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Butchering activities at the early mesolithic site Bedburg-Königshoven, Rhineland, F.R.G.

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SUMMARY

The site of Bedburg-Königshoven, Rhineland, is at the lignite mine of Garzweiler. Its large mammal assemblage is of Preboreal age. Butchering marks and chewing marks on the fossils are described and discussed.

SAMENVATTING

In dit artikel wordt de opgraving in de bruinkoolgroeve in Bedburg-Königshoven beschreven. De auteur beschrijft de fauna assemblage, die een Preboriale ouderdom heeft. De op de boten voorkomende slacht- en vraatsporen worden beschreven en afgebeeld.

Introduction

The site of Bedburg-Königshoven lay at the centre of the large opencast lignite mine of Garzweiler, in the valley of the River Erft, some twenty kilometres to the southeast of Münchengladbach (fig.1).

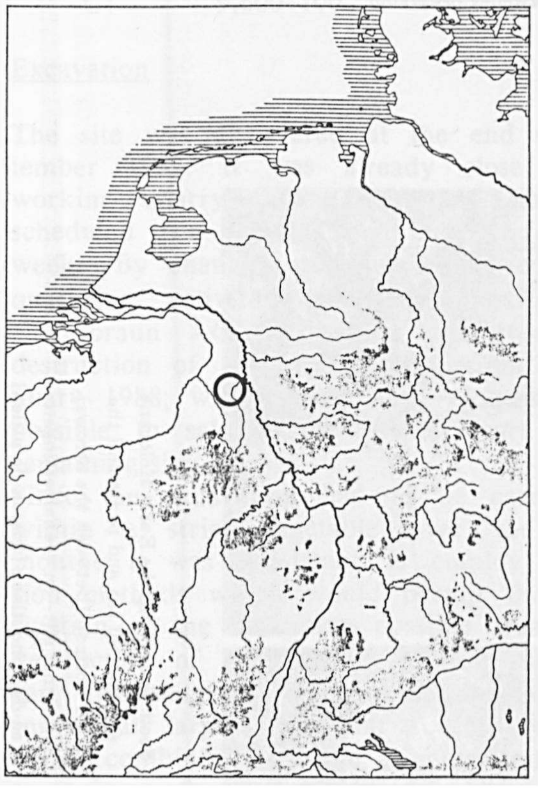


fig. 1 Site location in the valley of the Erft
fig. 1 De vindplaats in de vallei van de rivier Erft

Despite the advanced state of mining some 500 square metres of early Holocene sediments had survived within a silted-up channel of the Erft river.
Mining has been greatly changing the landscape here since the beginning of this century. The site itself is cut through on two sides by quarry faces which converge to the south, and also truncated vertically in it's northern part (fig.2). Nevertheless, the study of older maps, and investigation of the surviving stratigraphy, allow the accurate reconstruction of the original situation. The site was situated within a former meander of the River Erft. Preserved at this point were only limnic sediments representing silting-up of this body of water and the subsequent development of peat. Terrestrial sediments adjacent to the site, which would have contained the main settlement area, had already been destroyed. That the area has been dominated by wetland conditions since the late glacial is apparent from the stratigraphy of the site (fig.3).

The base of the recorded fluviatile series is formed by Upper Pleistocene sands and gravels, which at this point cut into the underlying Tertiary lignite deposits. The gravels are covered by waterlaid silts. At the top of the sequence of silts is an organic sediment (gyttja) containing the archaeological horizon (between the arrows). The upper part of the gyttja deposit contains by far the greatest

fig. 2 Surviving block of Pleistocene and Early Holocene sediments in the Garzweiler lignite mine.

fig. 2 Resterend blok van Pleistocene en vroeg Holocene sedimenten in de Garzweiler bruinkool mijn.

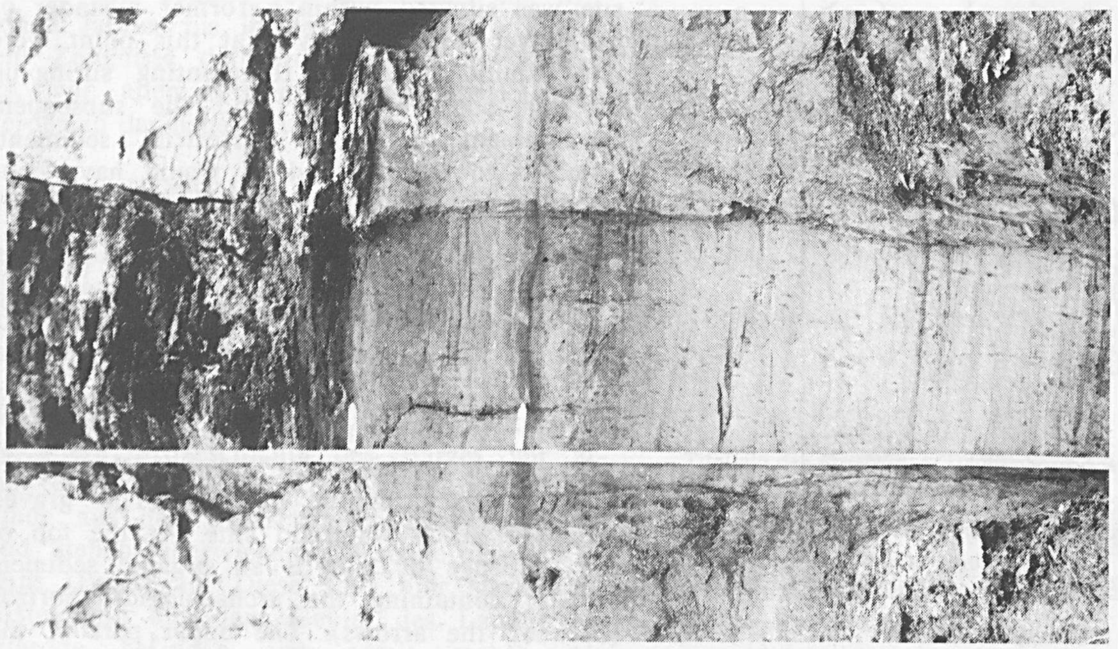


fig. 3 Section showing the Early Holocene sequence of silt and peats and the find horizon (between the arrows).

fig. 3 Sectie met silt- en veenafzettingen en de vondstlaag (tussen de pijlen) part of the archaeological material. Overlying the gyttja is a series of peat deposits. At the base is a reed peat, followed by a well decomposed wood peat of terrestrial origin (carr). Within the carr-peat deposit occur carbonate bands of probably sub-aquatic origin (tufa), which point to renewed flooding of the area.

A pollen analysis of the excavation was carried out at the University of Göttingen (H.BEHLING, 1988), providing information for both the chronological position and ecological setting of the occupation of the site. It was established that the site was occupied during the Preboreal period, which is the name of the earliest part of the Postglacial.
A series of twelve samples of wood and peat was submitted for converntional radiocarbon dating to the Radiocarbon Laboratory of The University of Cologne. The data obtained from two samples of wood from the same context as the archaeological assemblage fall towards the middle of the Preboreal.

KN3999	Sample 5,100/107	
Cl	9,780+100	Wood
KN3998	Sample 4 101/103	
Cl	9,600+100	Wood

Excavation

The site was discovered at the end of September 1987. It was already close to the working quarry face (fig.2) and had been scheduled for removal within the following weeks. By changing schedules and redirecting quarrying activities wherever possible, the Rheinbraun AG was able to postpone the destruction of the site until the end of January 1988; within these four months it was possible to salvage the greater part of the remaining site.
Since the excavation had to be carried out within a strict timetable over the winter months it was important to employ excavation methods which would permit the investigation of the maximum possible area before destruction of the site. A solution was chosen, involving the three-dimensional recording of all larger finds and a rapid tempo of work, combined with the bagging and wet screening of the excavated sediment over large areas of the site. The latter operation proved to take much more time than the excavation itself, lasting into the autumn of 1989.
The bagged material was wet screened through sieves of 5 mm and 3 mm mesh. A section through the site along the axis west=100 m was screened to 1 mm.The screening operation demonstrated that the material recovered on the excavation is typical of the assemblage as a whole. Using these methods a total of 370 m2 from something over 500 m2 of the surviving sediment was excavated. 190 m2 were investigated in detail and bagged for wet screening. The concentration of archaeological material decreased with distance from the shore; it was possible to excavate 180 m2 of the area poor in material. This was not bagged due to poor prospects of find recovery. 150 m2 of mainly sterile sediments were not investigated.

Excavation of a large area of the site yielded information about spatial distribution of material. The recovered material is spread relatively diffusely over the site, but is more concentrated closer to the ancient shoreline. Larger finds, such as the skulls of aurochs or the antler frontlets, were all found at about the same distance from the bank.
The most common category of material comprises the bones of several species of large mammal, which were definitely hunted by man. Together with them were found almost 200 mainly flint artefacts, grinding-and hammer stones and bone tools. It is possible to refit a certain proportion of the excavated material. Some of the conjoined bone fragments lay more than 10 metres apart.

The lack of surface damage to the bones, and the intact state of the more fragile elements -e.g. the aurochs skulls - are not suggestive of important erosional processes. It is possible that at least some of the material remains *in situ* from activities within the shallow water zone or during the drier parts of the year. In some cases it can be demonstrated that the distribution patterns mirror human activities on the site rather than post settlement erosion. The distribution of material can convincingly be shown to be a result of deliberate disposal of waste into deeper water.

The Preboreal large mammal assemblage

The following species of large mammal were assigned to the Preboreal assemblage:

Rodentia	Beaver	*Castor fiber* L.
Carnivora	Badger	*Meles meles* (L.)
		Canis familiaris L.
Perissodactyla	Horse	*Equus* sp.
Artiodactyla	Red deer	*Cervus elaphus*
	Roe deer	*Capreolus capreolus* (L.)
	Aurochs	*Bos primigenius Bojanus*
	Wild pig	*Sus scrofa* L.

The large mammal list is clearly comparable to others of Preboreal date from northern Europe (e.g. Thatcham, Star Carr). It is however noticeable that the elk is not represented at Bedburg, although this species is normally present on early Holocene sites. In view of the small size of the Bedburg faunal complex in terms of demonstrated numbers of individuals this absence should not be overemphasized.

	n	(%)
Bos primigenius	354	(73.00)
Cervus elaphus	34	(7.00)
Capreolus capreolus	28	(5.80)
Sus scrofa	6	(1.20)
Equus sp.	12	(2.50)
Canis familiaris	7	(1.50)
Meles meles	7	(1.50)
Castor fiber	2	(0.40)
Indeterminate	35	(7.10)
Total	485	(100.00)

Frequency of bones assigned to the Preboreal assemblage
(n) = number of bone fragments.

The relatively high number of bone fragments for the categories *Capreolus* and "indeterminate", and to a lesser extent for *Canis, Meles* and *Sus* drop predictably to a totally insignificant level if calculated by weight of bone. This is of particular importance for the "indeterminate" category: less than 1% of the assemblage calculated by weight was indeterminable to species level. This is a reflection of the high proportion of larger and easily identifiable fragments present in the assemblage.
Much of the recovered material provides information on butchering practises and, through refitting of bones fragmented by man, about the site dynamics. In other less common cases there are indications of the season of occupation of the site and of the minimum number of individuals represented.
The species most commonly represented at the site is the aurochs. Almost all elements of the skeleton of this species could be identified evidencing intensive butchering of the aurochs at this site (fig.4). Only elements of the axial skeleton and the proximal ends of ribs are under-represented or absent. At least 11 aurochs were butchered at the site (fig.5).

Taphonomy of the faunal assemblage

The excellent state of preservation of the faunal material, which was deposited under anaerobic conditions, has optimally conserved original bone surfaces, patterns of cut marks and fractures, and evidence of later surface alterations such as gnawing marks of scavengers and weathering.
Despite the very fragmentary state of the material - typically the bones have almost all been smashed to extract the marrow - it is possible to gain much information regarding the modification of the assemblage both by human agency and by further taphonomic processes.

Weathering and differential preservation

The presence of bones in anatomical connection demonstrates that in some cases incorporation into the sediment was very rapid. Heavily weathered bones are by contrast rare and were probably eroded into the limnic sediments after a lapse of time.
The state of preservation of all bone fragments was recorded, in order to control this against the presence of cutmarks and the overall representation of the less robust bones of the skeleton. A system was used whereby three categories of surface alteration - exfoliation, splitting and corrosion- were registered (fig. 6). It was established that the variuos kinds of alteration were never so pronounced as to influence the proportional survival of elements of the skeleton. Within the gyttja all bone elements, even the most fragile, were just as likely to be well preserved as more robust specimens.

Body Part	Left	Right	indet.	Total
Horn core	1	2	4	7
Cranium	5	9	20	34
Max.teeth	3	7	-	10
Mandible	15	9	3	27
Mand.teeth	7	6	-	13
Cerv.vertebra	-	-	1	1
Thor.vertebra	-	-	5	5
Lumb.vertebra	-	-	5	5
Sacrum	-	-	5	5
Caud.vertebra	-	-	1	1
Vertebra indet.	-	-	2	2
Rib	21	20	4	45
Sternum	-	-	1	1
Scapula	1	4	1	6
Humerus	8	8	1	17
Radius	7	4	2	13
Ulna	4	3	-	7
Carpal	13	2	-	15
Metacarpal	-	6	-	6
Pelvis	13	8	2	23
Femur	6	13	4	23
Patella	2	3	-	5
Tibia	9	10	1	20
Malleolare	1	1	-	2
Astragalus	3	1	-	4
Calcaneum	-	1	-	1
Tarsal	-	2	-	2
Metatarsal	6	5	1	12
Metapodium	-	-	5	5
Phalanx 1	(6)	(4)	-	10
Phalanx 2	(5)	(4)	-	9
Phalanx 3	(2)	(2)	-	4
Sesamoid	-	(1)	-	1
Limb bone indet.	-	-	11	11
Indeterminate	-	-	2	2
Total				354

fig. 4 Representation of body parts of *Bos primigenius* by number of identified fragments.

fig. 4 Aantallen identificeerbare skeletonderdelen van *Bos primigenius*.

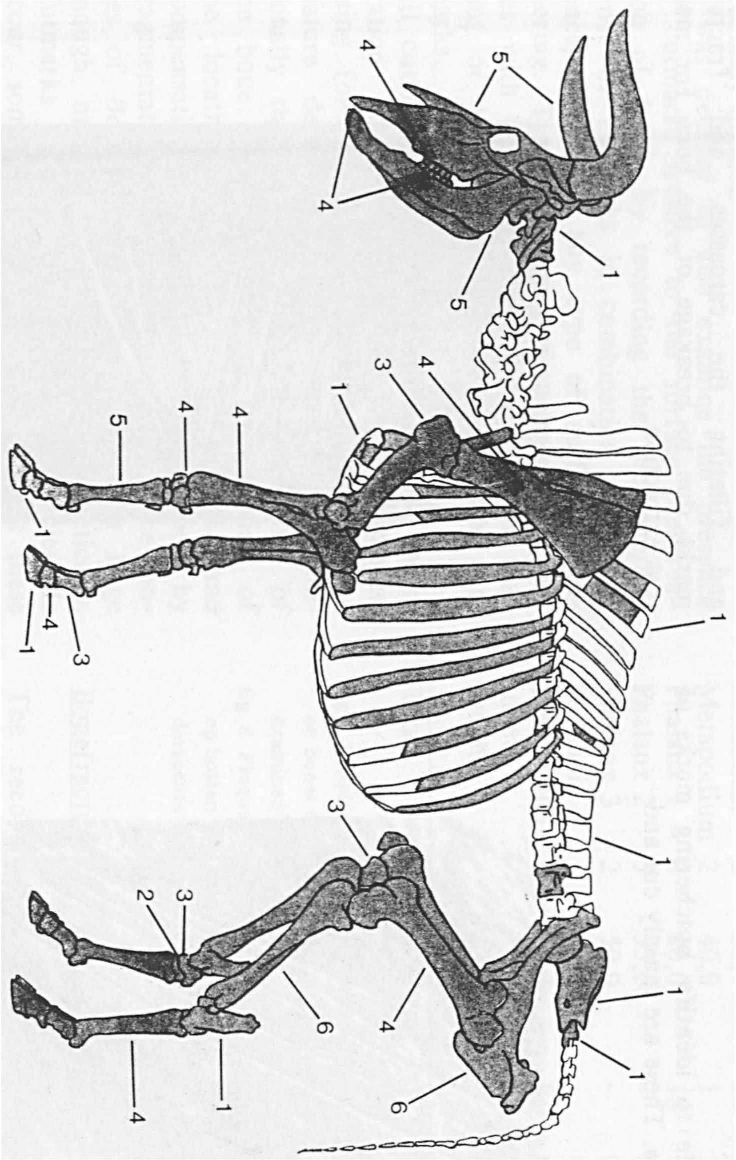


fig. 5 Minimum number of individuals for *Bos primigenius* based on the duplication of each skeletal element.

fig. 5 Minimum aantal individuen van *Bos primigenius* op basis van de duplicatie van skeletelementen.

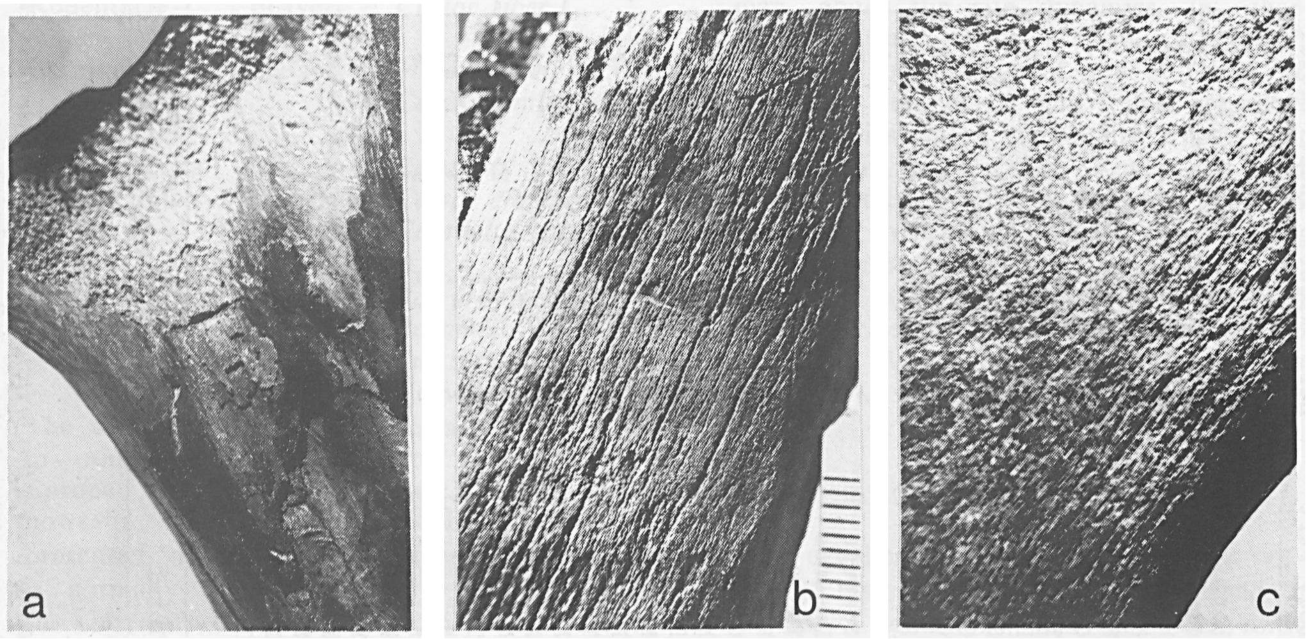


fig. 6 a: Exfoliation of a bone surface; b: Splitting of a bone surface; c: Corrosion of a bone surface (scale 2:1).

fig. 6 a: Afschilfering van een beenoppervlak; b: Kloven op een beenoppervlak; c: Verwering van een beenoppervlak (schaal 2:1).

Butchering marks

It is possible to identify butchering marks of various types. These are mainly cut and scrape marks (fig.7) resulting from jointing and filleting the carcasses, and fracture marks due to breakage of the bone for marrow extraction.

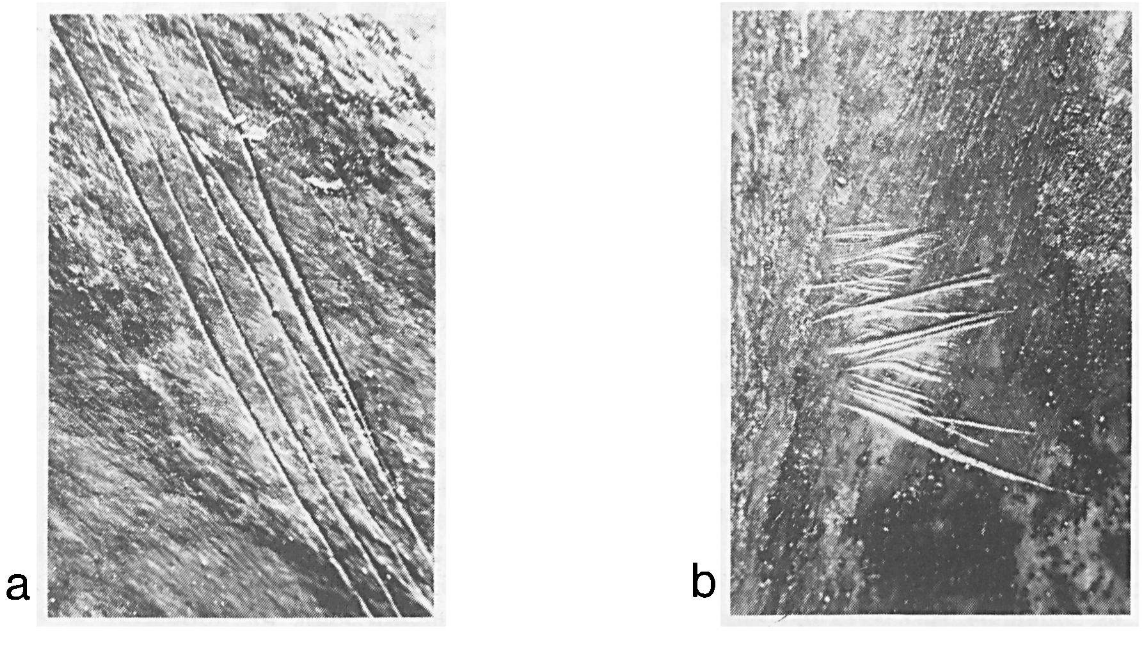


fig. 7 Cutmarks on bones of *Bos primigenius*: a. Scapula; b. Pelvis (Scale 1:4)

fig. 7 Snijsporen op botten van *Bos primigenius*: a. Scapula; b. Pelvis (Schaal 1:4)

Cutmarks

Cut marks on and around the joints are normally due to dismembering the carcass. In the case of the larger animals such as aurochs this would at least in part have taken place at the kill site in order to enable transport to the site. Also present are cut marks on the shafts of bones and on the scapulae, vertebrae and ribs which were caused by filleting meat from these parts. A small number of bones have cutmarks which can probably be attributed to skinning the carcass; in the case of some of the metapodials cutmarks on the shaft may be due to cleaning the bone of tissue and periosteum prior to marrow fracturing, or to the removal of sinew and tendons. In all these cases the placement of the cut marks demonstrates very systematic butchering practises.

All fragments of bone were examined for cutmarks; the number and the proportion of all pieces identified as *Bos primigenius* with cutmarks are shown in fig.8. Cutmarks are present on 50,6% of all fragments.

The overall total of 354 examined pieces includes teeth and very small corroded fragments, which suggests that the true proportion of pieces with cutmarks is actually appreciably higher.

It was decided to also examine the presence of cutmarks relative to the surface preservation of bone, by recording the presence/absence of cutmarks in combination with presence/absence of any type of surficial weathering. The proportion of unweathered bones with cutmarks is predictably higher than that of the weathered specimens with cutmarks.

All cutmarks were recorded during the registration of the individual bone fragments, using for convenience the system of nomenclature described by BINFORD (1981). Additionally they were drawn onto an outline of the bone element, providing an overview of the location of cutmarks in general, and compensating for the loss of information by fragmentation and weathering. Only the bones of *Bos primigenius* are present in large enough numbers to be treated synthetically. Cutmarks on the bones of other species do occur, sometimes in large numbers, but these can only be described individually. Unless otherwise stated all descriptions refer to bones of Bos primigenius.

	Cutmarks	%	Fracture	%
Horncore	-	0,0	-	0,0
Cranium	12	35,3	-	0,0
Max.teeth	-	0,0	6	60,0
Mandible	13	48,1	22	81,5
Mand.teeth	-	0,0	-	0,0
Cerv.vert.	1	100,0	-	0,0
Thor.vert.	4	80,0	2	40,0
Lumb.vert.	2	40,0	2	40,0
Sacrum	3	60,0	3	60,0
Caud.vert.	-	0,0	-	0,0
Vert.indet.	1	50,0	-	0,0
Rib	17	38,0	14	31,1
Sternum	-	0,0	-	0,0
Scapula	5	83,3	1	16,7
Humerus	6	35,5	15	88,2
Radius	8	61,5	9	69,2
Ulna	5	71,4	7	100,0
Carpal	5	33,3	-	0,0
Metacarpal	3	50,0	4	66,7
Pelvis	20	87,0	22	95,6
Femur	12	52,2	19	82,6
Patella	2	40,0	-	0,0
Tibia	12	60,0	20	100,0
Malleolare	-	0,0	-	0,0
Astragalus	2	50,0	-	0,0
Calcaneum	1	100,0	-	0,0
Tarsal	1	50,0	-	0,0
Metatarsal	8	66,7	10	83,3
Metapodium	2	40,0	1	20,0
Phalanx 1	8	80,0	10	100,0
Phalanx 2	5	55,6	-	0,0
Phalanx 3	2	50,0	-	0,0
Sesamoid	1	100,0	-	0,0
Limb bone indet.	5	45,4	6	54,5
Indeter.	-	0,0	-	0,0
Total	179	50,6	173	48,9

fig.8 Frequency of cutmarks and fracture on bones of *Bos primigenius* (number of examined fragments).

fig. 8 Frequentie van snijsporen en breuk op botten van *Bos primigenius* (aantal onderzochte fragmenten).

Bonefracture

The recoverd bones are highly fragmented for the extraction of marrow. Almost all limb bones, and all mandibles, are cracked open.

Skull

The anterior section of all skulls of *Bos primigenius* is always fractured off. The *maxillae* and *premaxillae* were always found seperately from the brain case. The thin bone walls and the nature of the preservation of the skulls do not permit recognition of impact fractures, but there can be no doubt that the fronts of the skulls were removed deliberately.

The fractured buccal roots of second and third maxillary molars, which were found seperately from the bones of the skull, show where one of the impact points on the skull was situated (fig. 9 i, ii).

Mandibule

In the case of the mandibules breakage is carried out very systematically (fig. 15). The front of the mandibule and the articular hinge are first removed by fracture (fig. 9 iii, iv), after which the lower border of the mandibule is removed by a series of blows to give acces to the narrow cavity (fig. 9 v). The first operation is probably intended to convert the disarticulated, but still complete mandibule, into two conveniently sized pieces for the second operation.

This treatment of the mandibule is common on butchring and processing sites. An illustration of the systematic exploitation of the mandibule is given by U. MOHL (1978) in reference to a series of Preboreal butchered elk from Skottemarke and Favrbo in Denmark.

Opinions differ as to whether the exploitation of this very small quantity of fat and marrow can be interpreted as an indication of conditions of resource depletion. It occurs for example in the Central Rhineland on many sites of widely differing character and age, and on mandibles of different species. At the Magdalenian sites of Andernach and Gönnersdorf, mandibles of horse and reindeer were fractured in this way. During the Alleröd, elk and red deer mandibles were similarly treated at the sites of Niederbieber and Urbar. Possibly the physical condition of the prey animal was often a determining factor, as has been convincingly shown for the Garnsey Palaeoindian bison kill site (J.D.SPETH 1983). Here male and female animals were treated in different ways, according to their nutritional value. It is however debatable whether such a selection would be the rule on sites at which the animals were not procured in mass-kills. The evidence of the Bedburg bones is rather that all parts of the body, regardless of sex, were exploited for marrow extraction to the maximum, the only exception being provided by the forelimbs of two calves which probably contained no marrow and were found as "bone cylinders" (L.R.BINFORD, 1981) which had been gnawed by carnivores.

Vertebrae

The majority of the fragments of vertebrae recovered were dorsal and lateral spines of the thoracic and lumbar vertebrae. In many cases they were not gnawed by carnivores but clearly broken from the body of the vertebra. At the same time cutmarks on the spines show that filleting had taken place. The reason for the fragmentation of the vertebrae may have been to facilitate extraction of the spinal marrow (N.NOE-NYGAARD, 1987). With the dorsal and transverse processes removed, it would have also been easier to boil the vertebrae for the extraction of bone grease. This process may have been the motive behind the intense fragmentation of the sacrum.

Ribs

The fracture patterns on the proximal articulations of ribs show that they were in many cases, but not invariably, seperated from the vertebrae by breaking across the joint (fig. 10 i).

There is no evidence that the ribs were subsequently fractured for the extraction of bone grease. All breaks can be explained by dismembering or breakage in the sediment, and the majority of recovered ribs are intact.

Pelvis

The two halves of the pelvis were clearly brought to the site intact, but probably already seperated from one another by breakage. It cannot be established whether they were at this stage still articulated to the femur or already a seperate unit.

The acetabulum is always seperated from the ilium and ischium by fracture (fig. 10 ii). The former element often shows impact scars on the denser bone surface, the latter two bones are commonly smashed into smaller

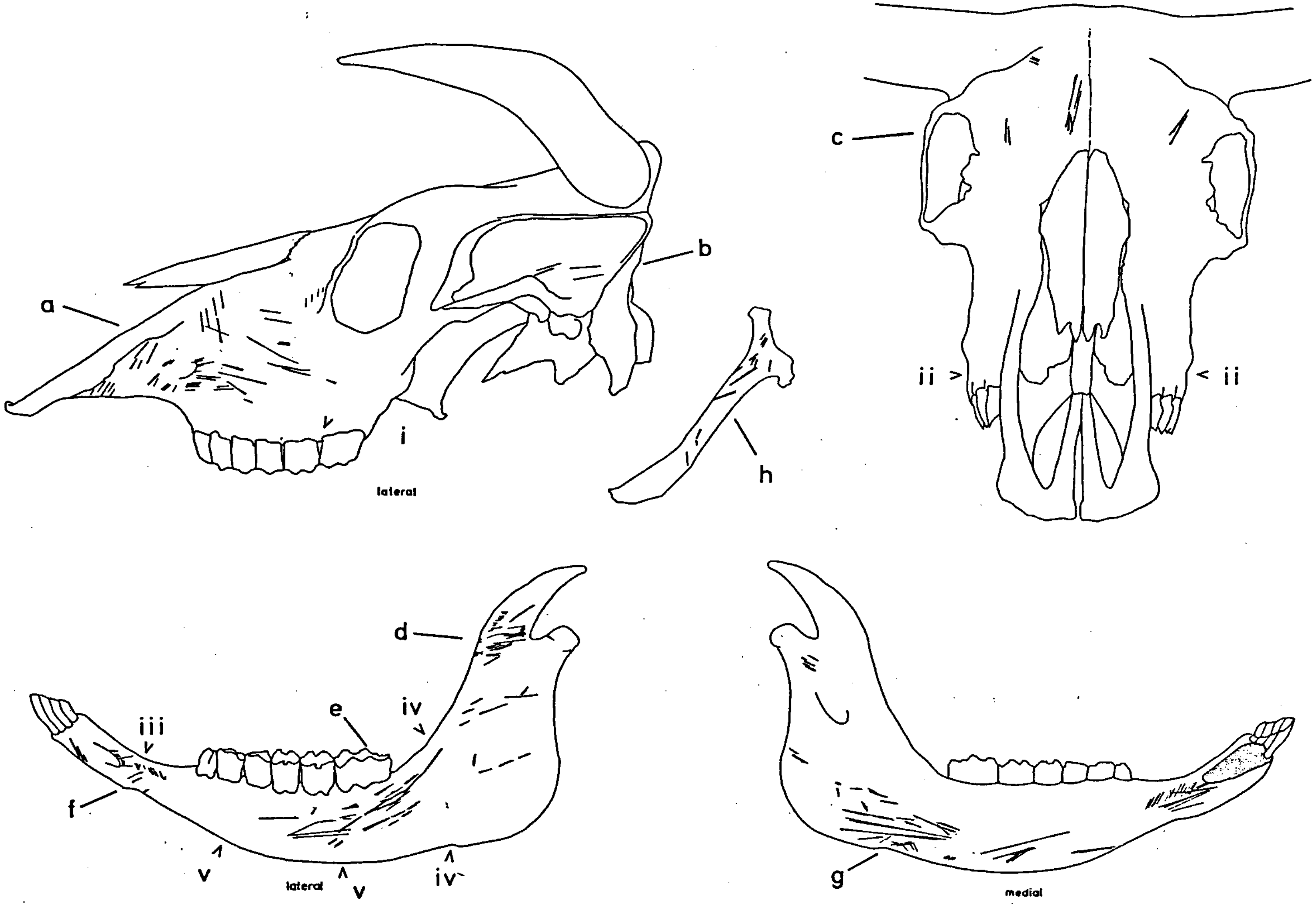


fig. 9 Placement of cutmarks on bones of *Bos primigenius* by element of the skeleton: Skull: a, b, c; mandible: d, e, f, g; hyoid bone: h. Location of impact fractures on bones of *Bos primigenius* by element of the skeleton: Skull: i, ii; mandible: iii, iv, v.

fig. 9 Plaats van de snijsporen op botten van *Bos primigenius*: schedel: a, b, c; mandibula: d, e, f, g; tongbeen: h. Plaats van afslagen op botten van *Bos primigenius:* schedel: i, ii; mandibula: iii, iv, v.

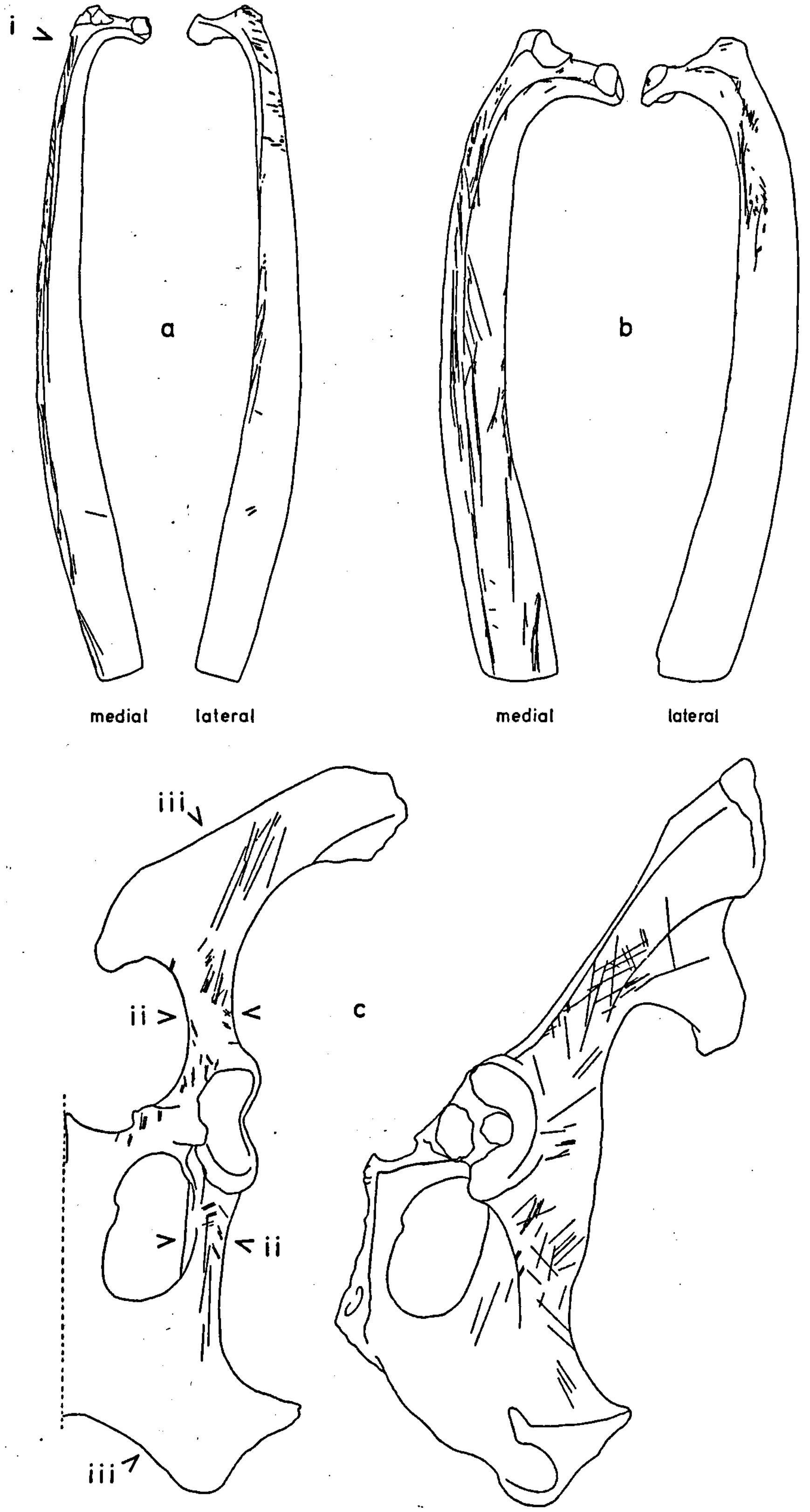


fig.10 Placement of cutmarks on bones of *Bos primigenius* by element of the skeleton: ribs: a, b; pelvis: c.
Location of impact fractures on bones of *Bos primigenius* by element of the skeleton: ribs: i; pelvis: ii, iii.

fig. 10 Plaats van de snijsporen op botten van *Bos primigenius*: ribben: a, b; bekken: c.
Plaats van de breukvlakken op botten van *Bos primigenius*: ribben: i; bekken: ii, iii.

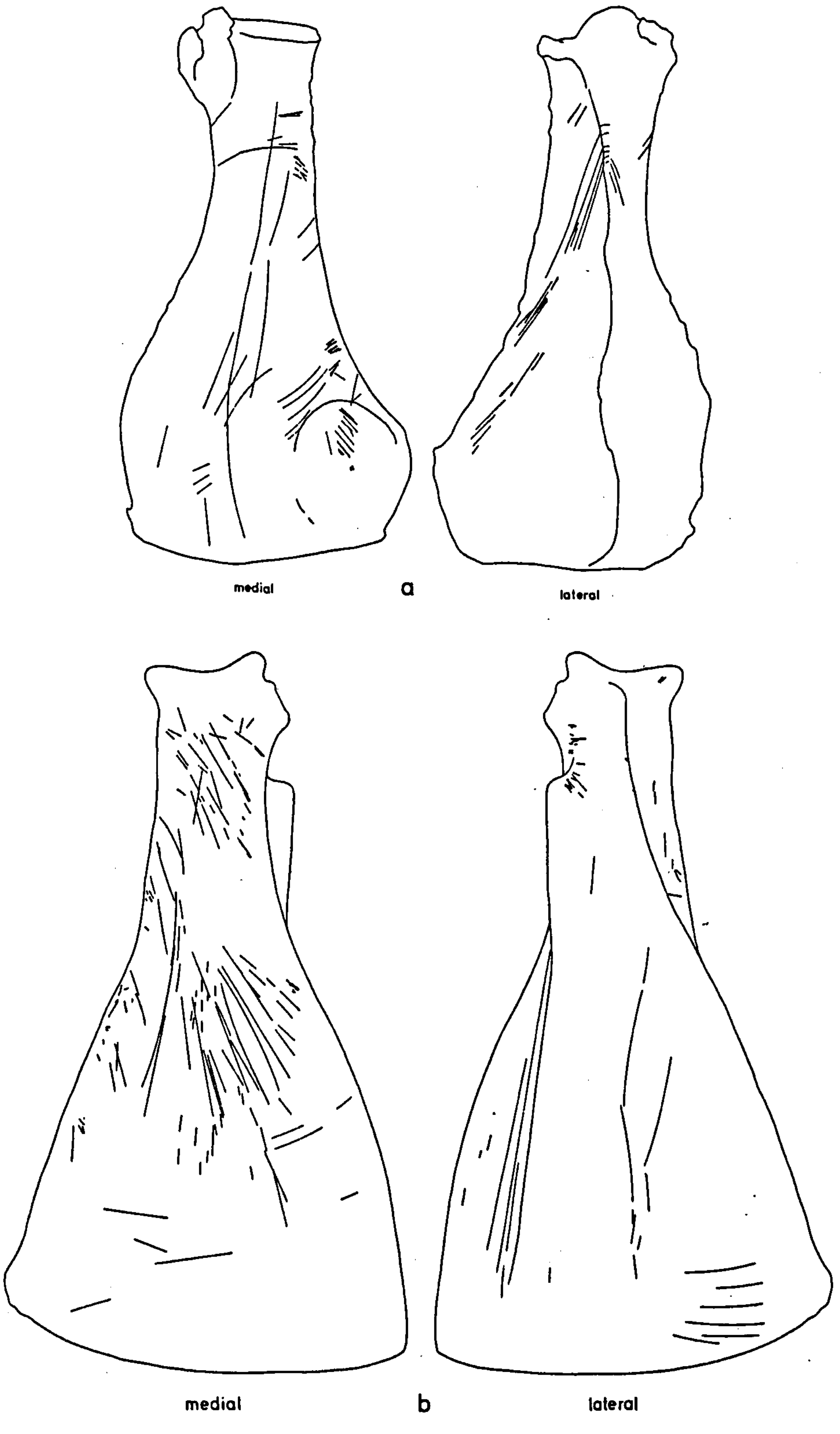


fig.11 Placement of cutmarks on bones of *Equus* sp. by element of the skeleton: scapula: a
Placement of cutmarks on bones of *Bos primigenius* by element of the skeleton: scapula: b.

fig. 11 Plaats van snijsporen op botten van *Equus* sp.: scapula: a.
Plaats van snijsporen op botten van *Bos primigenius*: scapula: b.

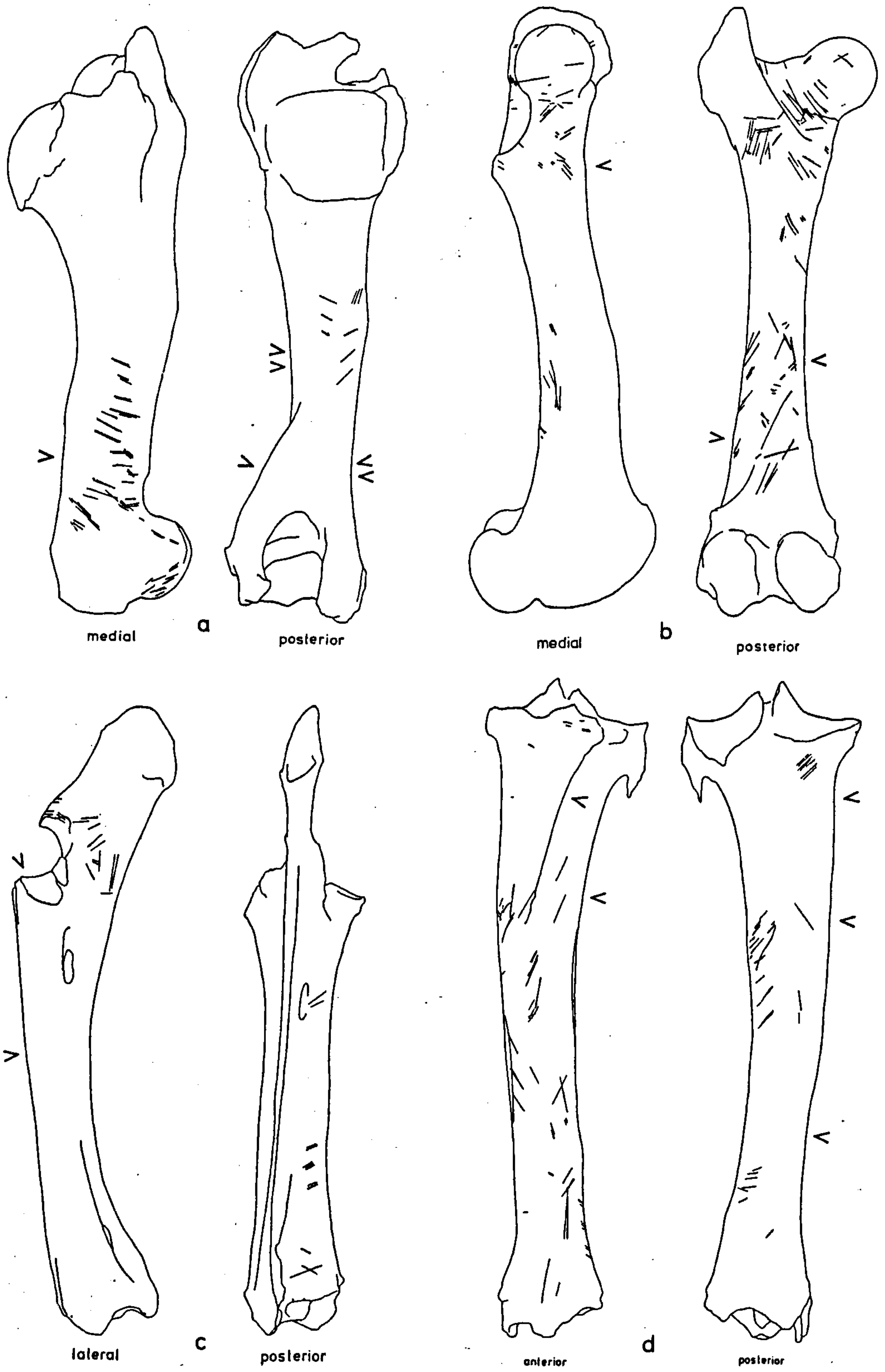


fig.12 Placement of cutmarks on bones of *Bos primigenius* by element of the skeleton:
humerus: a; femur: b; radiocubitus: c; tibia :d.
Location of impact fractures on bones of *Bos primigenius* by element of the skeleton:
humerus: a; femur: b; radiocubitus: c; tibia: d.

fig. 12 Plaats van snijsporen op botten van *Bos primigenius*: humerus: a; femur: b;
ulna/radius
tibia: d.
Plaats van breukvlakken op botten van *Bos primigenius*: humerus: a; femur: b;
ulna/radius: c; tibia: d.

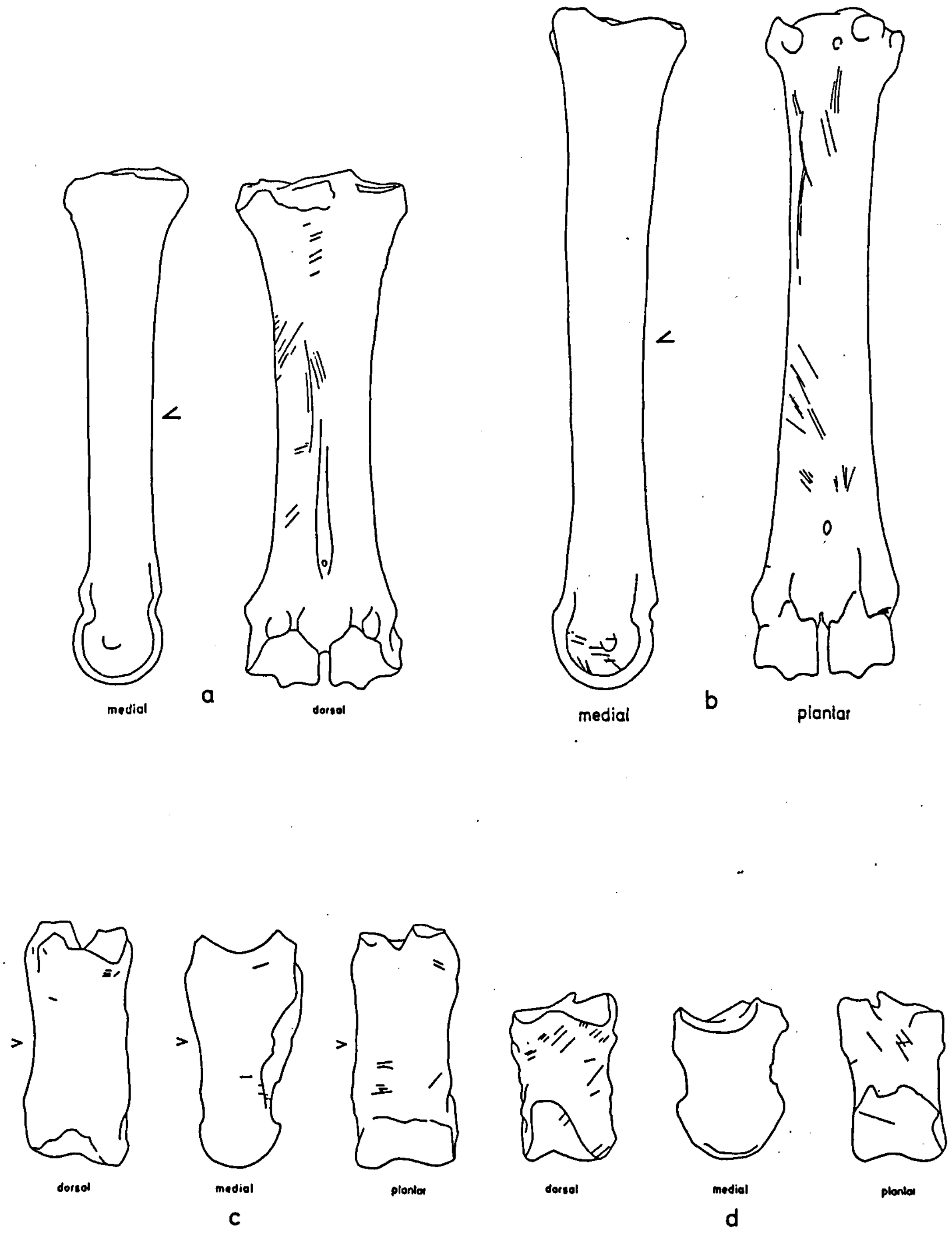
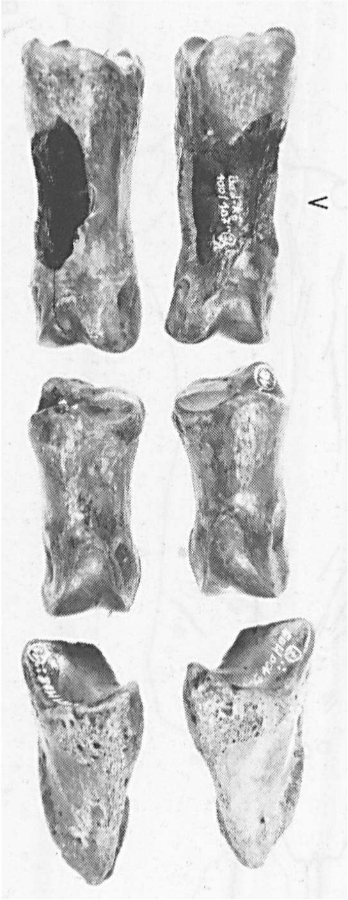


fig.13 Placement of cutmarks on bones of *Bos primigenius* by element of the skeleton: metacarpus: a; metatarsus: b; phalanx 1: c; phalanx 2: d.

Location of impact fractures on bones of *Bos primigenius* by element of the skeleton: metacarpus: a; metatarsus: b; phalanx 1: c.

fig. 13 Plaats van snijsporen op botten van *Bos primigenius*: metacarpus : a; metatarsus: b; phalange 1: c; phalange 2: d.

Plaats van de breukvlakken op botten van *Bos primigenius*: metacarpus: a; metatarsus: b; phalange 1: c.



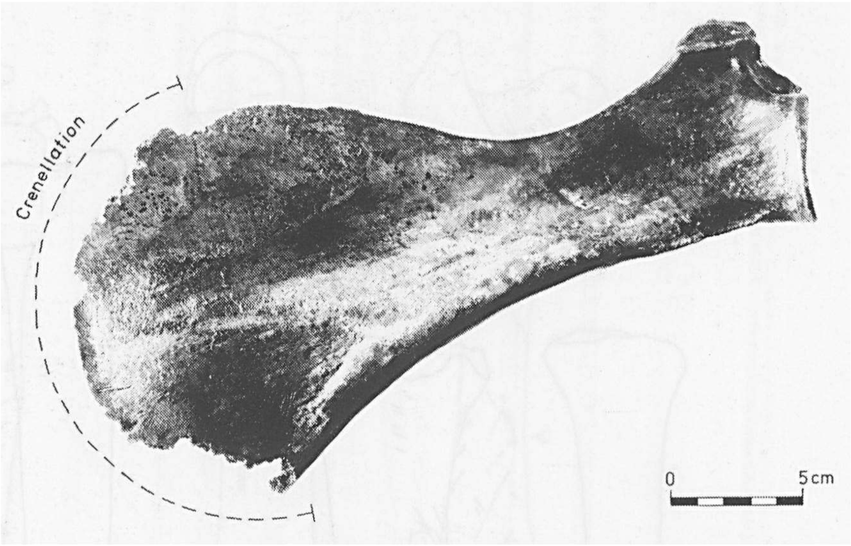


fig. 16 Carnivore gnawing of bone: crenellation of a horse scapula.
fig. 16 Een door roofdieren aangekauwd bot: scapula van een paard.

fig. 14 Phalanges of *Cervus elaphus* with impact fracture.
fig. 14 Phalange van *Cervus elaphus* met breukvlak.

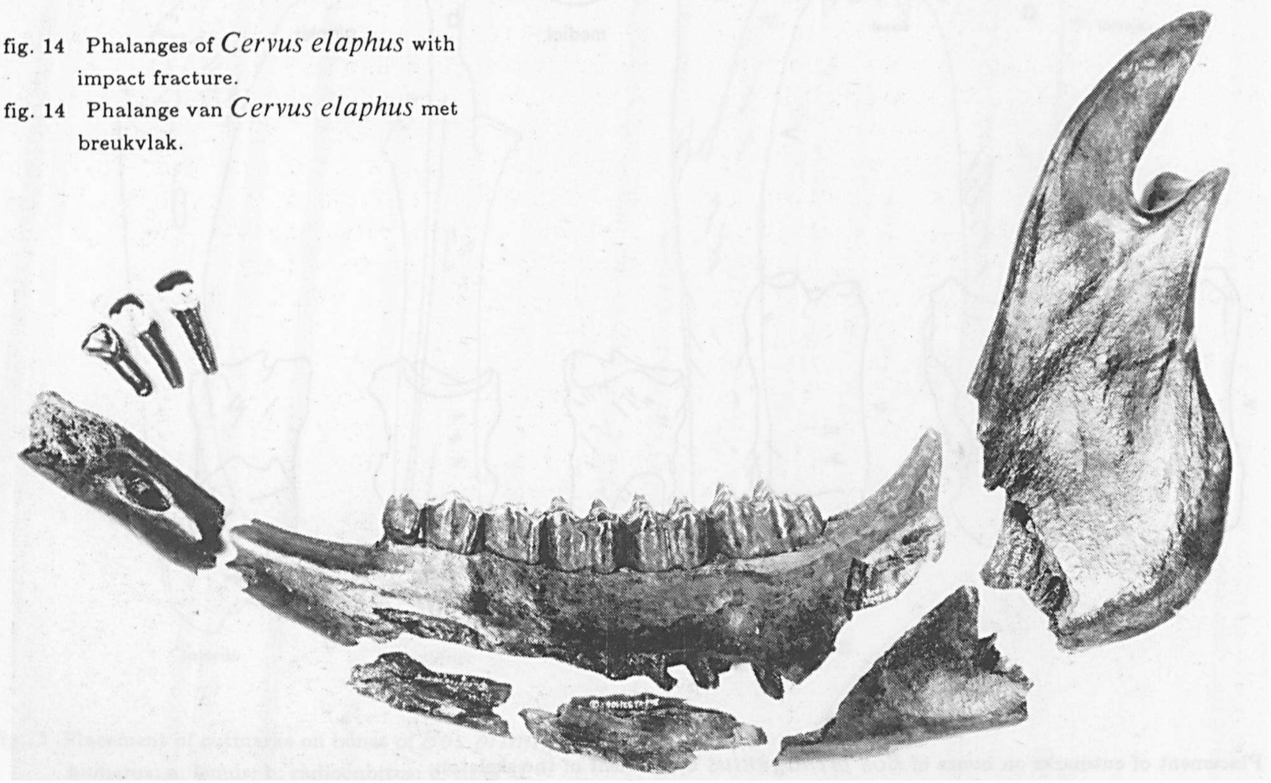


fig. 15 Refitted fragments of an intentionally fractured mandible of *Bos primigenius.*
fig. 15 Samengevoegde fragmenten van een opzettelijk gebroken mandibula van *Bos primigenius.*

fragments, and have impact areas due to blows to the cancellous bone (fig. 10 iii). It is unclear to what extent the smashing of the pelvis is caused by dismembering he carcass, and to what extent it is a result of secondary processing for bone grease.

The clear evidence provided by cutmarks on both pelvis and femur, that the hind limb was routinely disarticulated from the acetabulum would make the use of breakage for the same purpose redundant. In this case the smashing of the pelvis into smaller fragments would be due to secondary processing.

Limb bones

The highly fragmented limb bones show less standardization of breakage patterns, nevertheless certain common features occur.

Humerus

In nine cases fragments of humerus (fig.12.a) show clear impact scars revealing the position of the blow which detached the piece from the shaft. Five of these are on the lateral face, one is on the medial face and three pieces show impact scars on both faces. The last pattern is suggestive of the use of an anvil, as in a description of the fracture of caribou humeri by the Nunamiut (L.R.BINFORD 1981). The decision to deliver the blow to this part of the humerus is conditioned by the structure of the bone.

It is not possible to recognize a pattern of fracture for the proximal end of the shaft. Fragments of epiphysis are however crushed and broken, with sharp edges suggestive of intentional fracture. This is clearly not carnivore gnawing and may be due to bone grease processing.

Radius

Most of the fragments of the radius (fig.12.c) are from the mesial part of the shaft and not very informative as to the exact mechanism of fracture.

One butchering unit removed by fracture seems to be the distal radius and the carpal bones. The metacarpus could be most easily dismembered from the carpals by cutting through the tendons at this point, whereas the distal radius was fractured from the shaft above the joint, retaining the carpals in articulation.

In at least one case the radius has been split lengthways by blows to the proximal articular surface and to the anterior face of the shaft. The latter blow has detached a flake of bone from the inner wall of the marrow cavity, and broken the medial half of the radius transversely at this point.The lateral half of the bone is complete almost to the distal epiphysis and refits to a medial fragment of radius.

N.NOE-NYGAARRD (1987, p.35) suggests that the term "marrow splitting" should be restricted to the deliberate longitudinal splitting of the limb bones by "a series of blows along the bone diaphysis...". This is the case in the above example. It is interesting that this specific pattern of marrow fracturing was not observed by Noe-Nygaard at the contemporary site of Star Carr, but only in younger contexts.

Another example of "marrow splitting" of the radius may be evidenced by a second fragment, the lateral half of a proximal articulation. The piece is very robust and has been broken by a blow to the anterior surface leaving a conchoidal impact scar.

A different type of fracture can be recognized on a very massive mesial fragment of radiocubitus. The piece comprises parts of the posterior and lateral faces. The radius and ulna are fused to a solid unit.

The spine of the ulna has been smashed off by blows to the lateral face, leaving conchoidal flake scars. Prior to this the face to be struck was stripped of meat as can be seen in cutmarks extending the length of the groove between the two bones.

Femur

The shaft of the femur (fig.12.b) was smashed by blows to either the lateral or the medial face. Too few pieces show direct impact scars to be able to see a preference for one or the other procedure.

Distal fragments are also too rare to be able to speak of deliberate fragmentation of the cancellous bone; certain pieces are however sharp-edged and probably not caused by carnivore gnawing.

The proximal epiphysis is more commonly represented. In all but one case this part of the femur has been split longitudinally, being most frequently represented by the caput femoris. The exception is provided by an intact epiphysis in which the trochanter ma-

jus is still present.
In a further case these two elements were recovered separately and could be refitted. The proximal end of the femur, comprising caput femoris and trochanter majus had been broken off just above the trochanter minor by a blow to the anterior face, leaving impacted bone and possibly only incidentally splitting the trochanter and femur head apart longitudinally.
The evidence of cutmarks for the disarticulation of the femur from the pelvis by cutting suggests that the removal of the proximal femur by smashing is part of the marrow fracturing process and not related to primary dismemberment.

Tibia

The tibia (fig.12.d) has been fractured by blows to various parts of the shaft. Impact scars evidence striking both the lateral and medial, but also the anterior and posterior faces of the bone. Laterally sited blows were aimed at the base of the crista tibiae, while three fragments show that a blow sited just medially from the foramen was also usual.
As is usual in marrow smashing of the tibia, the distal articulation is fractured from the shaft by a transverse break just above the joint. It is not clear whether the tarsals remained in articulation.

Metapodials

The metatarsus (fig.13.b) and the metacarpus (fig.13.a) were subjected to the same procedure. The larger fragments found are either proximal or distal articular ends with a long section of shaft; the mesial part of the shaft alone is represented by a very few splinter-like fragments.
The method of breakage is very simple, the metatarsals being broken into two pieces by a centrally placed blow, normally to the dorsal surface. The only exception to this pattern is the shaft of an immature metacarpus which was not marrow fractured and is proximally gnawed and distally unfused.
Cutmarks on the dorsal and plantar surface probably demonstrate that some care was taken in cleaning the bone of tissue to ensure successful fracture.
This pattern of fracture greatly resembles that described for metapodials at Star Carr (N.NOE-NYGAARD, 1987). There is no evidence at either Bedburg or Starr Carr for the controlled longitudinal splitting of the metapodials.

Phalanges

After being exposed by cutting, the first phalanges of both aurochs and red deer were broken open to extract their marrow.
In the case of the aurochs this was done by blows to the dorsal,peripheral and even achsial face of the phalanx (fig.13.c). The last category of impact scar between the two toes shows that the feet must have been at least opened out, even if demonstrably not always disarticulated.
In some cases the blows to the first phalanx broke the bone into two fragments, in others the piece was left entire with a more or less regular impaction. In the case of red deer the blow was to the dorsal surface (fig.14). On the left bone of the pair this removed the mesial section of the dorsal, medial and lateral faces, leaving only the plantar face intact, the blow to the right phalanx impacted a large oval plate of bone which was not found.

Perforated foot bones of this type are often described in the literature as tools or "whistles" (vide discussion in R.WETZEL and G.BOSINSKI, 1969). In this case the context makes clear that they merely represent butchering waste. This explanation was also given for at least the articulated material of this type from the early mesolithic site of Hohen Viecheln (E.SCHULDT, 1961).
The deliberations regarding exhaustive exploitation of bone marrow from the mandible (see above) also apply to the phalanges.

The animals represented at the site were subjected to standardized butchering procedures. Every category of bone provides evidence for the intensive filleting of meat. All bones which contained any quantity of marrow were fractured, the exceptions being a very few bones of immature animals. Finally it is most probable that the intense fragmentation of cancellous bone is not due to dismemberment of the carcass but represents processing of bone grease.

Carnivore gnawing of the assemblage

Not only butchering marks, but also chewing marks of scavenging animals can be recognized. The gnawed bones are otherwise as fresh as non-chewed specimens, which suggests that scavenging was probably synchronous with the settlement activities, and that these bones were not exposed on the surface longer than ungnawed specimens. The most likely explanation, supported by the size of tooth mark on the bones, is that the bones were gnawed by dogs, which are evidenced at the site by a well preserved skull, isolated teeth and postcranial bones.

Ravaging of a faunal assemblage by scavengers can be a major factor affecting the survival of bones. In order to evaluate the importance of this influence in Bedburg all bone fragments were examined for traces of carnivore gnawing.

This was subdivided into four categories, which to a large extent reflect the types of bone damage caused by carnivores observed and described by L.R.BINFORD (1981).

Crenellation affects mainly thinner cancellous bones, such as a horse scapula (fig.16). The removal of short sections of bone gives the edge of the bone a scalloped appearance.

Furrowing again affects cancellous bone, in this case usually the denser extremities of the limb bones, leaving distinctive irregular edges. An example is a fragment of distal femur of aurochs (fig.17).

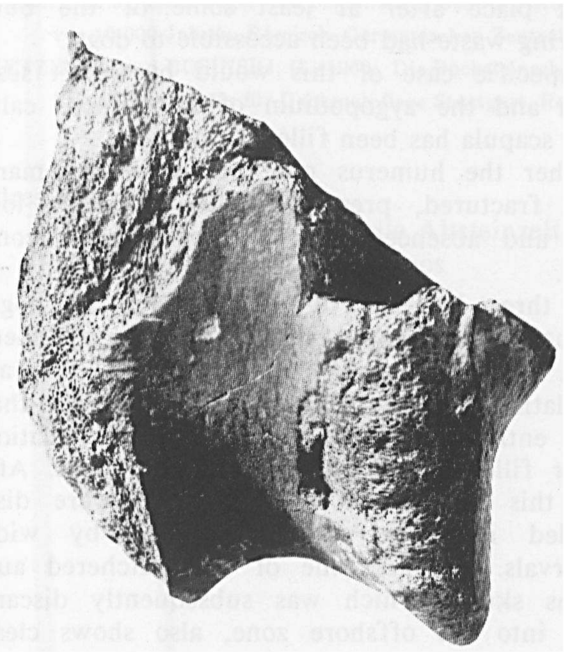


fig. 17 Carnivore gnawing of bone: furrowing of a fragment of distal femur of aurochs.

fig. 17 Distaal fragment van een oeros femur, geknaagd door roofdier.

Punctures are again present on thin and cancellous bone, and represent the perforation of the thin outer surface by a tooth, usually a canine, leaving a depression, often with a central plate of bone. They often occur in opposed pairs.

Pitting (fig.18.i) and striation (fig.18.ii) are in contrast to the previous forms of alteration present on denser bone, such as the shafts of limb bones, in this case the metacarpus of an immature aurochs.

fig. 18 Carnivore gnawing of bone: pitting (i) and striation (ii) of a metacarpus of aurochs.

fig. 18 Door roofdieren aangekauwd: putten (i) en strepen (ii) van een metacarpale van oeros.

The development of the various types of gnawing is very much conditioned by the character of the bone.
Several bones bear traces of more than one type of alteration. Of the 354 examined bones of aurochs, 116 show some form of carnivore gnawing, an overall proportion of 32,8%. This is quite a high proportion of gnawed bones, and certainly well above that observed in the Star Carr assemblage (A.J.LEGGE and P.A.ROWLEY-CONWY, 1988). It should be observed however, that in many cases the damage caused by gnawing was not severe, and in no case did it prevent the identification and recording of a specimen.

The role of scavenging dogs in the formation of a bone assemblage was studied by C.K.BRAIN (1967). He demonstrated graphically the attrition of bone assemblages by dogs relative to the robusticity of the element of the skeleton and provides a control by which the degree of destruction in Bedburg can be judged.
This aspect was studied in a revision of the Star Carr fauna (A.J.LEGGE and P.A.ROWLEY-CONWY, 1988), and demonstrated that the assemblage had not suffered appreciable damage by scavengers. This was in accordance with the observed low frequencies of carnivore gnawing on bones.
In view of the clear traces of carnivore gnawing on the Bedburg bones, it is relevant to make the same comparison and establish whether the survival pattern of the material resembles that of a ravaged assemblage or rather that found at Star Carr. It is neccessary to apply this method cautiously, since Brain's control sample consisted of goat remains, whereas the Bedburg material is intrinsically more robust (*Bos primigenius*). The "Percent Survival" of the different elements of the Bedburg aurochs material was compared with the degree of destruction observed on the control sample studied by Brain. Perhaps unexpectedly in view of the demonstrated presence of carnivore gnawing on much of the assemblage, the frequencies of bone elements are not those of a ravaged assemblage, in fact certain elements which should have a low survival potential, such as the sacrum, proximal femur and proximal humerus, are relatively frequent. It would appear that the character of the bone material, at least that of *Bos primigenius*, which became incorporated into the archaeological horizon, should not be regarded as heavily modified by scavenging animals, but can be accepted as still predominantly influenced by human activities.
The lost (terrestrial) part of the site no doubt contained an assemblage which was subject to continuing scavenger activity; this assemblage may have resembled Brains's sample, but this is demonstrably not the case for the material recovered from the limnic deposit. This is almost certainly because the recovered material was removed from the influence of scavenging animals (and weathering) before these could greatly affect the character of the assemblage. In other words, for the purpose of interpreting the surviving assemblage the role of dogs as a destructive factor can be ignored.

B. GRONNOW (1985) describes ethnographically documented examples of the cleaning up of a butchering site. Of especially interest is the disposal of waste material into an adjacent body of water. This would seem to be the most plausible explanation for the presence and distribution of the bone assemblage in Bedburg. Here too, the preferential disposal of larger bone refuse (aurochs) over that of the smaller species would influenece the nature of the surviving assemblage. Should this hypothesis be accepted, it is interesting to recognize that cleaning up took place after at least some of the butchering waste had been accessible to dogs.
A specific case of this would be a left scapula and the zygopodium of an aurochs calf. The scapula has been filleted, but
neither the humerus nor the radius are marrow fractured, presumably due to their low age and absence of significant marrow content.
All three bones have been gnawed by dogs, reducing the two limb bones to cylinders (L.R. BINFORD, 1981) and removing the articulation of the scapula. It would seem that this entire joint was discarded in articulation after filleting and dismembered by dogs. After this however, the three parts were discarded into the water seperated by wide intervals. At least one of the butchered aurochs skulls, which was subsequently discarded into the offshore zone, also shows clear traces of gnawing by dogs.

The combination of deliberate disposal of material into the surviving area of the site with the destruction of bones by dogs would additionally bias the survival of the faunal assemblage in favour of the larger species. Very little material belonging to, for example, pig and roe deer would survive gnawing by dogs to be then discarded by man into the adjacent body of water.

In summary it can be stated that the faunal material identified as *Bos primigenius* demonstrates in a representative manner the butchering methods of an early mesolithic community. Other species within the hunted assemblage are however certainly under-represented due to a combination of factors, including the destructive activities of domestic dogs.

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