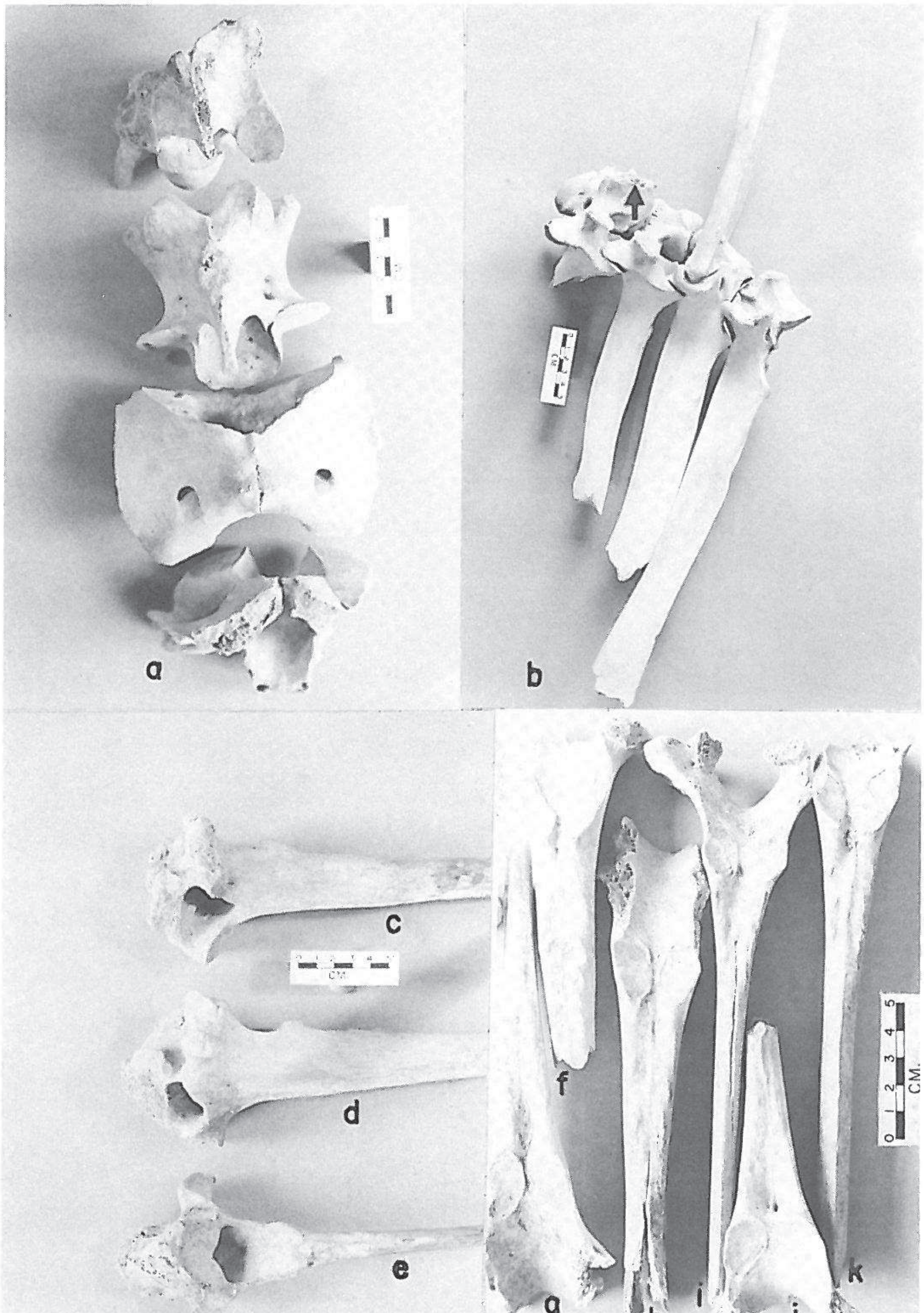

Figure 13 - Three cervicals and occipital bone originally articulated (a), two cervicals, two thoracics and No. 1 ribs articulated (b), and vertebrae bearing butchering tool marks (c-k).

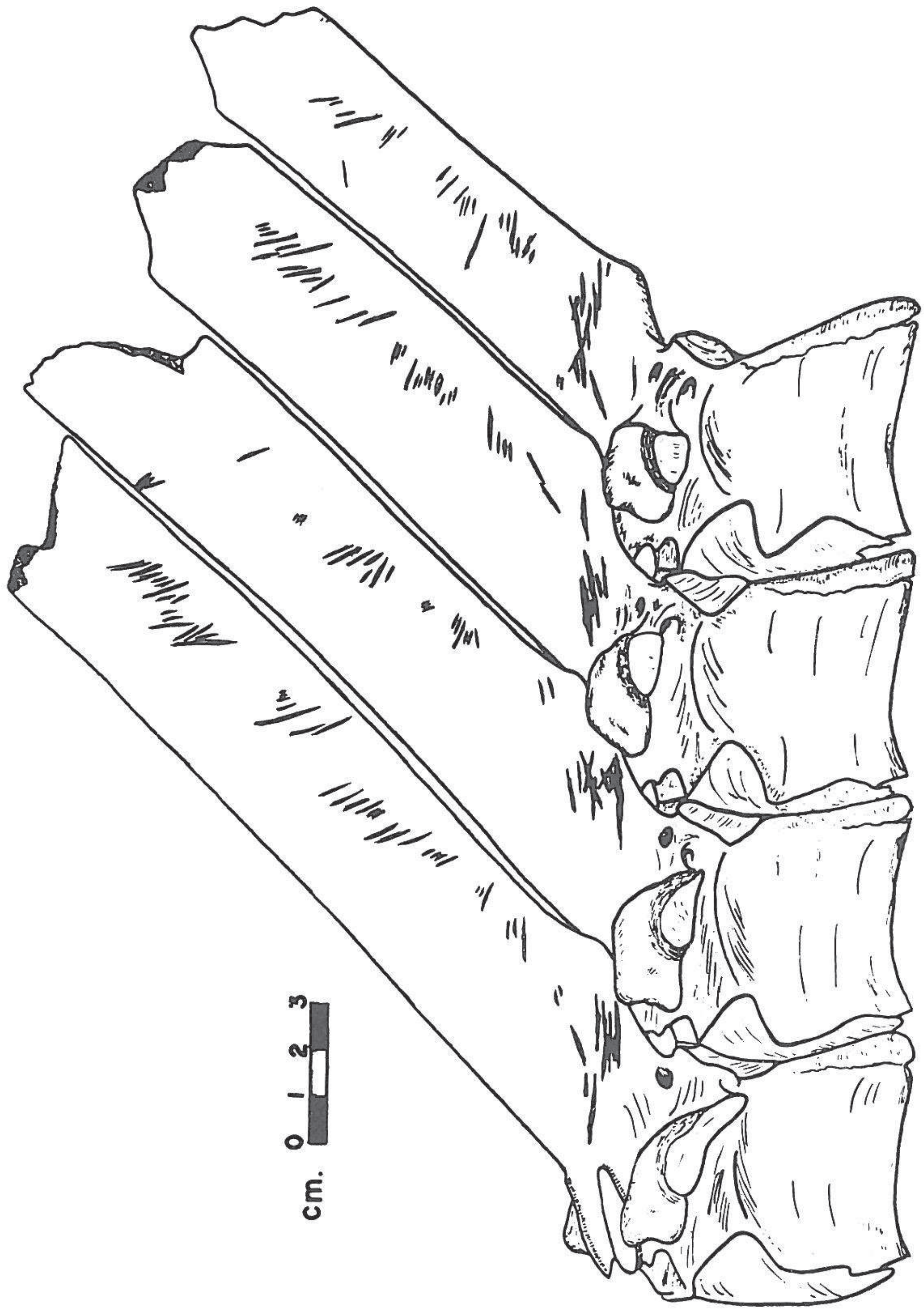

Figure 14 - Butchering Marks on Thoracic Vertabrae Unit.

concentrated on the forward thoracics. Distal ends of dorsal spines of thoracic and lumbars are usually chopped or broken loose and did not appear but rarely in the site deposits. It is assumed they remained with the meat that was removed. Several dorsal spines also bear evidence of chopping tool use (Fig. 10i).

Some uncertainty exists as to the method of removal of the large ventral branches of the transverse processes of especially the fifth and sixth cervicals. Some appear to have been broken loose by chopping from either a medial or a lateral direction judging from the depressed fractures (Figs. 13b, 15d-e). As mentioned in butchering the front leg, it is postulated this was done to remove the origin of certain muscles including the serratus cervicis in the neck. Quite likely both ventral branches were removed while the animal lay on one side since depressed fractures often appear laterally on one branch and medially on the other branch of a single vertebra. Pounding and chopping marks appear especially in the area of separation of the last cervical and first to second thoracic and also in the area of the seventh or eighth thoracic. As a result, the head and neck of the rib near the point of separation was often broken from pounding and chopping. Another common method was to chop loose the articular area of the rib which must also have resulted in cutting much of the ligature holding the vertebral column together, and also resulted in pounding and chopping marks surrounding the area of separation (Fig. 13c-e). One of the more common bits of evidence for separating the vertebral column is a number of thoracic vertebrae, with chopping marks through to the vertebral foramen separating the dorsal spines from the transverse processes and the body of the vertebrae (Fig. 13f-k).

The Skull

The skull and the atlas were usually separated from the vertebral column at the atlanto-axis articulation. This separation was accomplished in part at least by chopping loose muscle attachment on the posterior parts of the wings of the atlas (Fig. 16f). Depressed fractures appear on the dorsal side of the atlas indicating blows from this direction. A sharp twist would then separate the axis from the atlas. The axes bear little evidence of tool marks except that the dorsal spines on 7% of specimens are chopped loose. A possibility is that they were loosening the attachment of the ligamentum nuchae in this way on a few animals.

The next operation was apparently to remove the mandibles. The most common method was to place the skull face down and with a reasonably heavy but blunt-pointed hammerstone, direct sharp blows downward and slightly inward to the temporal condyles and break them off at the point of articulation with the mandibles (Fig. 16e). This destroyed the zygomatic arch and the force of the blow often carried through with sufficient force to break off the coronoid process of the mandible. It is postulated, also, that a lack of broken temporal bones in the site deposits may be an indication that they were used to aid in stripping the masseter muscles, which were then removed with the rest of the meat. After this, the mandibles were quite free and were removed. The tongue was also readily accessible at this time, and the regular appearance of cut marks on the medial side of the

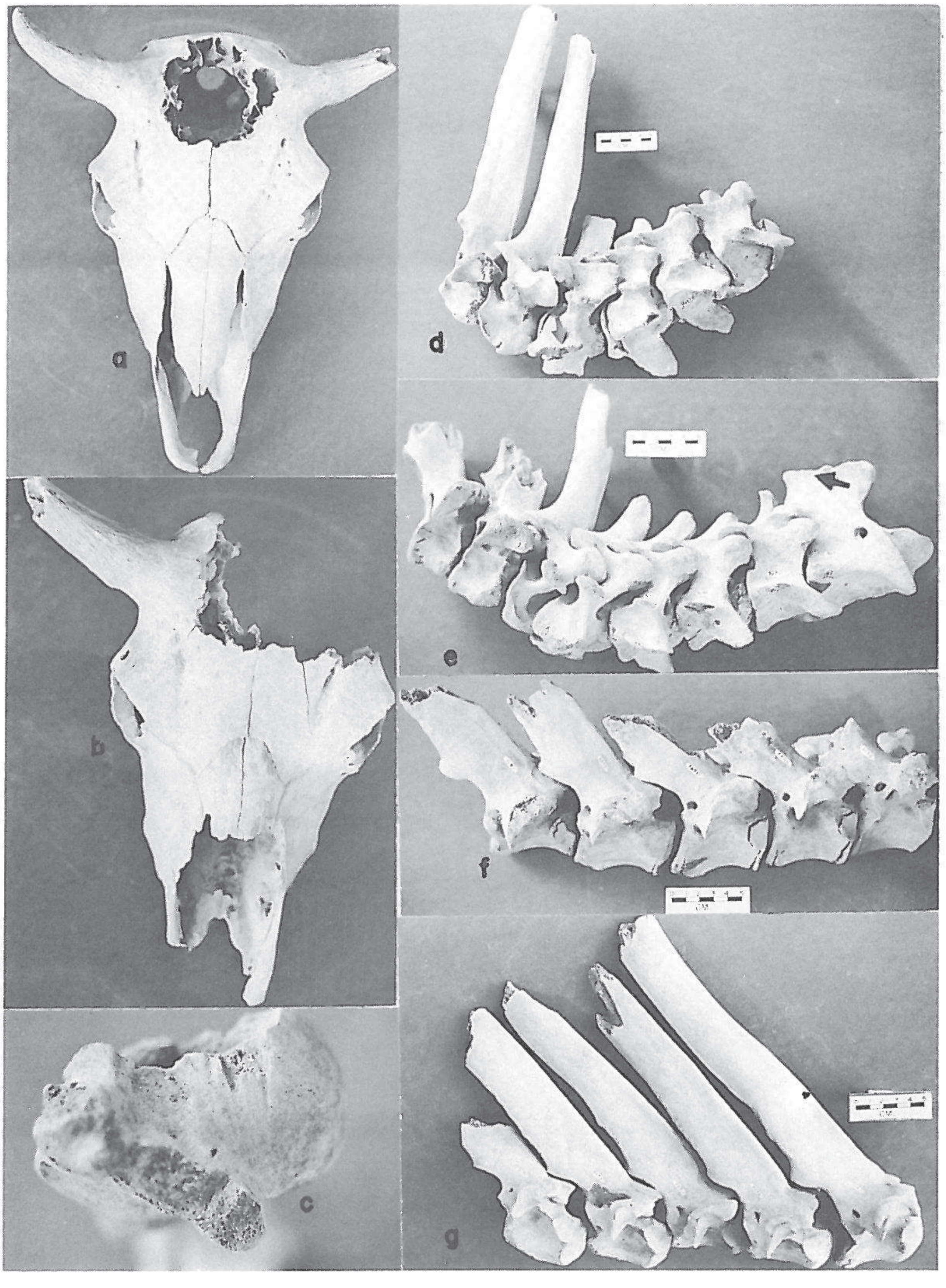

Figure 15 - Butchered skulls (a-b), humerus bearing tool marks (c), and articulated vertebral units with butchering marks (d-g).

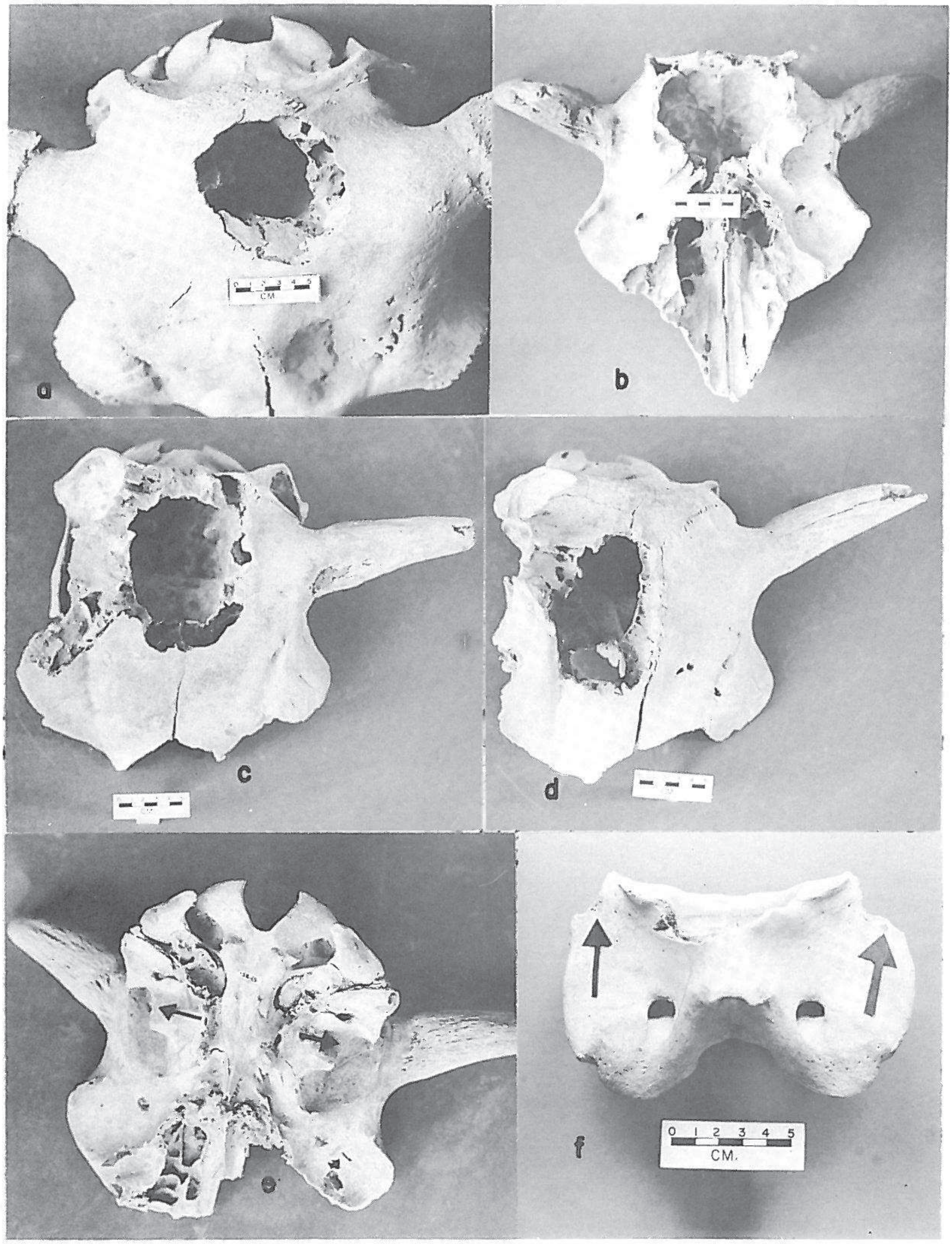

Figure 16 - Butchered skulls (a-e), and atlas vertebra with tool marks (f).

mandibles may have been to loosen the mylo-hyoideus muscle. Most hyoid bones are broken, usually across the anterior part of the great cornu.

Another method of removing the mandibles was to break them anteriorly at the diastema or close to the first premolar. In this case, they could have been removed with little or no damage to the zygomatic arch. Often the blows were hard enough to break off the anterior part of the premaxillary and cause considerable damage to the first one or two upper premolars.

In no case were the mandibles left articulated to the skull. Both mandibles of a pair were often recovered close together but never joined at the symphysis. Broken distal ends of mandibles were commonly recovered still fused (Fig. 9c-d).

It was common, also, to split the maxillary by means of downward blows delivered to the palatine process of the maxilla and the horizontal part of the palatine bone. Wide scattering of maxillary units indicate this was deliberate and not accidental, but the delicate nature of these bones resulted in deterioration that obscured clear evidence of chopping or pounding marks. From the repeated occurrence of this process, there was probably some part or contents of the anterior part of the skull that was desirable and was being collected, such as the soft gristle of the nose. This is mentioned by Ewers (1955:149) for the Blackfeet and Mandelbaum (1940:193) for the Plains Cree. Nasal bones were usually separated from the frontal bones and were badly scattered, although this may have been largely accidental and not deliberate. Many mandibles bear evidence of direct blows delivered to the angle of the mandible and subsequent breakage at various points. This may have been another variation in removing them from the skull.

It was common practice to chop or pound loose the ventral border of the mandibles, presumably to obtain the contents of the cavity at the base of the lower teeth row (Fig. 9a-b). Another possibility is that this was to loosen the insertion of the masseter muscles. The latter seems plausible considering that the ventral borders seldom were found in the site deposits and may have been taken elsewhere.

There were variations in the process of brain removal. A large percentage of skulls were too badly decomposed to retain this evidence. Of the remaining, however, the most common method was to chop a central or slightly skewed hole in the frontal bones between the horns (Fig. 15a, 16a, d). Occasionally a horn was broken loose, which could have happened from the jumping, and this hole was enlarged into the brain cavity (Fig. 15b 16c). In one instance, the frontal eminence and the external occipital protuberance were crushed and entrance gained from this angle. Another common method was to break the atlas and separate it from the skull and enlarge the foramen magnum (Fig. 16b). At least four skulls were still attached to some of the cervical vertebrae, and these had holes in the frontal bones for brain removal. Other skulls bear no evidence of brain removal or other breakage but mandibles had been removed.

Fetal material was lacking almost completely indicating this was removed. The few specimens suggest a 3-4 month old fetus on the basis of comparison with Bos indicus, which may or may not be too reliable.

Pathological Bone

Several bones, including both No. 1 ribs, a No. 2 and No. 3 rib, Tibial tarsal, fibular tarsal, metatarsal, and a first phalanx, bear pathological bone formation built up to as much as twice the size of the original bones. The ribs and tarsals bear the same butchering marks as the other specimens and all are probably from a single mature buffalo. Four solidly fused thoracic vertebrae were recovered as a unit, and the four vertebrae were attached to only three dorsal spines.

Faunal Remains Other Than Bison

Bison bison comprised nearly all of the total bone. Three specimens of large Canid were recovered. At least one is believed to be dog and another is most certainly dog. This is based on the extreme wear on Lower P3, P4, and M1, which were the only lower teeth recovered and were in a fragment of mandible. A nearly complete skull was recovered with most of the teeth missing. However, right upper M1 and M2 are present and demonstrate wear to a point that it is difficult to consider them as other than domesticated dog. They have been identified as such by Paul McGrew, paleontologist at the University of Wyoming. They are large and within the lower range of Canis lupus. One front foot of a Canis sp. was apparently cut off deliberately since cutting marks appear on both the ulnar and radial carpals. Skinning is suggested, also, by cutting marks on two of the No. 1 phalanges. This suggests that the leg was first skinned out and the foot then cut off analogous to the method used to cut off a buffalo foot. There is a strong suggestion that at lease one of these was, in addition, deliberately butchered. An ulna, two humerii, a femur, and a pelvis bear marks of chopping and cutting tools. One Canid humerus was used as a tool by utilizing a sharp point formed fortuitously when it was broken. The occurrence of dog remains in Late Prehistoric buffalo kill sites is common and identification, as indisputably dog, is usually from unnatural tooth wear or deliberate breaking of the canine teeth. At the Piney Creek site (Frison 1967), there were dogs of a size comparable to wolf and, in addition, a much smaller type. Here, also, the evidence suggested the animals were deliberately butchered.

Other specimens include two metatarsals and a phalange of Antilocapra americana. One metatarsal was made into a tool possibly used to remove marrow from bones (Fig. 20w). There were two specimens of jackrabbit (lepus sp.) and one of cottontail (Sylvilagus sp.). Mustelids included one badger (Taxidea taxis) and one weasel (Mustela sp.), both represented by mandibles. Bird bones include those of a single Anseriformes or probably a mallard duck. All of these were recovered from the bottom level. Several specimens of gopher (Geomys sp.) were of recent origin and appear unrelated to the site deposits.