Archs. Sci. Genève	Vol. 43	Fasc. 1	pp. 1-97	1990

ANIMAL REMAINS FROM THE NEOLITHIC LAKE VILLAGE SITE OF YVONAND IV, CANTON DE VAUD, SWITZERLAND

BY

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RÉSUMÉ

Cette étude ostéologique concerne les restes osseux découverts dans la station littorale d'Yvonand IV (canton de Vaud, Suisse). Les fouilles ont été réalisées entre 1973 et 1977 par Roland Jeanneret et Jean-Louis Voruz, sous la direction de Denis Weidmann.

A l'exception de quelques pièces de l'âge du bronze final III (Ha B1-B2), provenant de l'érosion de la station voisine d'Yvonand I, ce matériel se rattache aux groupes culturels du Horgen et du Lüscherz, présents autour du lac de Neuchâtel lors du début du néolithique final.

Les restes animaux sont très bien conservés; ils constituent un échantillonnage remarquable et significatif des espèces identifiées. La subsistance reposait sur l'élevage d'animaux domestiques, mais aussi pour une bonne part sur la chasse des animaux sauvages, qui fournissent viande et fourrures. Les suidés, sauvages ou domestiques, étaient consommés en plus grand nombre au Horgen qu'au Lüscherz.

Les restes osseux d'Yvonand IV ont été mis à disposition du British Museum (Natural History) pour le temps de l'étude. L'analyse de l'ensemble du matériel est un document d'archive, disponible sur demande au BM (NH). Le résumé des mensurations est donné dans une annexe de ce rapport. Les restes osseux sont conservés au Muséum d'histoire naturelle à Genève et un échantillonnage a été donné au BM (NH).

ABSTRACT

An archaeozoological study is presented of the mammalian remains from Yvonand IV, canton of Vaud, Switzerland. The site was excavated by Roland Jeanneret and Jean-Louis Voruz, under the direction of Denis Weidmann, between 1973 and 1977. Most of the finds were from the late Neolithic periods of the Horgen and Lüscherz with a small representation from the late Bronze Age.

The animal remains were very well preserved and the assemblage is notable for the very large number of species identified. The economy of the site was based on domestic livestock and a high proportion of wild animals that had been hunted for meat and furs. Swine, both wild and domestic, were exploited in higher numbers in the Horgen than in the Lüscherz.

The mammalian remains from Yvonand IV were loaned to the British Museum (Natural History) for the period of study. The analysis of the material is contained in an archive which is held at the BM(NH), and is available on request. Summaries of the measurements are given in an appendix to this report. The mammalian remains are now held at the Muséum d'histoire naturelle, Genève, except for a small number that were donated to the British Museum (Natural History).

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Acknowledgements

My thanks are due, first, to Prof. Hans-Peter Uerpmann who initiated the project. I am greatly indebted to Ms K. M. Shaw, formerly of the Biometrics Section, British Museum (Natural History), for her invaluable help with processing the data. I am deeply grateful to the Département des travaux publics, canton de Vaud, Lausanne, for the loan of the animal remains from Yvonand IV, for the donation of a proportion of the material to the BM(NH), and for the generous grant that has made possible this publication. Denis Weidmann, archaeologist responsible for the canton de Vaud, made all the arrangements for the loan from the Département and I am indebted to him for his visits to this Museum and for his help and kindness throughout the period of the work. I am grateful to Dr J.-L. Voruz, curator of the site, for his help with the archaeological and chronological data.

I should like to thank Dr Kim Dennis-Bryan and Mrs Shashu Lalji of the BM(NH) for their help with the preparation of the manuscript. The photographs for the plates were taken at the BM(NH) by Mrs Eva Zielenska-Millar. Figures 2-7 were prepared by Mrs Dee Hughes, University of Cambridge.

Introduction

The site of Yvonand IV in the canton of Vaud lies on the shoreline of a small bay on the southeastern margin of Lake Neuchâtel at an altitude of 430 to 430,50 m. The bay has been formed from the delta of the river Menthue which flows from a steep-sided valley and carries with it a great quantity of alluvium that has reached a depth of 2 m since the end of the Bronze Age. A number of archaeological sites are situated on a line approximately parallel to the lake, stretching for 800 m in length and with a width of 300 m. The bay provided a sheltered environment for the prehistoric settlements with open fertile land for grazing and the growing of crops, as well as wooded mountains inland for the hunting of wild animals for meat and furs.

Lake Neuchâtel, like the lakes of Bienne and Morat, lies in the former basin of the Rhône glacier. On the west bank, the Jura mountains rise to 1400 m above the lakes whilst to the east there is a moraine landscape that is no higher than 600 m. The climate and rainfall at the present day are moderate with a summer mean temperature of 18.6°C and a winter mean of 0°C. Snowfall is relatively light at the present day and it is probable that in the Neolithic the climate was even more equable with cool winters and warm summers. Recent reviews on the lake village sites and the first farmers in Switzerland have been written in English by Barker (1985) and Sakellaridis (1979).

The prehistoric lake villages of Switzerland were first exposed to modern view during the winter of 1853-4 when exceptionally low levels of Lake Zürich at

Obermeilen revealed numbers of wooden stakes standing up in the mud. A local school teacher informed the antiquarian Ferdinand Keller (1800-1881) of Zürich of these sightings and after his first study was published in 1854 the searching for buried lake villages became a popular occupation with large-scale dredging for finds as well as the first attempts at underwater archaeology. The discovery of the lake villages is of course well documented in Switzerland, whilst a short essay on the subject has been written in English by Harding (1980).

Keller's book (1866) on the lake villages contains perhaps the earliest collection of "specialist reports" in archaeology. There is a chapter on vegetable fibre and flax, another on plants by Oswald Heer, another on the animal remains by Rütimeyer, and analysis of the bronze implements by von Fellenberg. The chapter by Rütimeyer is a condensed version of a long article written in 1861 which is one of the earliest reports on archaeozoology. It is a remarkable document and many of Rütimeyer's conclusions are still of relevance to the modern study of the ancient distribution of birds, fish and mammals. There is, however, one respect in which the work of Rütimeyer has had an unfortunate effect, this being in his system of nomenclature, for this father of archaeozoology was a great believer, not only in the trinomial, but also the quadrinomial. Every subfossil bone had to belong to a breed with its own Latin name; thus he designated the earliest wild boar from Robenhausen, Meilen, and Concise as *Sus scrofa ferus,* another he called the marsh swine, *Sus scrofa palustris ferus,* and a third, the domestic form, was *Sus scrofa palustris domesticus.* Today, 130 years later, Rütimeyer's names, for example, *Canis familiaris palustris,* are still found in the literature and are still causing confusion in the study of primitive domestic animals, because the lake village dogs were not a subspecies or even a breed, but merely a component of the European population of Neolithic domestic dogs.

Rütimeyer's descriptions and identifications were based on the relative sizes of the animal remains within each taxon, as are those of today, for size is still the only criterion that distinguishes the remains of wild boar from those of domestic pig, and the remains of aurochs from domestic cattle. Rütimeyer, however, extended the parameters of size to more dubious deductions. Thus he claimed: "One race we have already, on sure grounds, named the 'marsh cow'. With those just mentioned it completes the series. It lived in the stone age, was most abundant in the older settlements, and has lasted up to the present day in the greater part of Switzerland. It is allied to what is called at the present day the brown cow, which almost exclusively occupies the whole mountainous part of Switzerland, and in many wild mountain valleys does not exceed the size of the small race from which it has sprung. This race of cattle seems to warrant an assumption as to the colour of the marsh cow of the stone age". (Translated by Lee, 1866, p. 357). Rütimeyer, however, understood some basic tenets about the distribution of wild species and their domestic descendents. For example, he realized that the domestic cattle and his 'marsh swine' could have been derived from the local aurochs and wild boar, whilst the dog and the sheep were very unlikely to have been domesticated in Switzerland. Furthermore he observed that there were no remains of domestic fowls amongst the Neolithic assemblages and he commented that, "The little animals which are so inconvenient in our modern houses, rats and mice, do not seem to have troubled the inhabitants of the lake dwellings, so that they could more easily do without cats, of which no remains whatever are found" (p. 356). It is now known, of course, that fowls, the black and brown rat, and the house mouse were all introduced into Europe by human travellers at different periods, but all following the Neolithic.

Within recent years the techniques used to investigate the remains of animals from archaeological sites have become very sophisticated but the results obtained do not differ very substantially from those of Rütimeyer. Perhaps the greatest progress can be seen in the study of a faunal assemblage as part of the wider investigation into palaeoecology and the economic systems of prehistoric peoples. This investigation is helped in Switzerland by the very remarkable state of preservation of the relics of the lake village settlements, and a number of reports have been published which has greatly furthered the study of archaeozoology in the Neolithic of Switzerland. Notable amongst these are the reports of Becker (1981), Becker & Johansson (1981), Boessneck *et al.* (1963), Chaix (1976*a*, 1976*b*, 1976*c*, 1976*d*, 1977), Forster (1974), Grundbacher & Stampfli (1977), Higham (1967) and Stampfli (1976).

Excavation and stratigraphy of Yvonand IV

The bay of Yvonand first drew the attention of archaeologists in 1860 when F. Troyon wrote on the ancient and modern lake-dwellers. Limited excavations in the bay of Yvonand, were first carried out in the 1920's. Dr. J.-J. Hübscher discovered the village Yvonand IV with 2 sondages in 1953. But the animal remains described in the present report were excavated between 1973-1977 under the direction of Denis Weidmann as a survey operation in advance of the construction of the N1 autoroute from Lausanne to Berne and as a rescue excavation before the building of the *Geilingen* workshop. Preliminary descriptions of these excavations have been provided by Jeanneret & Voruz (1974) and Jeanneret (1977), pending the final reports. Meanwhile a programme of high precision dating has been carried out using radiocarbon and dendrochronology (Weidmann, personal communication).

The periods covered by the site of Yvonand IV fall into the late Neolithic Horgen and Lüscherz with a small deposit from the late Bronze Age (HaB1-B2). Most of the animal remains came from the Horgen level but there was also a high proportion of the material that was not clearly stratified and so can only be ascribed to a prehistoric date falling within the time-span of the site. The stratigraphy and dating of the animal remains from Yvonand IV are given below in Table 1:

Table 1 : The level number and dating of the animal remains from YVONAND IV (1973-1977)

Trench	Level no.	Computer code	Period	14 C uncalibrated Date BC*	Dendro dates Date BC**
CB	2	N20	Late Bronze Age	about 800	-
CB2	4	N40	Lüscherz	2200	2700
CB22, C, CB23	6	N60	Lüscherz	2400	2900
CC2, B25	8	N80	Horgen	2500	about 3050
B26	8a	N90	Horgen		
BB	8a/8b	N10	Horgen		
B27	8b	N11	Horgen		
B28	8c	N12	Horgen	2700	3230 (base)
All other trenches		NSX	Undifferentiated		

* Weidmann (personal communication)

** Voruz (1984), p. 424

In the legends to the plates in this report the individual number is given for each element together with the computer code which enables the period to be seen by reference to this table. In addition, Table 1 should be referred to for dating the animal remains listed in the computer archive, held in the British Museum (Natural History), where the trench, level number, and computer code are cited for each individually numbered specimen.

As can be seen from the table the whole period of the Horgen and Lüscherz at Yvonand IV falls within a time-span of 500 years. The Horgen culture is the name given to a part of the late Neolithic levels that have yielded archaeological material from a widespread area of Switzerland, with the exception of the north and east of the country (Sakellaridis, 1979). The sites are mostly on the edges of lakes but a few burial mounds have been excavated. The Horgen people appear to have been cattle and swineherders. The Lüscherz culture is later in time at Yvonand IV, but at some sites it is coincident with the Horgen. The Lüscherz is found in western Switzerland and is characterized by a different kind of pottery from the Horgen; at Yvonand IV the Lüscherz people were still dependent on pigs for much of their meat although cattle-keeping had increased over the Horgen.

Worked bones, teeth and antlers

The bone tools from Yvonand IV are wonderfully preserved. They have been described and illustrated with great care by Voruz (1984) who kindly allowed me to examine them in 1978. The biological identification of these tools is given in Table 2 (see p. 68-9) although the high degree of workmanship of the bone means that it is often impossible to ascribe a taxon to the artefact.

A characteristic implement of the Horgen culture was a stone axe hafted in an antler sleeve (Voruz, 1984, figs 43, 44). Other tools that are particularly fine are the many forms of single and double ended points, some made from metapodia and some from the flat blades of ribs. Particularly notable are a small number of barbed antler harpoons (Voruz, 1984, fig. 38). There is also a large number of "chisels", these being bone shafts with a bevelled end or with the broken end sharpened from both sides (Voruz, 1984, fig. 69). Pendants made from boars' tusks and the canines of the Brown bear also occur with some frequency (Table 2).

A further small collection of worked bones and teeth were picked out from the animal remains that were sent to the British Museum (Natural History) for analysis. These artefacts and the waste from bone-working are presented in Table 3; they do not differ significantly in type from those described by Voruz, but the tools are mostly incomplete, broken, or more crudely worked. There is one very large boar's tusk pendant and a very fine bone scraper, made from a worked rib, in an antler handle.

Amongst the antler waste were nine carefully worked objects that are very curious (Plate 1). They are formed from the bases of antlers that had been chipped away in the region of the burr and worked to a rounded shape with a central raised tip. The burr has been completely removed so that the base of the antler, the pedicle, and the frontal bone are all contiguous. Sauter (1943) described somewhat similar bone objects that had been constructed to be used as lamps but they were different in workmanship and they had clearly-made holes through the bone by which the lamps were hung up. None of the antler objects from Yvonand IV is hollowed out on the cranial side as were those described by Sauter and they show no evidence of burning. The nine carved bones are from both sides of the skulls of Red deer stags; they are remarkably similar in appearance and their shape leads to the inescapable conclusion that they were meant to represent the human female breast. Three of these carved bones came from unstratified levels whilst the remaining six came from the oldest levels of the Horgen, that is dating to about 3300 BC (calibrated).

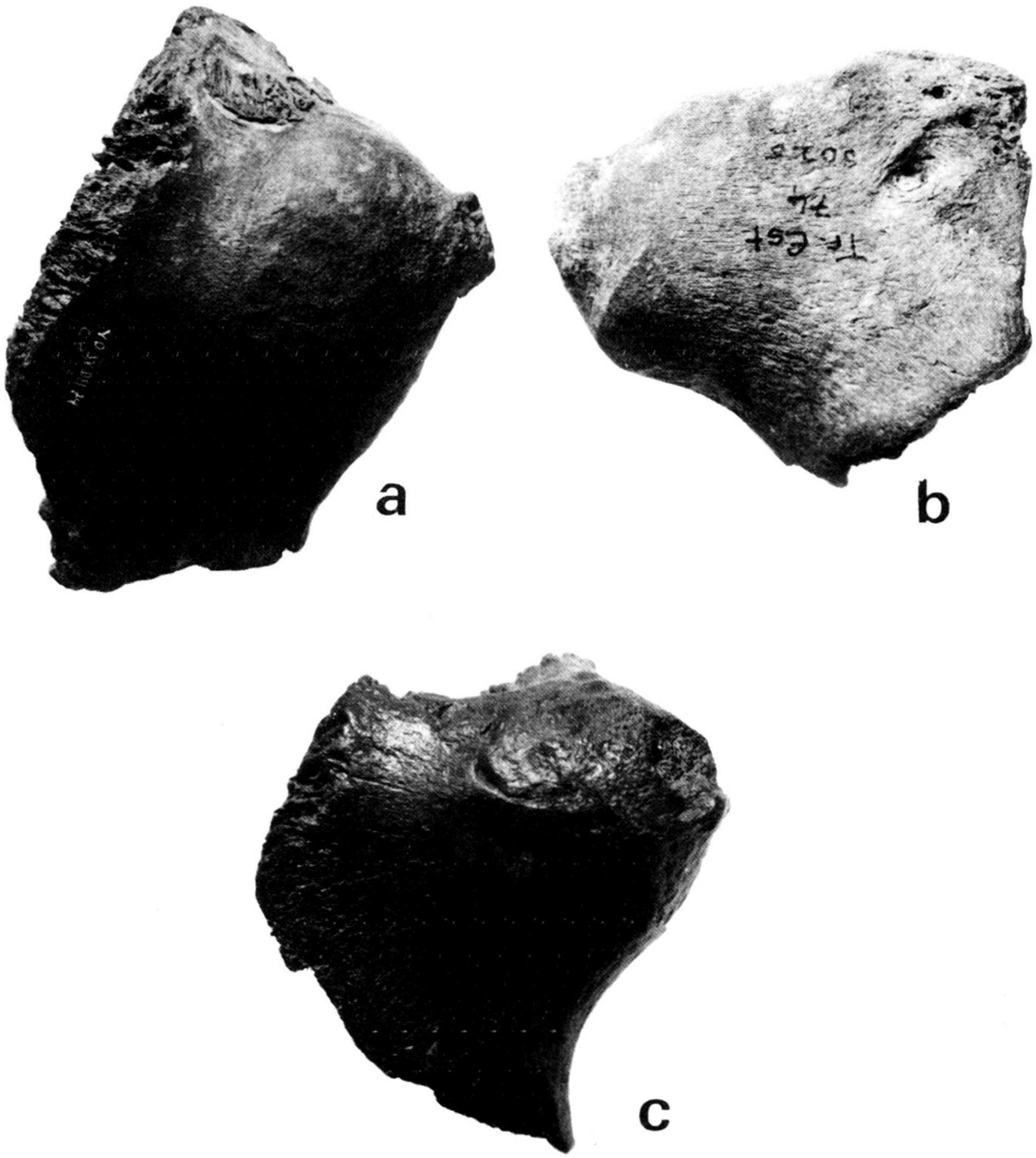


PLATE 1.

Worked antler bases. Red deer, *Cervus elaphus:* a, 5022 N12; b, 5025 NSX; c, 5024 N11. (For explanation of the numbers see Table 1 and page 5).

Note: The worked bones and antlers that were amongst the assemblage of animal remains sent to the BM(NH) for study have been included in all the tables of numbers and weights of elements, but the bone tools described by Voruz (listed in Table 2) have not been included in these tables.

The Mammalian Remains from Yvonand IV

Every fragment of animal bone from the excavations was washed, treated with consolidant, and numbered in white ink with details of its stratigraphy. The bones were then packed in two crates and despatched on loan to the British Museum (Natural History). Such perfect treatment of the material (which must be almost unknown for animal remains in British archaeology) together with the good preservation of the bones has made the processing of the collection a very straightforward task. First the animal remains were unpacked and sorted according to taxa. The unidentified fragments were separated into "cow-size", "sheep-size", "dog-size" and "hare-size", and were then weighed for each level number and re-bagged. The "cow-size" fragments include all those that could be cattle, bison, or large deer. The "sheep-size" includes all caprines and small deer. Both these categories may contain some bones of wild and domestic pig, although these bones are usually more diagnostic than the bones of ruminants. This means that the numbers of elements of pig amongst the identified remains may be proportionately slightly higher than for other taxa.

The weights of the identified elements are compared with the unidentified fragments in Table 4 (see p. 71-3). On the basis of weight 63% of the collection was identified, there being 169,954 gm of identified material and 100,995 gm unidentified. The 5028 identified elements were numbered in sequence. Each element was weighed, measured when possible, and described with all relevant details of butchery, ageing and pathology etc. This information was entered into a data base that is held as an archive in the British Museum (Natural History). Only summaries of the measurements are given in this report (see the Appendix) but the full data are available on request to the BM(NH). The absolute numbers and percentages of the elements within each taxon are presented in Table 5, whilst the numbers of elements for each part of the skeleton are given in Tables 6 and 7 for the Horgen and the Lüscherz. The minimum numbers of individuals calculated from the identified elements for each taxon are given in Table 8. For Tables 2-8 see pages 68-81.

The following taxa have been identified from the collection of mammalian remains sent on loan to the British Museum (Natural History). They will be described in systematic order:

Erinaceus europaeus Hedgehog
Lepus sp. Hare

Sciurus vulgaris Red squirrel
Castor fiber Beaver
Canis lupus Wolf
Canis lupus/familiaris Wolf/dog
Canis familiaris Domestic dog
Vulpes vulpes Red fox
Ursus arctos Brown bear
Mustela putorius Polecat
Martes sp. Marten
Meles meles Badger
Lutra lutra Otter
Felis lynx Lynx
Felis silvestris Wild cat
Equus caballus Wild/domestic horse
Sus scrofa Wild boar
Sus domesticus Domestic pig
Sus scrofa/domesticus Wild/domestic pig
Cervus elaphus Red deer
Capreolus capreolus Roe deer
Bos primigenius Aurochs
Bos taurus Domestic cattle
Large ruminant, Aurochs/domestic cattle/large deer
Rupicapra rupicapra Chamois
Capra hircus Domestic goat
Ovis aries Domestic sheep
Capra/Ovis Domestic goat/sheep
Small ruminant, Caprines/small deer

The mammalian remains within these taxa fall into three groups, small animals and carnivores that were presumably killed for their furs and perhaps for medical or other reasons apart from food, wild animals that were hunted for food, and domestic animals which included the dog. The different functions of these groups of animals are reflected in their age structure, as it can be deduced from the bones and teeth, and by the butchery of the bones. As would be expected the remains of the fur-bearing animals, the carnivores and beaver, show very little signs of butchery and the animals were nearly all adult when they were killed. The dog bones, also, are not chopped and it is evident that dogs were not eaten at this site. The bones and teeth of the wild animals killed for meat are mostly from adult animals whilst those of the domestic livestock have a high proportion of juveniles with unfused limb bones and unerupted permanent teeth. Tables 6 and 7 show that all the animals appear to have been butchered at the site because all parts of the body are represented.

The techniques of butchery correspond closely to those described for other Neolithic sites in Switzerland. The ancient inhabitants of the lake-side settlements were obviously very careful and provident people. They did not smash bones with a stone to extract the valuable narrow but with great precision they made small "windows" in the shafts from which they must have scooped it out (Plate 2). This tradition followed the practices of butchery seen in the earlier Cotaillod cultures as described and illustrated from the sites at Twann by Becker (1981) and Becker & Johansson (1981). Similarly the opening of a "window" in each horizontal ramus of the mandibles of pigs and ruminants to obtain the small but rich piece of marrow tissue is paralleled at many sites in Switzerland (Plate 3). An even more widespread practice was the use of the scapula blade to provide small flat pieces of bone as seen in Plate 4*a*, and in Becker & Johansson (1981, Plate 9). The ox scapula shown in Plate 4*b* is more unusual for the way it has been cut and smoothed suggests that it may have been used as an ice skate.

A number of the skulls, as shown for example by that of the pig in Plate 5, have been neatly bisected, a task that would seem to be difficult with a stone tool. The caprine thoracic vertebra in Plate 6 has also been carefully bisected while the metacarpal of a Red deer in the same Plate is an example of one of the very few bones that appears to have been smashed or battered by a stone, for it shows the conchoidal fractures that are the result of hammering.

A very high proportion of the bones have been gnawed by dogs so it is evident that although there are rather few individuals represented by their skeletal remains there were probably as many dogs in the settlement as there are around any country village today. The sheep metatarsal in Plate 7 shows the typically forked shape of a bone that has been chewed by another ruminant.

Very few bones in the assemblage show any sign of malformation or disease. Where these do occur they are described under the relevant taxon.

Ageing of the bones was done by assessment of the state of epiphysial fusion. This was coded for each bone on the computer input and the tables of bone fusion have been compiled from this information. Ageing of the teeth was done on the stage of eruption and wear of the crown and also entered into the data base. In the tables compiled from tooth eruption and wear, both mandibles and isolated lower teeth have been evaluated. For the mandibles the stage of the last tooth to be erupted was taken as representative of the animal's age at death. With individual teeth, however, a more pragmatic approach was necessary and the assessment of age cannot be very accurate. Thus, if the tooth was a much worn lower second molar it was scored in the table as an erupted third molar because this stage would be closer to the animal's age than an erupted second molar (with third molar unerupted). The tables on tooth wear and their age phases have been compiled to correspond with those on the animal remains from Twann (Becker & Johansson, 1981).

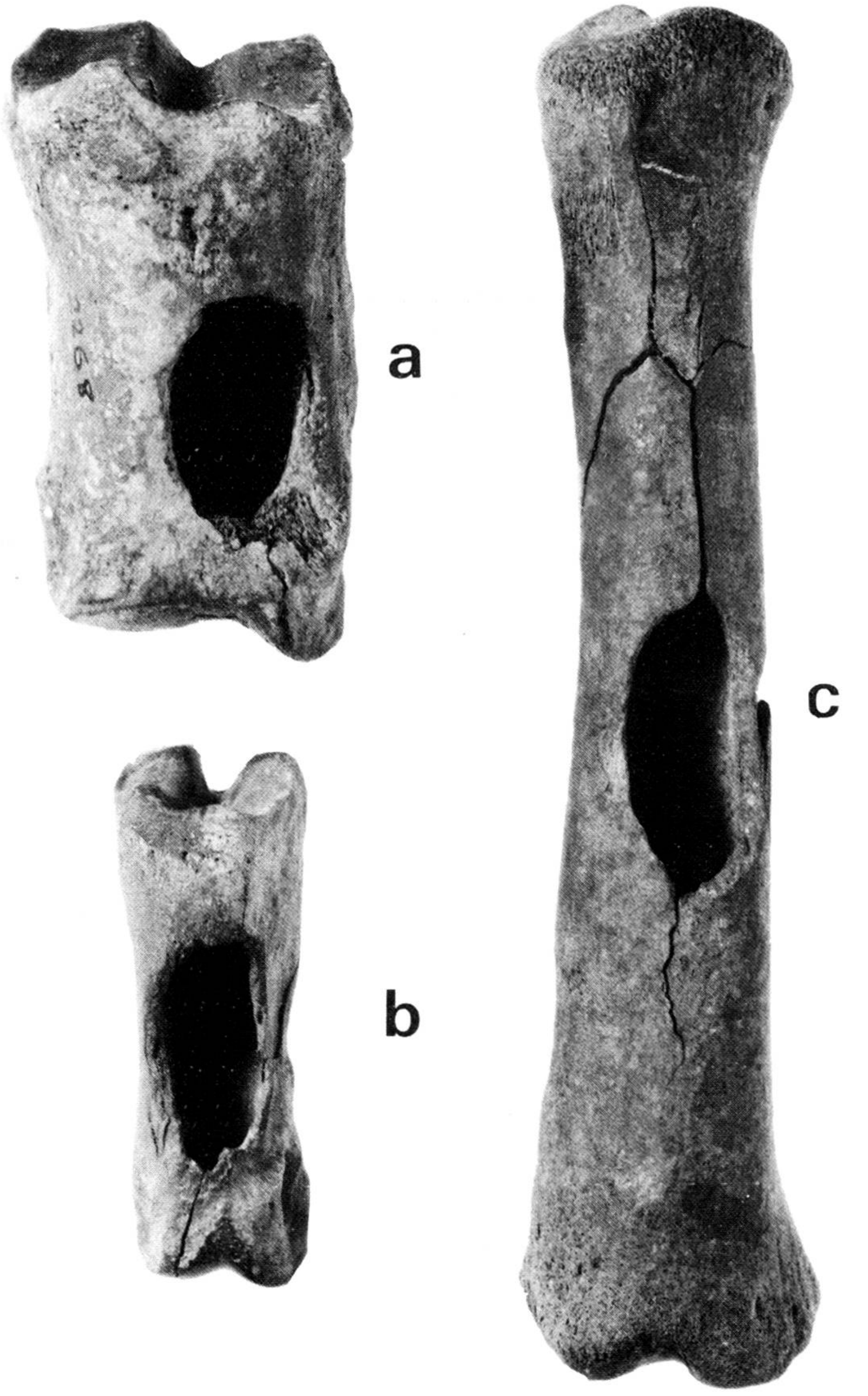


PLATE 2.

To show butchery for extraction of marrow: a, Aurochs, *Bos primigenius,* phalanx 1 (fore) 2268 NSX; b, Red deer, *Cervus elaphus,* phalanx 1, 535 NSX; c, Pig, *Sus domesticus,* radius, 481 N80.

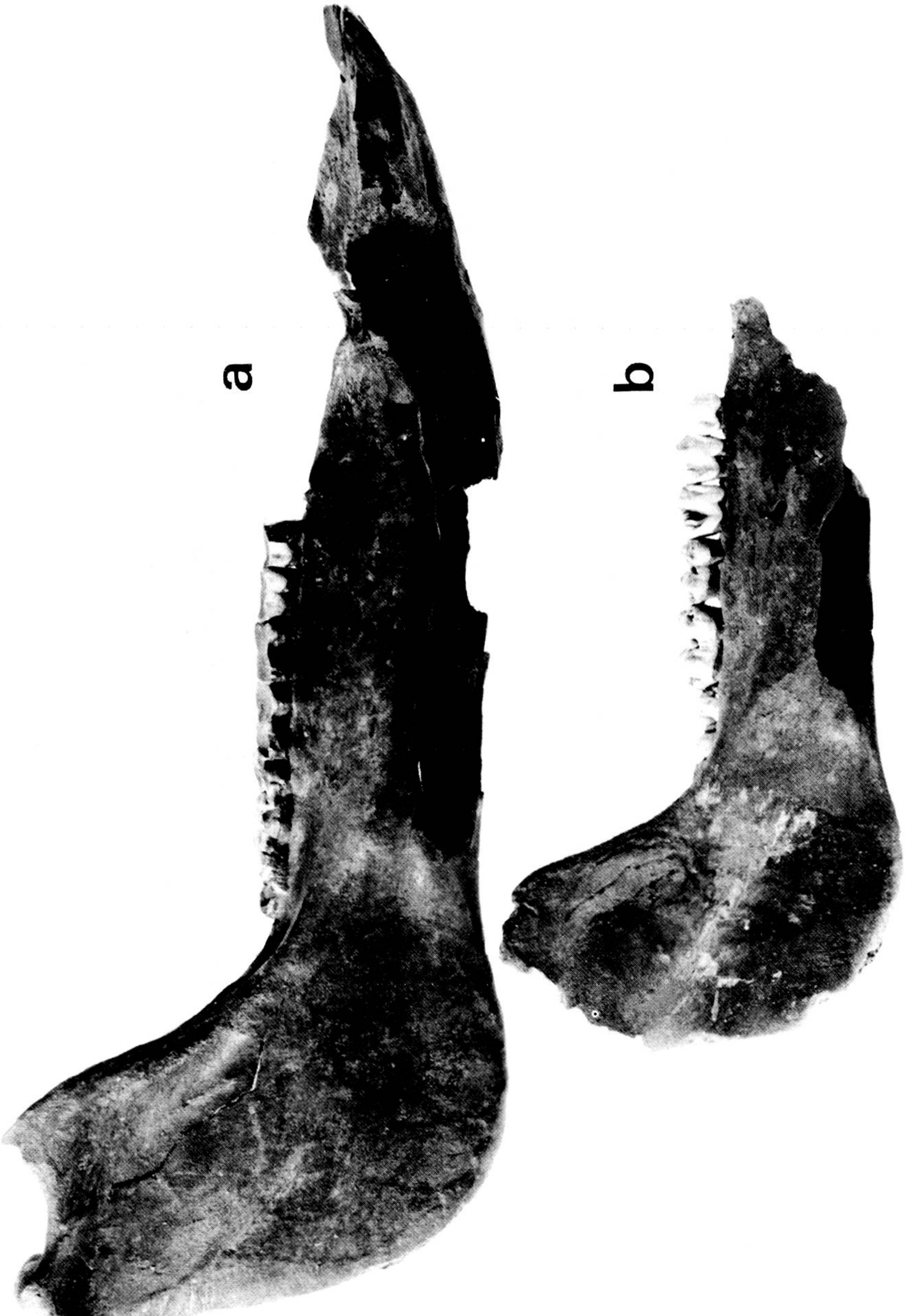


PLATE 3.

To show butchery for extractions of marrow from mandibular rami:
a, Boar, *Sus scrofa,* male, 1968 NSX; b, Pig, *Sus domesticus,* 100 N60.

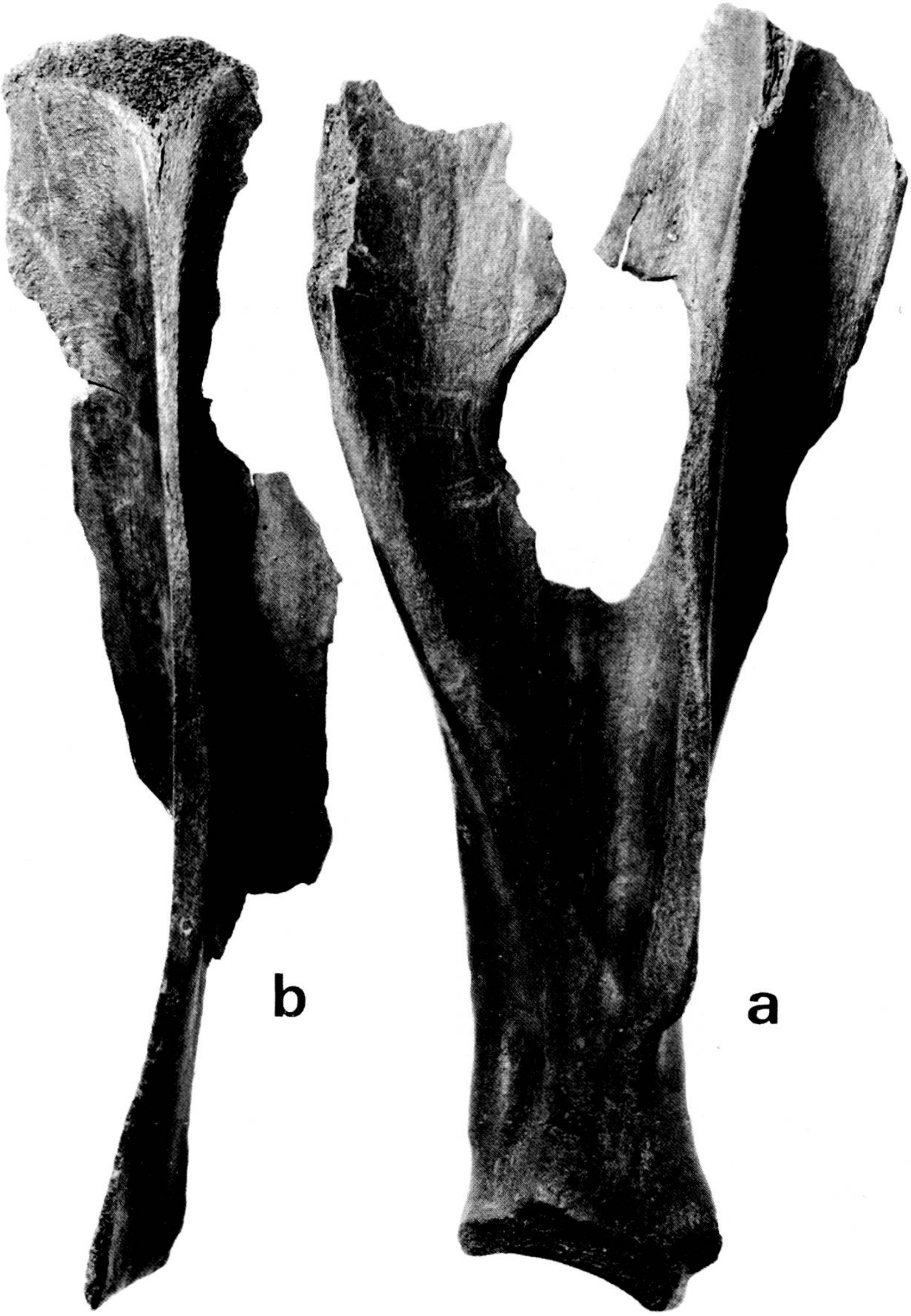


PLATE 4.

Bone working on scapulae of domestic cattle, *Bos taurus:* a, a round flat piece of bone has been removed from the blade, 28 N40; b, a scapula that has been cut and polished, possibly for use as an ice skate, 2833 N60.

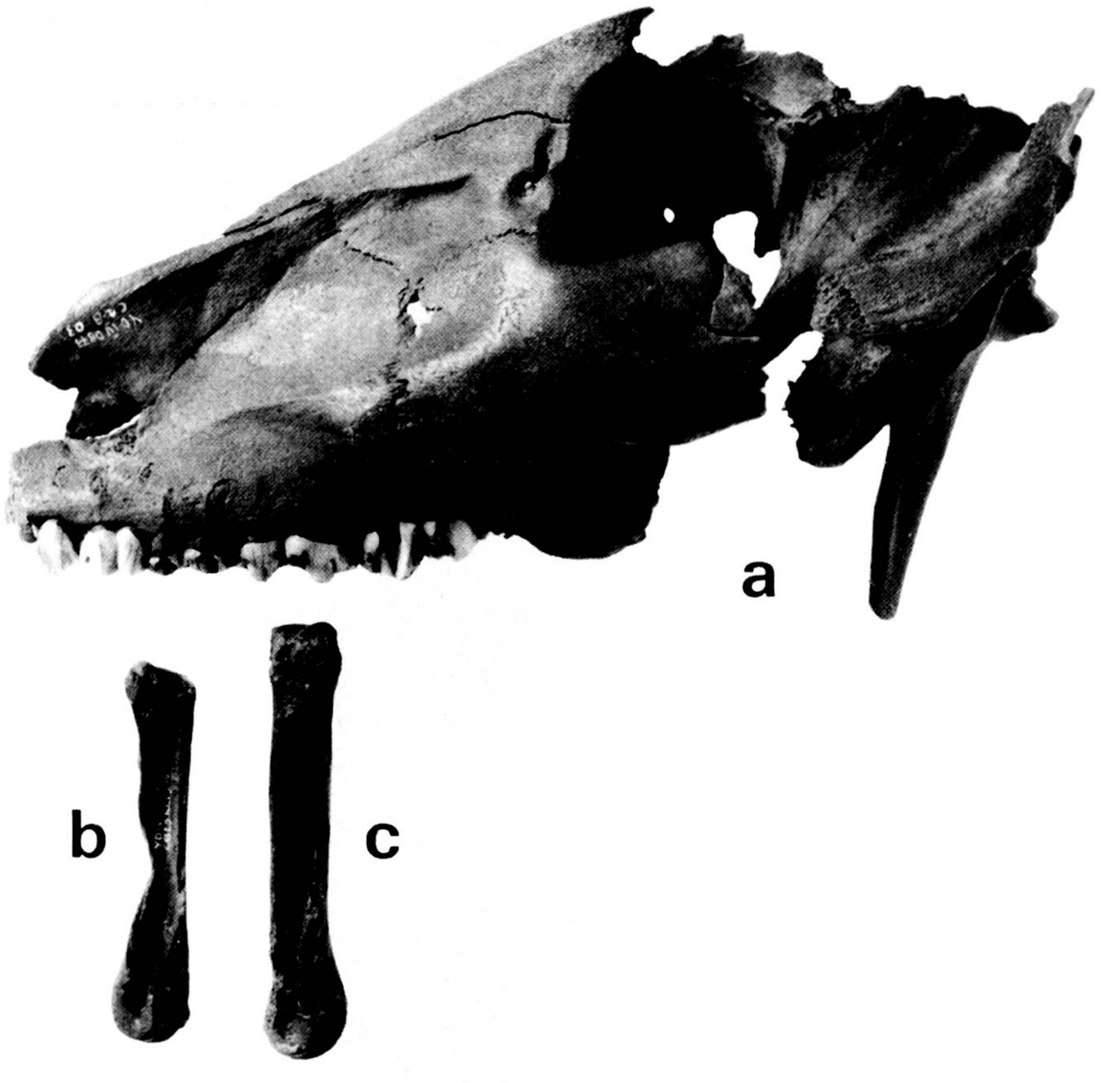


PLATE 5.

Butchery. a, Pig, *Sus domesticus,* bisected skull 110 N60; b, and c, *Sus* sp. metacarpal 4, 1888 N80 and metatarsal 4, 1889 N80.

PLATE 6.

Butchery, a, Sheep/goat, *Ovis/Capra,* bisected thoracic vertebra, 500 NSX; b, Red deer, *Cervus elaphus,* metacarpal, 1445 N80.

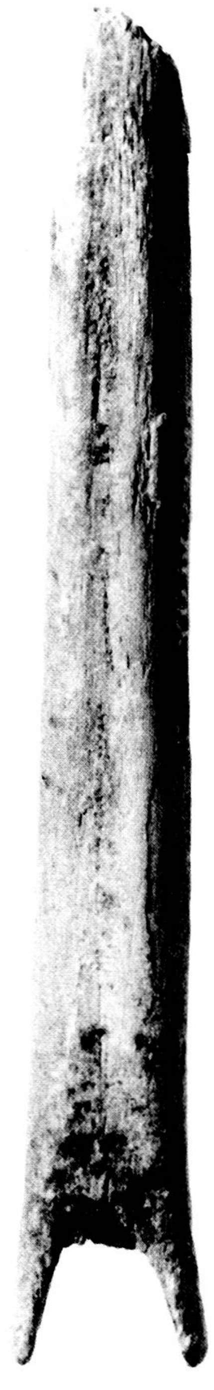


PLATE 7.

Sheep, *Ovis aries,* shaft of metarsal to show artiodactyl gnawing, 159 NSX.

INSECTIVORE

Erinaceus europaeus Hedgehog

One right mandibular ramus was retrieved from the Horgen. Length of ramus, 43.2 mm; length of cheek tooth row 23.6 mm.

LAGOMORPH

Lepus sp. Hare

Two elements of hare have been identified, a left mandibular ramus with a cheek tooth row length of 17.9 mm, and a left humerus with a length of 94.3 mm and a distal width of 10.0 mm. From these bones it is not possible to ascertain whether the species represented is the Brown hare, *Lepus capensis,* or the Mountain hare, *Lepus timidus.* Today there are isolated populations of the Mountain hare in the Alps but it is probable that the species was more widespread in prehistoric times, while the common hare may have been a rather late immigrant to Europe from the east after the end of the last glaciation. During the Neolithic period the rabbit (*Oryctolagus cuniculus*) was still confined to Spain and the southern coastland of France.

RODENTS

Sciurus vulgaris Red squirrel

Only one bone was identified as squirrel, this being a complete left femur from the Lüscherz. The squirrel was a large individual with a femur length of 54.8 mm and distal width 8.2 mm.

Castor fiber Beaver

A total number of 17 elements in the assemblage have been identified as beaver, including three mandibles from the Horgen and five from the Lüscherz. One further mandible came from the unstratified levels. The limb bones do not appear to have been butchered but the angles of the mandibles, at the edge of the vertical ramus, have been chopped and smoothed in a number of specimens (arrowed in Plate 8*a*). These mandibles may have been used as some sort of tool. In other mandibles the canine tooth has been removed by chopping away the bone from the horizontal ramus. There is, however, no evidence of scratching on the canine tooth which would indicate that the jaws had certainly been used as artefacts, as described by Hatting (1969) for prehistoric beaver mandibles from Denmark.

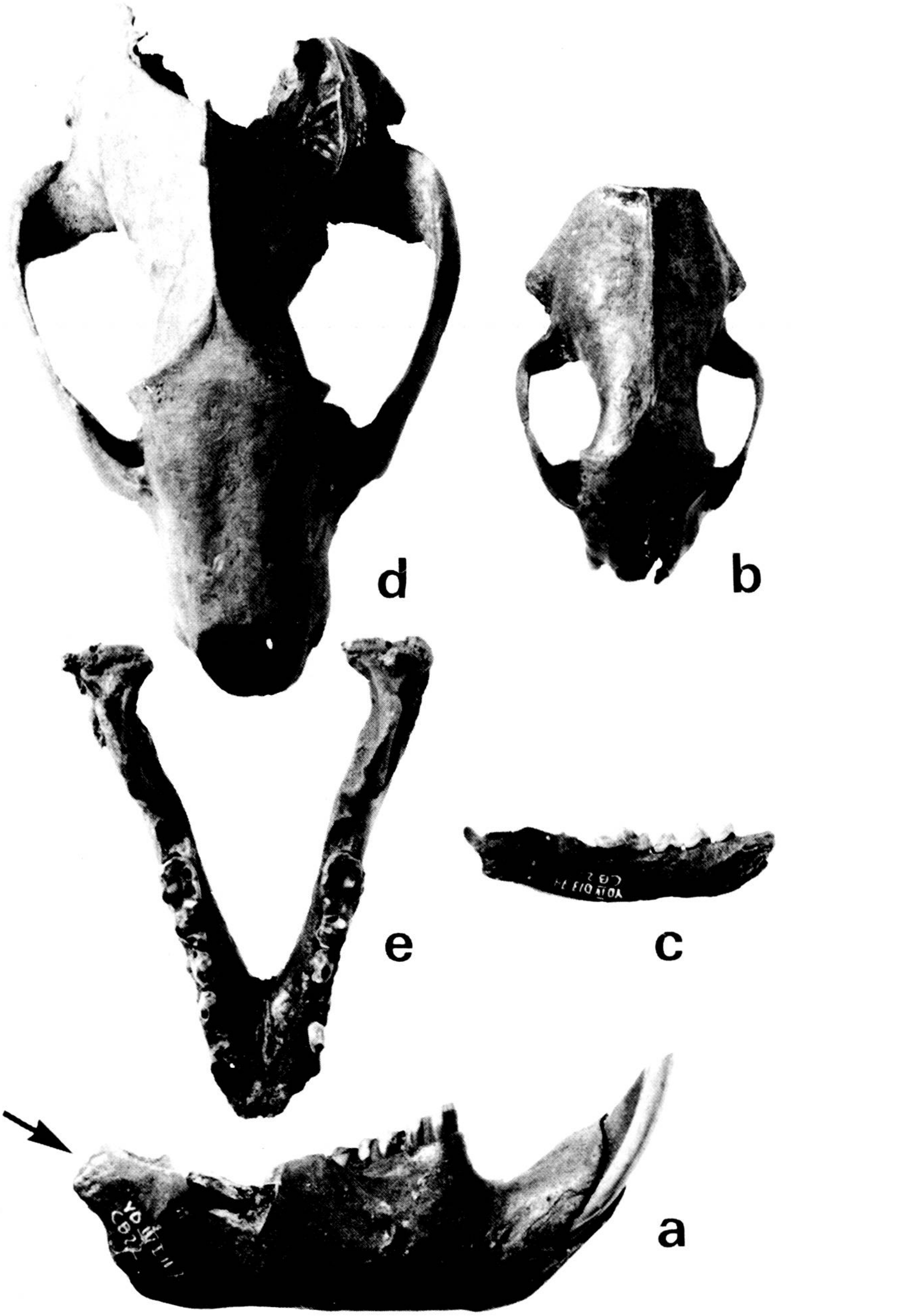


PLATE 8.

a, Beaver, *Castor fiber,* right mandibular ramus, 5193 N60; b, Polecat, *Mustela putorius,* skull 2488 N60; c, Marten, *Martes* sp., left mandibular ramus, 392 N40; d, and e, Badger, *Meles meles,* skull, 1706 N80 and mandible, 2515 NSX.

Mayhew (1979) has studied the enamel patterns of the cheek teeth of the European and American beaver and he observed that in the post-Pleistocene European beaver, but not in the American, there is an isolated islet between the anterior and the middle enamel folds on the lingual side of the tooth. This islet is especially frequent on the lower third molars but disappears in the teeth of animals that are more than ten years old. The islet is present on the lower third molars of the beaver mandibles from Yvonand IV.

CARNIVORES

Canis lupus Wolf

Three foot bones are the only elements that can be ascribed with certainty to wolf. The bones are a third metatarsal from the Lüscherz, and a third metacarpal and a calcaneum from unstratified levels. A fourth bone, the shaft of a radius, could not be distinguished as wolf or dog. This bone was from the Horgen and has a shaft width of 11.1 mm.

By 1869 the wolf had become a rare carnivore in Switzerland (Fatio, 1869), but as Fatio commented its remains are common in the lake sediments and wolves must have been hunted by humans throughout all periods. Even in the Neolithic the wolf could have been pursued for sport but it must also have been killed for its fur and because wolves killed valuable livestock animals and occasionally people.

Canis familiaris Domestic dog

Domestic dog is represented by a total number of 74 elements. Most parts of the skeleton are present, with a preponderance of mandibles (14). Measurements of the bones show that the animals were rather small, uniform in size, with heights, estimated from the ten complete limb bones, ranging from 40 cm to 48 cm at the shoulder. The dogs had well-proportioned skulls and straight limbs and the mandibles show that the jaws were straight and the teeth evenly-spaced (Plate 9). The bones accord well with the remains of dogs from Twann (Becker & Johansson, 1981).

There are no signs of disease in the bones, nor of periodontal disease in the jaws. The dogs were mostly adult (see Table 9, for the numbers of fused and unfused elements) but not aged and there is no evidence to show how they died. There are no signs of butchery on the bones, with the exception of knife cuts on one lower canine tooth (unstratified). It is known from other sites that dog canines were used as artefacts and also the roots of the teeth were bored so that they could be worn as pendants.

The remains of dogs from Yvonand correspond in size with others from the Swiss lakes. Most of these dogs were small animals which were first named "Turbary dogs"

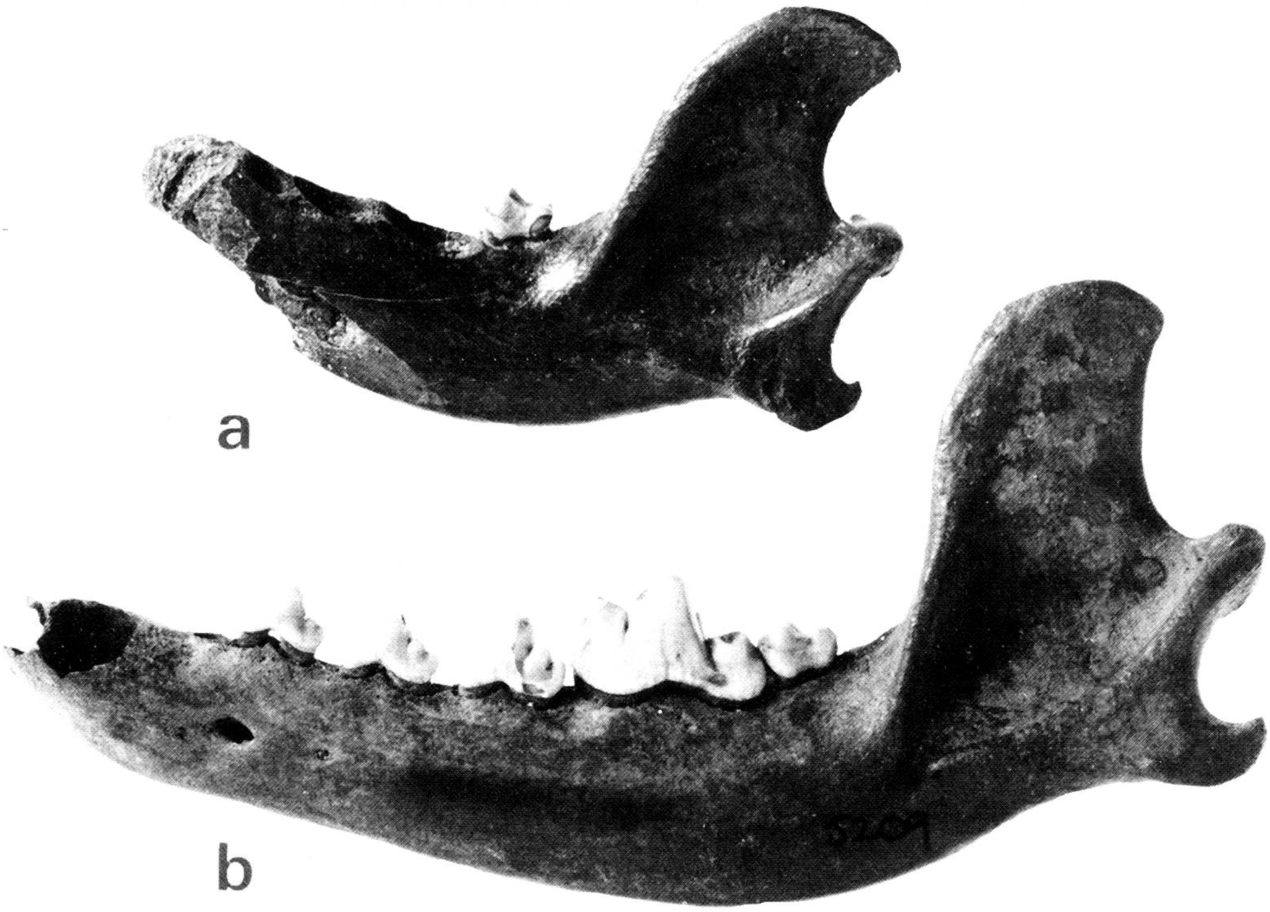


PLATE 9.

Domestic dog, *Canis familiaris,* left mandibular rami: a, 1708 N80; b, 5209 N12.

by Rütimeyer ("Turbary" means peat). a few larger, dogs, however, have also been identified from the prehistoric sites (Becker & Johansson, 1981; Boessneck *et al.*, 1963; Reverdin, 1927).

Table 9: Epiphysial fusion in the limb bones of domestic dog (*Canis familiaris*) from Yvonand IV.

Bone	Fusion times (from Sumner-Smith, 1966)	Numbers of bone	
		Horgen	Lüscherz
Proximal ulna	5-8 months	f(3), pf	f(2)
Distal humerus	5-8 months	uf	f
Proximal radius	5-8 months	-	f
Distal tibia	5-8 months	f	f
Distal fibula	5-8 months	f	-
Distal femur	6-8 months	f(2), uf	f
Distal ulna	6-8 months	-	f(2)
Proximal femur	6-9 months	f, uf	f
Proximal tibia	6-11 months	f, uf	-

Note: f - fused, pf - part fused, uf - unfused.
Numbers greater than one in brackets.

Vulpes vulpes Red fox

The Red or Common fox is represented by a total of 79 elements from the whole assemblage. This compares with 74 elements of domestic dog and 206 elements identified as badger. As with the other carnivore remains the fox bones had not been chopped, although there are knife cuts on one distal tibia, presumably the result of skinning. As can be seen from Table 10 all the bones of fox from Lüscherz had fused epiphyses whilst only three bones out of a total of 31 from the Horgen had unfused epiphyses.

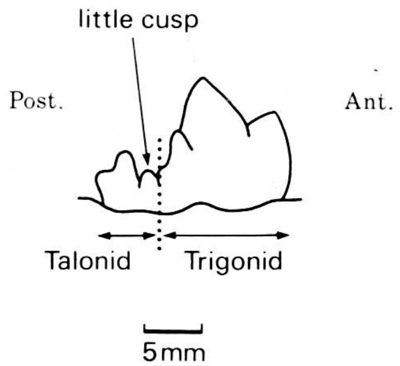
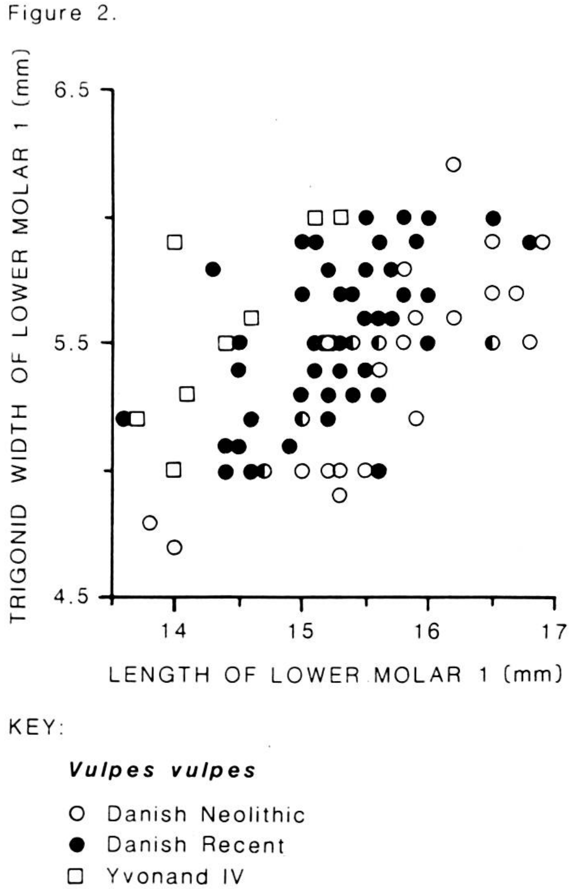


FIGURE 1.

Terminology of the lower carnassial tooth (lower right molar 1 of *Vulpes vulpes*).

The microevolution of the teeth of foxes in Denmark was studied by Degerbøl (1933) and discussed by Kurtén (1967). Degerbøl reported that the lower carnassial tooth (M_1) tended to be broader in modern foxes than in Neolithic specimens. He also observed that the change in relative width was associated with the development of a little cusp on the lingual side of the lower carnassial between the trigonid and the talonid of the tooth (Figure 1). This cusp is commonly absent in subfossil teeth from Denmark and it is also frequently absent from the carnassials of modern Scandinavian foxes. However the cusp is almost always visible on the lower carnassials from Yvonand (Plate 10) and it is also present on the teeth from France and Germany that were examined in the British Museum (Natural History).

Kurtén explained the genesis of the extra little cusp as being connected with a shift in the length-width allometry of the lower carnassial. Thus he summarized that the cusped teeth from modern Denmark are homozygous and broad, whilst the heterozygous cusped and cuspless teeth are narrow as in the majority of his sample of Finnish and Swedish fox teeth. Homozygous cuspless teeth are narrow as in the Danish Neolithic specimens (see Kurtén, 1967).



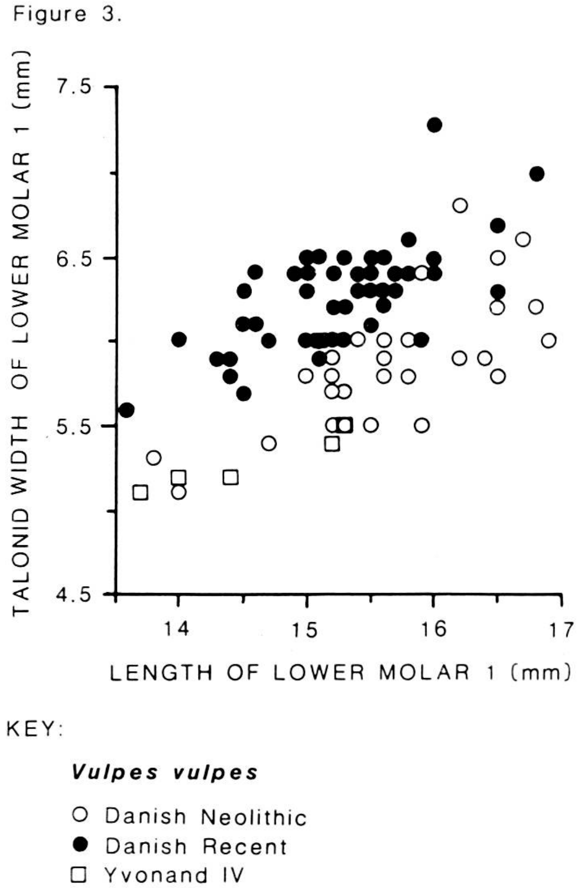


FIGURE 2.

Trigonid width plotted against length of tooth in the lower carnassials (M_1) of *Vulpes vulpes* from Yvonand IV to compare with those from the Danish Neolithic and modern samples of Degerbøl (1933).

FIGURE 3.

Talonid width plotted against length of tooth in the lower carnassials (M_1) of *Vulpes vulpes* from Yvonand IV to compare with those from Danish Neolithic and modern samples of Deberbøl (1933).

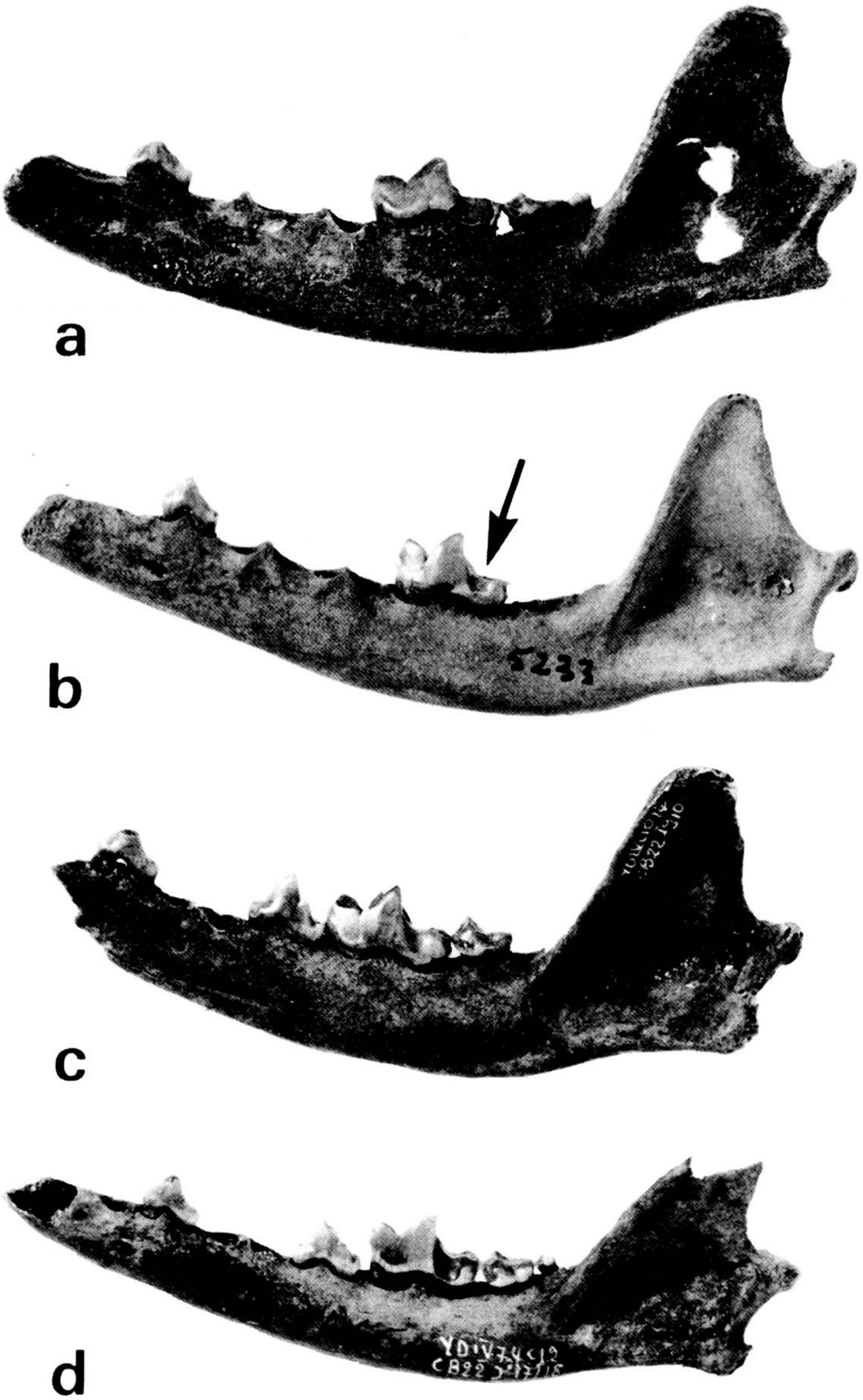


PLATE 10.

Fox, *Vulpes vulpes,* left mandibular rami: a, 5236 N60; b, 5233 N12 (the position of the lingual cusp described in the text is arrowed); c, 5237 N60; d, 1065 N60.

Figures 2 and 3 show the length to width proportions of the lower carnassial teeth from Yvonand IV, based on measurements of both the trigonid and the talonid widths. These are compared with the proportions for Neolithic and recent Danish teeth as quoted from Degerøl (1933). It can be seen that the Yvonand teeth are shorter and wider than the Danish Neolithic and even slightly wider than the Danish recent. But the interesting fact is that they are only wider on the trigonid measurement and not on the talonid. For the talonid width the Yvonand teeth are in proportion with the Danish Neolithic and narrower than the recent. Yet the extra little cusp is not close to where the trigonid width is measured but lies in the 'valley' just in front of the talonid (Fig. 1). So perhaps after all the presence of absence of the cusp is not directly linked to the width of the tooth. Clearly, more work could be done on the microevolution of fox teeth.

Table 10: Epiphysial fusion in the limb bones of Red fox (*Vulpes vulpes*) from Yvonand IV.

Bone	Numbers of bone	
	Horgen	Lüscherz
Calcaneum	f	-
Distal metacarpal	-	f
Distäl metatarsal	f (5)	-
Distal metapodial	f (2)	f
Proximal ulna	f (2)	f
Distal humerus	f (5)	-
Proximal radius	f, uf	f
Distal tibia	f	f (2)
Distal fibula	f	-
Distal femur	f (5)	f
Distal ulna	f	-
Distal radius	uf (2)	f (2)
Proximal femur	f (2)	f
Proximal fibula	f	-
Proximal tibia	-	f (5)
Proximal humerus	f (3)	-

Note: f - fused, uf - unfused.
Numbers greater than one in brackets.

Ursus arctos Brown bear

A total of 41 elements have been identified as Brown bear, including two canine teeth that had been worked. All parts of the body are represented and many of the bones had been butchered (Plate 11) and then gnawed by dogs, so it can be assumed that bear meat was eaten, unlike other carnivores in the assemblage which are represented by mostly complete bones. Only one bone is unfused and therefore from a young bear (Table 11).

There are not enough elements to provide information on the size of bears in the Neolithic of Switzerland but none of the bones or teeth is exceptionally large and they could all represent female animals. Fatio (1869) stated that bears were still present in the cantons of Vaud and Neuchâtel so it can be seen that although the

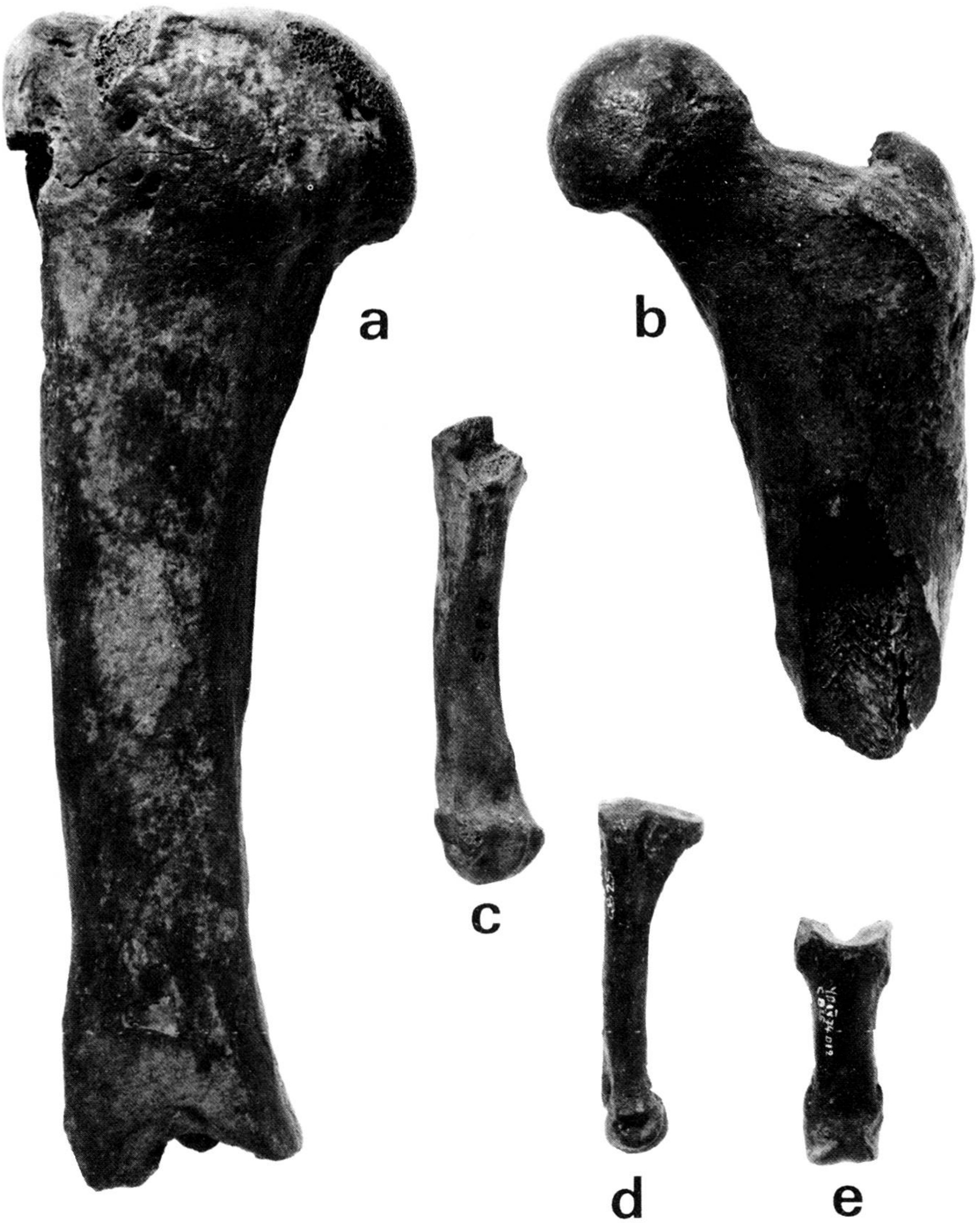


PLATE 11.

Brown bear, *Ursus arctos:* a, Proximal end of right humerus, 5176 NSX; b, proximal end of left femur 5179 N80; c, left metatarsal 5, 5188 N12; d, right metatarsal 3, 5187 N80; e, phalanx 1, 5190 N80.

Table 11: Epiphysial fusion in the limb bones of Brown bear (*Ursus arctos*) from Yvonand IV.

Bone	Numbers of bone	
	Horgen	Lüscherz
Proximal humerus	-	f
Proximal radius	f	-
Proximal ulna	uf	-
Distal metacarpal	f	-
Proximal femur	f	-
Distal metatarsal	f (5)	f (2)
Proximal ph1	f	-
Proximal ph2	-	f

Note: f - fused, uf - unfused.
Numbers greater than one in brackets.

Brown bear has had an uneasy relationship with humans for many thousands of years it has survived well in forested and mountainous regions. It is probable that the omnivorous bear would have raided the crops of the Neolithic inhabitants of Yvonand as well as killing off sheep and even the small domestic cattle from time to time. In turn the bears would have been hunted by people; the thick furs would have been a most valuable asset for clothing and bedding, and the fatty meat a highly-prized food.

Mustela putorius Polecat

Rather surprisingly only three elements from the assemblage could be ascribed with certainty to the Polecat. These are a complete skull with most of the teeth, from the Lüscherz (Plate 8*b*), an ulna from the Horgen, and a right mandibular ramus that is unstratified. Selected measurements of these elements are as follows:

Skull: Condylobasal length 70.6 mm; length of toothrow 25.4 mm: length of upper carnassial (P^4) 7.3 mm.

Ulna: Length 41.1 mm.

Mandibular ramus: Length 42.4 mm; length of cheek tooth row 20.7 mm; length of lower carnassial (M_1) 8.8 mm.

The condylobasal length of the skull of a female polecat from Switzerland in the BM(NH) is 68.0 mm (see also Miller, 1912). It is most probable that the remains of polecats from the Swiss Neolithic sites are from the European polecat, *Mustela putorius,* rather than the steppe polecat, *Mustela eversmanii* which is found today further to the east and north of Europe and Asia. Miller (1912) commented that the type specimen of *Mustela manium* Barrett-Hamilton, 1904, the polecat from Switzerland, is identical with *Mustela putorius.*

Fatio (1869) wrote that the polecat was widespread in Switzerland and was more common than the marten, and yet the remains of this carnivore are more frequent at Yvonand than are those of the polecat. Perhaps the pelt of the marten was more highly valued.

Martes sp. Marten

There are two species of marten in Europe, the Beech or Stone marten, *Martes foina* and the Pine marten, *Martes martes.* At the present day the two species are sympatric in some regions including Switzerland although in general *M. foina* has a more southerly distribution than *M. martes.* The living animals can be separated very easily by the markings of the pelts, the Beech marten having a larger white throat patch which is easily distinguished from the smaller bib of the Pine marten.

The martens are forest carnivores feeding on a wide variety of prey, including rodents and birds. The Pine marten, as its name implies, inhabits coniferous forests more frequently than does the Beech marten which is found in mixed or deciduous woodland. The Pine marten is therefore an inhabitant of colder climates and higher latitudes, but the fossil evidence suggests that the Beech marten was a later immigrant to Europe from the Near East after the end of the last glaciation and it may not have been present in western Europe in the early Holocene (Anderson, 1970).

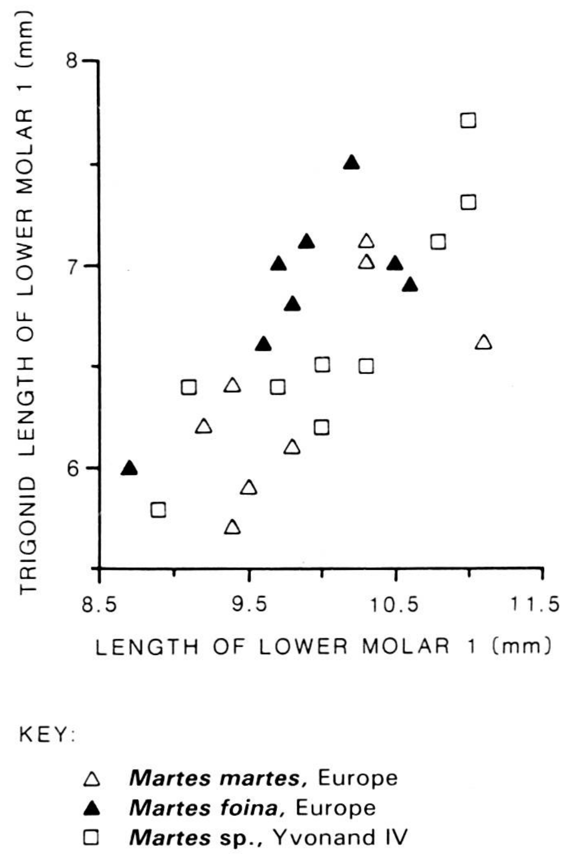


FIGURE 4.

Trigonid length plotted against length of tooth in the lower carnassials (M_1) of *Martes* sp. from Yvonand IV to compare with those from *M. martes* and *M. foina* in the modern collections of the BM(NH).

It is not easy to distinguish the two species of marten on subfossil material unless a very large series is available, when differences can be seen in the skulls and in the proportions of the teeth. Although the material from Yvonand has provided a number of complete mandibles the distinguishing characters are not sufficiently clear to make a certain diagnosis (Plate 8*c*). These features are a smaller first premolar in *M. foina* and in the carnassial the trigonid (main cusp) is longer in *M. martes* (see Figure 1 for illustrations of the cusp terminology).

Figure 4 shows the length of the trigonid plotted against total length of the lower carnassial in the mandibles from Yvonand and from specimens of *M. martes* and *M. foina* in the BM(NH). The Yvonand specimens on the whole lie within the range of the *M. martes* specimens. Anderson (1970) gives mean values of the length of the trigonid for specimens from postglacial and Würm (last glaciation) deposits, as quoted below. *M. foina* occupies a position between the males and females of *M. martes*. On this basis, the three Yvonand specimens with length of trigonid greater than 7.0 are possible male *M. martes* and the rest possible female *M. martes*.

		Postglacial		Würm	
		mean	range	mean	range
M. martes	male	7.12	6.7-8.0	7.19	6.7-8.0
M. foina	male	7.00	6.7-7.2	7.13	6.9-7.6
M. foina	female	6.55	6.3-6.9	7.68	6.3-7.1
M. martes	female	6.38	6.0-6.9	6.44	5.9-7.0

Figure 5 shows the width of the trigonid plotted against total length of lower carnassial for the Yvonand and BM(NH) specimens and for Neolithic and Recent Danish specimens of *M. martes* from Degerbøl. Again, most of the Yvonand specimens lie within the range of *M. martes;* the three largest, which are the most divergent, are the three which are identified as male *M. martes* on the basis of the length of trigonid. If the remains are assumed, however, to be from *M. martes,* as seems reasonable, then of the limb bones, a radius and ulna (radius length 48.8 mm, ulna length 60.1 mm), two humeri (one with length 66.3 mm and one with distal width 12.5 mm), and two femurs (lengths 77.8 mm and 73.7 mm) are, by comparison with the figures given by Anderson, more likely to be from female animals. Two tibiae (lengths 88.2 mm and 83.5 mm) are probably from male animals. The sex of the rest (two humeri with lengths 71.2 mm and 73.3 mm, and three ulnae with lengths 67.0 mm, 68.5 mm and 68.8 mm) cannot be determined with any confidence.

The limb bone measurements also fall within the range of those of *M. martes,* of both sexes, as cited by Anderson (1970). On these grounds therefore the remains of marten from Yvonand are more likely to be the Pine marten, *Martes martes,* although because of the high degree of sexual dimorphism in the martens, it is not possible to differentiate individual postcranial elements, as the two species overlap in size with female. *M. martes* being the same size as male *M. foina*.

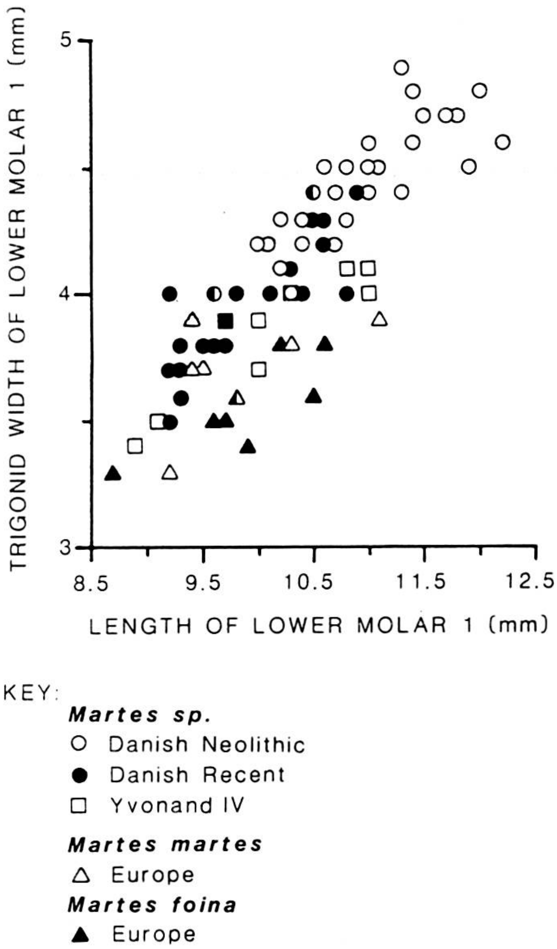


FIGURE 5.

Trigonid width plotted against length of tooth in the lower carnassials (M_1) of *Martes* sp. from Yvonand IV to compare with those from the Danish Neolithic and modern samples of Degerbøl (1933), as well as with carnassials of *M. martes* and *M. foina* in the modern collections of the BM(NH).

There are 46 elements from Yvonand identified as marten; most of the bones are complete and have fused epiphyses so were from adult animals (Table 12). It is most probable that the martens were killed for their pelts.

The remains of marten from Burgaschisee-Sud were ascribed to the Pine marten rather than the Beech marten by Boessneck *et al.* (1963), whilst those from Twann were only identified to the genus level, *Martes* sp. (Becker & Johansson, 1981). Chaix (1976*a*) mentions both species in his report on the animal remains from Garage

Martin, Yverdon, but without details. The Pine marten has, in addition, been identified from the sites of Auvernier-La Saunerie by Stampfli (1976) who compared measurements of the subfossil martens with modern comparative material.

Table 12: Epiphysial fusion in the limb bones of marten (*Martes* sp.) from Yvonand IV.

Bone	Numbers of bone Horgen	Lüscherz
Scapula	uf	-
Proximal humerus	f (2), uf	-
Distal humerus	f (4)	-
Proximal ulna	f (6), uf	-
Distal ulna	f (2)	-
Proximal femur	f (4), pf	uf } one
Distal femur	f (2)	uf } bone
Proximal tibia	f (3), uf (3)	-
Distal tibia	f (2)	-
Distal fibula	f	-
Distal metapodial	f	-

Note: f - fused, pf - part fused, uf - unfused.
Numbers greater than one in brackets.

Meles meles Badger

The remains of badger from Yvonand outnumber those of all other carnivores, there being 95 elements in the Horgen, 38 in the Lüscherz, 6 in the Late Bronze Age and 67 unstratified (Tables 5-7).

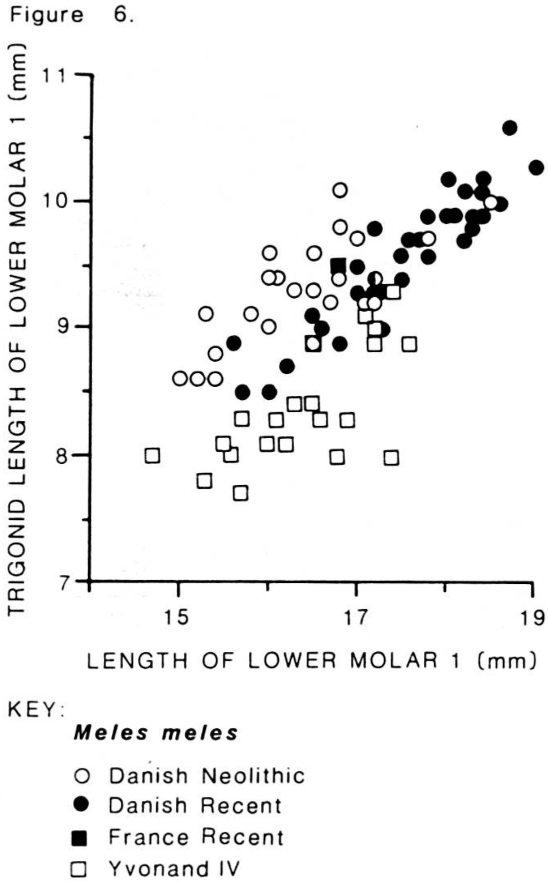
There is one nearly complete skull of a badger in the assemblage (Plate 8*d*). The back of the skull has been chopped, presumably for removal of the brain. There is also a large number of mandibles and a high proportion of complete limb bones as would be expected in a carnivore that was killed for purposes other than food. Most of the elements have fused epiphyses and are therefore from adult animals, as shown in Table 13.

Table 13: Epiphysial fusion in the limb bones of Badger (*Meles meles*) from Yvonand IV.

Bone	Numbers of bone Horgen	Lüscherz	Late Bronze Age
Proximal humerus	f (5), uf (2)	f (2)	f, uf
Distal humerus	f (12)	f (7)	f (2)
Proximal radius	f (9), uf (2)	-	f
Distal radius	f (7), uf (2)	-	f
Proximal ulna	f (9)	f (2)	f
Distal ulna	f (4), uf (2)	f	f
Distal metacarpal	f	-	-
Proximal femur	f (7), uf	f, uf	-
Distal femur	f (4)	f (2), uf	-
Proximal tibia	f (3)	f	-
Distal tibia	f (6)	f	-
Distal fibula	f (4)	-	-
Calcaneum	f	f	-

Note: f - fused, uf - unfused.
Numbers greater than one in brackets.

The microevolution of the European badger since the end of the Pleistocene has been little studied except by Degerbøl (1933) and Kurtén (1967). Degerbøl observed that the badger remains from early Holocene sites in Denmark were from animals smaller than the present day local population, which is exceptionally large. In addition he showed that there were differences in the lower carnassial tooth (M_1) between subfossil badgers and those living today. The subfossil carnassials from Denmark are smaller and more slender, whilst the heel of the tooth (talonid; see Figure 1) is small, short and narrow compared to that of the recent specimens. Degerbøl asserted that in the modern badger the carnassial has become more molariform, that is more robust and with a longer talonid.



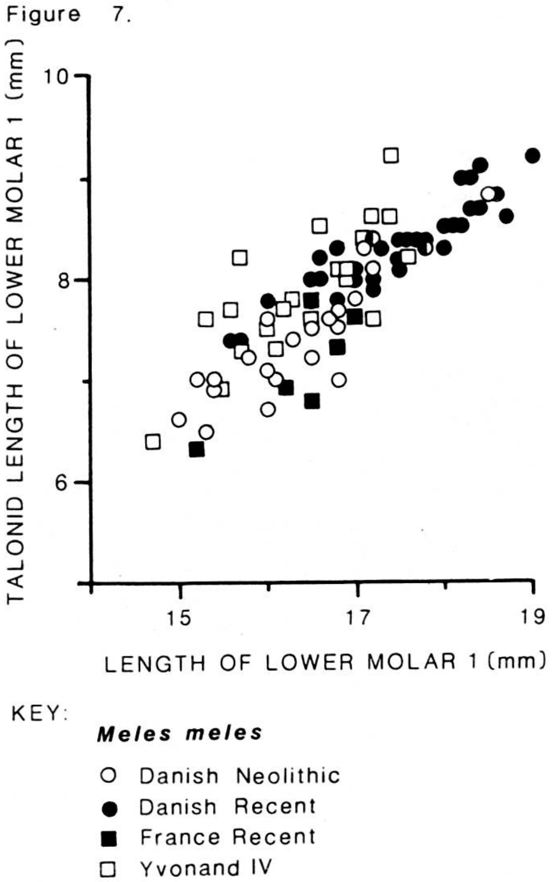


FIGURE 6.

Trigonid length plotted against length of tooth in the lower carnassials (M_1) of *Meles meles* from Yvonand IV to compare with those from the Danish Neolithic and modern samples of Degerbøl (1933) and with carnassials from France in the modern collections of the BM(NH).

FIGURE 7.

Talonid length plotted against length of tooth in the lower carnassials (M_1) of *Meles meles* from Yvonand IV to compare with those of the Danish Neolithic and modern samples of Degerbøl (1933) and with carnassials from France in the modern collections of the BM(NH).

PLATE 12.

Badger, *Meles meles,* to show exostoses on the alveolar margin of the tooth row, 2515 NSX.

In Figures 6 and 7 trigonid length and talonid length are plotted against length for the Yvonand teeth and, for comparison, the Danish Neolithic and Recent samples of Degerbøl, and five teeth of badgers from France in the collections of the BM(NH). The Yvonand teeth are of comparable length to the Danish Neolithic sample but have significantly relatively shorter trigonids and relatively longer talonids than any of the other samples. The short length of the trigonid is particularly marked.

All the mandibles from Yvonand are from adult badgers and some have very worn teeth. Only in one mandible, however, is the anterior symphysis fused, showing that it was an aged animal, and in this jaw there is a marked periodontal disease (Plate 8*e*). The labial margin of the alveolus for the lower carnassial has some osteoporosis in nearly all the mandibles which is presumably a reflection of some deleterious aspect of the diet (Plate 12). It may be of interest to note that a high proportion of the mandibles of wild badgers in the collections of the BM(NH) also show a bony expansion of the alveolar rim.

Comparison of the measurements of the limb bones of badgers from Yvonand shows that they fall within the range of those from Burgaschisee-Sud and those of modern German badgers as measured by Boessneck *et al.* (1963).

Lutra lutra Otter

Only two finds of otter have been identified from Yvonand, these being mandibular rami with teeth, one from the Horgen and one from the Lüscherz. Selected measurements of these rami are as follows:

Right ramus, Horgen: Length of tooth row 42.0 mm; length of M_1 8.1 mm. Right ramus, Lüscherz: Length of ramus 68.1 mm; length of tooth row 43.0 mm; length of M_1 8.0 mm.

The otter may never have been a very common carnivore in Switzerland. Rütimeyer (1866) reported that its remains had been found only at the lake sites of Robenhausen and Moosseedorf, whilst Fatio (1869) commented that without being rare the otter was never very abundant in Switzerland in his time, although it was to be found in some streams in the canton de Vaud.

Felis lynx Lynx

The proximal end of a femur from the unstratified levels has been identified as coming from a lynx. The bone has a proximal width of 39.1 mm. The width of the femur head is 17.6 mm and its depth is 17.8 mm.

Stampfli identified 13 elements as lynx from Auvernier-La Saunerie (1976) and a few bones of this large cat were recorded from Twann (Becker & Johansson, 1981), as well as two elements from the Lüscherz of Yverdon-Garage Martin (Chaix, 1976*b*) but as would be expected the lynx was not a very commonly hunted carnivore in Neolithic Switzerland. At the present day the lynx has been reintroduced to certain areas of the Alps after its extermination earlier this century; it was a very rare carnivore in the time of Fatio (1869) due, he claimed, to the destruction of the forests.

Felis silvestris Wild cat

Only a small number of elements of wild cat have been identified, five from the Horgen, six from the Lüscherz and six that were unstratified. None of the bones shows evidence of butchery, although the distal ends of a few of the bones may have been snapped. This could have been caused by the removal of the feet from the carcass at the time of skinning, as presumably wild cats were killed for their pelts.

PERISSODACTYLA

Equus caballus Horse

A total number of six elements have been identified as belonging to horse, from all the levels of Yvonand. Although they are so few in number these bones and teeth are of great interest because they contribute to the small number of records for horse in early prehistoric Europe. At the end of the last glaciation the wild horse was a very common ungulate throughout Europe but with the forestation of the landscape, and probably also as a result of over-hunting, the horse became very rare throughout its European range. The domestic horse was introduced into Europe during the late Neolithic period in the third millennium BC.

From Yvonand two teeth came from the Horgen period (*c.* 3077BC calibrated), an upper cheek tooth (Plate 13*a*) and an upper third incisor and it is possible that these finds represent a relic population of wild horses that survived in the Alpine region (Bökönyi, 1974 p. 240). The remaining elements, a first phalanx, from the Lüscherz, a radius and another first phalanx (Plate 13*b*) from the Late Bronze Age, and two teeth (an upper cheek tooth and a canine) from undetermined levels, are perhaps more likely to be from early domestic horses.

The finds of horses from Neolithic sites in Switzerland have been reviewed by Becker & Johansson (1981) with their description of the 47 elements of horse that were retrieved from the sites of Twann. The dimensions of the two first phalanges from Yvonand show that they fall within the same size range as the three phalanges from Twann, as shown below:

a

b

PLATE 13.

Horse, *Equus caballus:* a, upper cheek tooth, 1411 N80; b, phalanx 1 446 N20.

Phalanx 1	Length	Proximal width	Distal width
	mm	mm	mm
Yvonand-Lüscherz	78.5	49.3	38.6
Late Bronze Age (Plate 13*b*)	77.5	48.5	41.7
Twann-Cortaillod	83.0	52.2	44.0
	82.6	53.9	41.8
	76.5	50.8	40.4

The radius from the Late Bronze Age of Yvonand has a distal width of 68.3 mm and a shaft width of 35.7 mm. There are no signs of butchery on these few adult bones and teeth and there is no way of knowing for what reasons the horses were killed.

ARTIODACTYLA

Sus scrofa and *Sus domesticus* Wild boar and domestic pig

According to the numbers of elements identified as Wild boar, domestic pig, and *Sus* sp., swine were the principal meat-providing animals at Yvonand throughout the total period of the excavations (Tables 5-8). In terms of the weights of bones and teeth, however, more meat was certainly obtained from the cattle (Table 4). For Tables 4-8 see pages 71-81.

In the period just preceding the Horgen, the people of the Pfyn culture (*c.* 3200BC), as exemplified by the animal remains from Feldmeilen-Vorderfield (Forster, 1974), were keeping cattle as their main source of meat. At this site the Pfyn culture is overlain by the Horgen from where the numbers of pig remains are over 30% as compared with just over 20% in the Pfyn (Table 25, p. 60). It can be seen that in the succeeding period of the Lüscherz, at Yvonand and at other sites, the people were again more dependent on cattle. This question is considered further in the Discussion (see page 59).

The identification of bones and teeth from the Suidae is usually relatively easy compared to the task of separating small fragments of other artiodactyls and therefore there will be a slight upward bias in favour of the numbers of elements identified as swine, and a lower proportion will be included in the assemblage of unidentified fragments, but this bias does not mask the overall picture. This is that, as at other sites in Switzerland, swine predominated in the Horgen, and this supports the hypothesis first put forward by Higham (1967) that pig-keeping was the basis of this culture. Sakellaridis (1979, p. 69) made the point, however, that at some Horgen sites there are higher percentages of red deer and dog than pig, but this seems a rather strange statement as it is hard to believe that dogs were more favoured as food-animals than pigs in any period.

Distinction between the Wild boar and domestic pig in the archaeological record has, up to the present time, been based solely on the relative sizes of the bones and teeth, and a number of excellent studies have provided the parameters of size within which the two groups can be categorised. For the present report the works of Clason (1967) and Willburger (1983) have been consulted as well as other studies of animal remains from Neolithic sites in Switzerland, amongst which Boessneck *et al.* (1963) is notable for the large number of measurements published. When the initial identifications were made on the animal remains from Yvonand the bones and teeth of swine were distinguished as wild or domestic according to key measurements in comparison with those already provided in these reports for *Sus scrofa* and *Sus domesticus.* In addition the general massiveness of an element that was not measurable was taken into account. However some overlap in the measurements of certain elements ascribed to wild or domestic will be seen in the Appendix lists because these dimensions were not used in the discrimination. The measurements have been collated and summarised so they could be used in correlation with the measurements of swine from Twann (Becker & Johansson, 1981), see Appendix p. 86-92.

The taxon *Sus* sp. has been used for the bones and teeth of swine that were not distinguishable between the wild and the domestic, either because they were of intermediate size or because they were from very young animals.

As at Twann and, as in general in the archaeological record, the bones and teeth of Wild boar from Yvonand are mostly from adult animals whilst those from domestic pigs represent a high proportion of juveniles. This can be seen in Tables 14 and 15 for the stage of fusion of the epiphyses of the bones and in Table 16 for the stages of eruption and wear of the teeth. Unfortunately there were not enough teeth of wild boar from Yvonand to justify placing them in age groups but it can be seen for the much larger sample from Twann (Becker & Johansson, 1981 from Table 25 (p. 60) that 67% of the Wild boar teeth were erupted third molars (from pigs aged more than three years at death) and 33% were from younger animals. On the other hand for the domestic pigs, only 37% of the teeth were erupted third molars and 63% were from juveniles. At Yvonand approximately 80% of the teeth of domestic pigs, from all the periods, were from animals of less than three years (Table 16).

As with the identification of wild and domestic cattle there is some overlap in size between the bones and teeth of wild and domestic swine, and there are a number of explanations for this. Firstly it is probable that a certain amount of interbreeding, either intentional or otherwise, took place between the two groups, although the rather small number of specimens falling in an intermediate category (*Sus* sp. in the Tables) suggests that this was not a very common occurrence. Secondly it is probable that the bones of female Wild boars overlap in size those of male domestic pigs,

Table 14: Epiphysial fusion in the limb bones of Wild boar (*Sus scrofa*) from Yvonand IV.

Bone	Numbers of bone: Horgen	Numbers of bone: Lüscherz
Scapula tuberosity	f (6)	f (2)
Distal humerus	f (4)	f (6)
Proximal radius	f (6)	uf
Proximal ph2	f (6), uf	f
Distal metacarpal	f, uf (2)	-
Distal tibia	f (7), uf	f, uf
Proximal ph1	-	f (2)
Distal metapodial	f (6), uf (3)	f
Proximal calcaneum	f (10), uf (3)	f
Distal metatarsal	f (2)	-
Distal fibula	f (3)	-
Proximal ulna	f, uf (7)	uf (3)
Distal ulna	f, uf	-
Proximal humerus	uf (3)	-
Distal radius	f (2), uf (3)	-
Proximal femur	f (2), uf (2)	f
Distal femur	f (3), uf (4)	-
Proximal tibia	f, uf (2)	uf (2)

Note: f - fused, uf - unfused
Numbers greater than one in brackets

Table 15: Epiphysial fusion in the limb bones of domestic pig (*Sus domesticus*) from Yvonand IV.

Bone	Fusion times (from Silver, 1969)	Numbers of bone: Horgen	Numbers of bone: Lüscherz	LBA
Scapula tuberosity	12 months	f (2), uf (5)	f, pf, uf (2)	-
Distal humerus	12 months	f (15), uf (20)	f (4), uf (6)	-
Proximal radius	12 months	f (22), uf (8)	f	-
Proximal ph2	12 months	f (2), uf (2)	f, uf	-
Distal metacarpal	2 years	f, uf (3)	f, uf	-
Distal tibia	2 years	f (20), pf (3), uf (15)	f (3), pf (2), uf (4)	-
Proximal ph1	2 years	f (12), uf (3)	f (4)	-
Distal metapodial	-	f (12), uf (7)	f	uf
Proximal calcaneum	2 - $2\frac{1}{2}$ years	f (2), pf, uf (13)	f (3), uf	-
Distal metatarsal	$2\frac{1}{4}$ years	f (2)	f, uf	-
Distal fibula	$2\frac{1}{2}$ years	f (2), uf (6)	-	-
Proximal ulna	3 - $3\frac{1}{2}$ years	f (2), uf (21)	uf (6)	-
Distal ulna	3 - $3\frac{1}{2}$ years	uf (5)	-	-
Proximal humerus	$3\frac{1}{2}$ years	f (2), uf (14)	uf (2)	-
Distal radius	$3\frac{1}{2}$ years	f (2), uf (14)	uf (2)	-
Proximal femur	$3\frac{1}{2}$ years	f, uf (5)	-	-
Distal femur	$3\frac{1}{2}$ years	f, pf, uf (6)	f (2), uf	-
Proximal tibia	$3\frac{1}{2}$ years	f, uf (11)	uf (2)	-

Note: f - fused, pf - part fused, uf - unfused
Numbers greater than one in brackets

a situation that also occurs with wild and domestic cattle. This should be testable with measurements of the skulls and mandibles as these can be easily sexed from the canine teeth which have open roots in the male and closed roots in the female. Unfortunately, however, there are not enough jaws with canines left in them from any of the levels at Yvonand to make this possible, one reason being that the Neolithic people removed the tusks to use as artefacts and pendants and the front of the jaws were often smashed in the process so that the alveolus is absent as well as the tusk. Plates 14 and 15 are of mandibles of domestic pigs that can be sexed and aged according to the method of Bull & Payne (1982), as follows: Plate 14*a* Female 12-14 months. Plate 14*b* Male 14-18 months. Note the compaction of premolar 3 which is a relatively rather large tooth, and the fact that the first molar (which would have erupted at around five months) is already much worn although the third molar is still unerupted. Plate 15*a* Probably female and more than five years old, all the teeth being fully erupted and much worn. Plate 15*b* Male 19-23 months.

Table 16: Ageing of the mandibles and lower teeth of *Sus domesticus* from Yvonand IV. Isolated teeth in brackets. The ageing sequence follows that of Becker & Johansson (1981) and Bull & Payne (1982).

Stage of tooth eruption	Numbers of mandibles and teeth			
	Horgen	Lüscherz	LBA	Unstrat.
1. Dec. premolars erupted. M1 unerupted. < 4 months	11 (1)	1 (2)		5 (3)
2. M1 part erupted. 4-6 months	2			3 (1)
3. M1 erupted. M2 unerupted < 9 months	19 (1)	7 (2)	(1)	7
4. M2 part erupted 10-12 months	5	2 (2)		1
5. M2 erupted. P4 erupted M3 unerupted < 18 months	14 (4)	2 (4)		5 (2)
6. M3 part erupted 18-20 months	7 (1)	1 (2)		1
7. M3 erupted > 20 months	8	3		3
7+. M3 worn Aged	5	2 (2)		2

Butchery of the bones of both wild and domestic pigs was carried out with great care. Plate 3*a* shows a mandible of a large and aged male Wild boar from which the tusk has been removed and a piece of bone or "window" has been cut out from the horizontal ramus so that the vascular tissue lying below the teeth could be extracted. On the same Plate (3*b*) there is a mandible from a small unsexed domestic pig that has been butchered in the same way, as has each horizontal ramus photographed in Plates 14 and 15. The skull of a young domestic pig shown in Plate 5*a* has been neatly bisected whilst the two metapodials below it, from small fully-grown domestic pigs, have been carefully split so that even the smallest piece of marrow could be removed, and it must be remembered that all this butchery was carried out with stone tools, without the use of any metal.

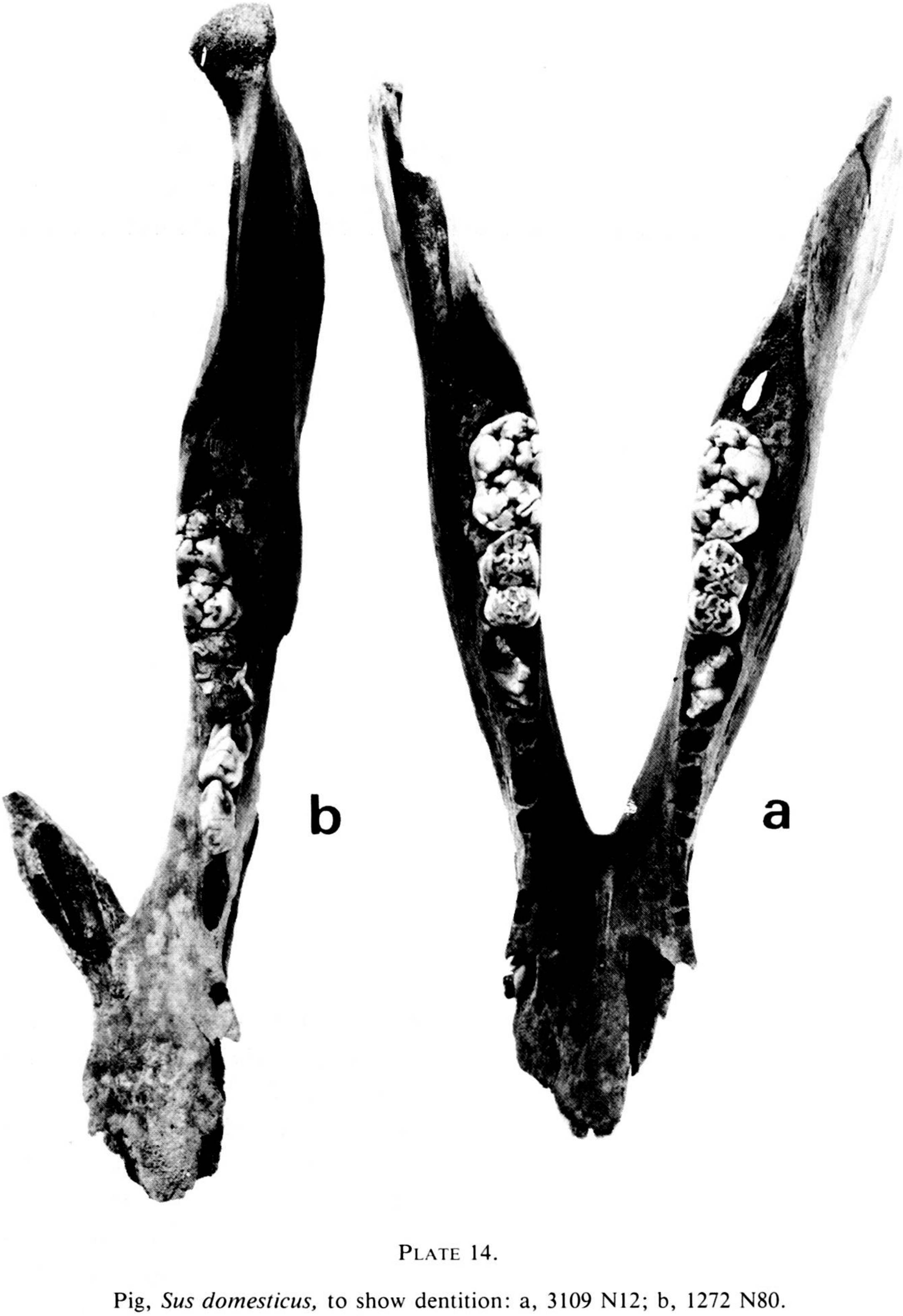


PLATE 14.

Pig, *Sus domesticus,* to show dentition: a, 3109 N12; b, 1272 N80.

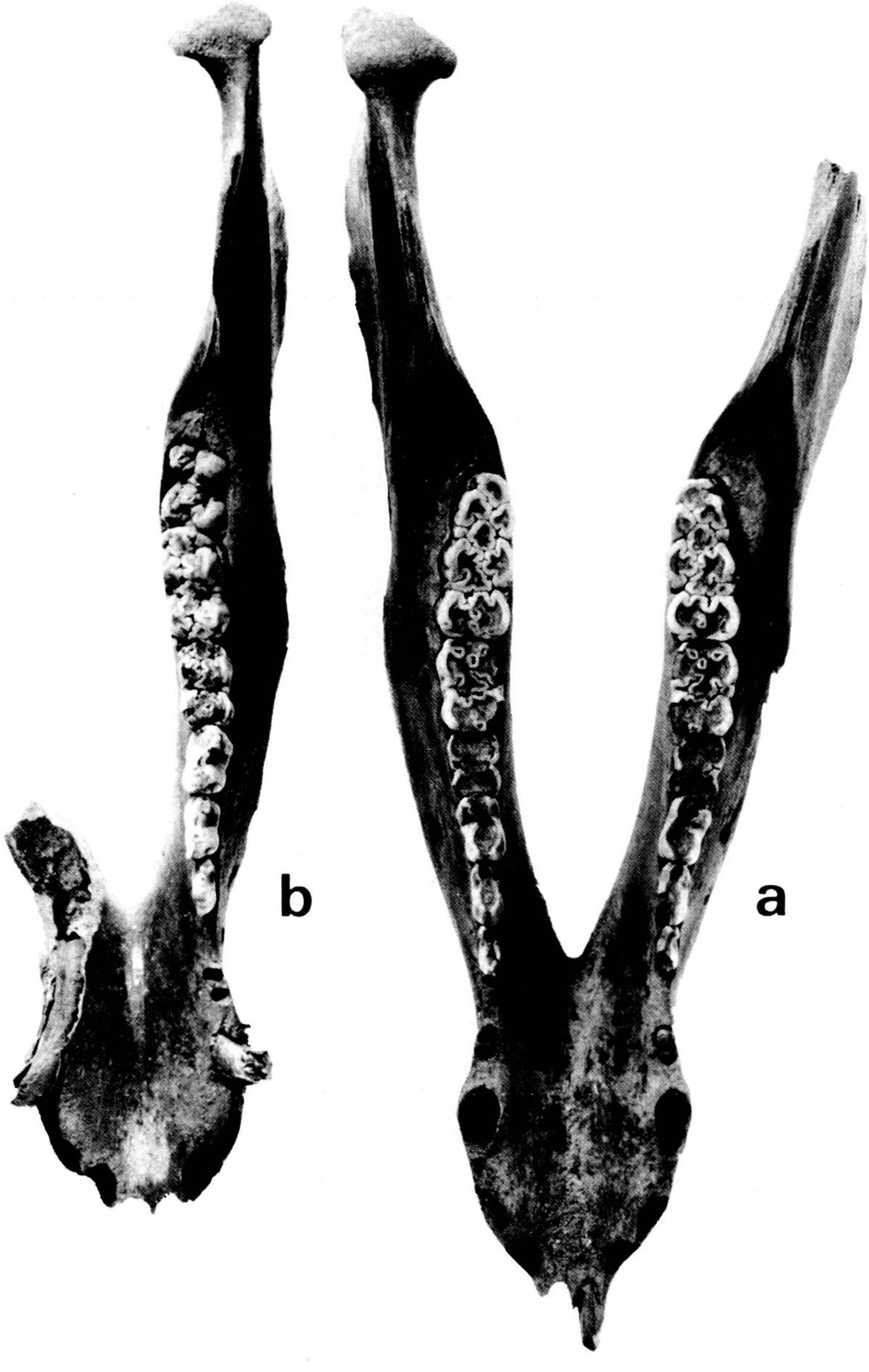


PLATE 15.

Pig, *Sus domesticus,* to show dentition: a, 953 N12; b, no number NSX.

PLATE 16.

Pig, *Sus* sp., to show pathology on scapula of very young piglet, 1522 N80.

As stated in the Introduction only a very small number of the bones and teeth from any of the levels at Yvonand show any signs of trauma or pathology. Amongst the pig bones, one right scapula from a very young piglet, shown in Plate 16, has evidence of a tumour on the posterior border of the bone.

Cervus elaphus Red deer

Red deer were the only wild animals that are present in the faunal assemblage in numbers high enough to represent a substantial percentage of the meat available to the inhabitants of Yvonand. The absolute numbers, weight, and percentages of Red deer remains in relation to those of the other taxa are given in Tables 4-8 (see p. 71-81).

Red deer would have been killed for their meat and hides, whilst their antlers were one of the most important resources available to Neolithic people throughout Europe. Antlers would have been collected from the stags each year, as they were shed, as well as being removed from stags that were killed in the hunt.

The large number of pieces of antler amongst the animal remains gives an upward bias to the numbers of Red deer represented because many of these pieces may be from shed antlers rather than from stags that were killed for their meat. However, apart from the waste from antler working (see Table 3) it is impossible to interpret why the pieces are in the assemblage which is almost entirely made up of domestic refuse. All the antler is therefore included in the tables of numbers and weights (see also the note on p. 8).

That Red deer were killed for their meat as well as for their antlers, and probably also for their hides, is evident from the butchered bones (Plate 2*b*). Many of the deer bones have been chopped and opened for the marrow in an identical way to the bones of domestic livestock.

Most of the Red deer were adult when they were killed, as can be seen from Table 17 which shows the stages of fusion of the epiphyses of the bones and Table 18 which gives the stages of the tooth eruption in the same manner as Table 47 in Becker and Johansson (1981) so that the ages of the Red deer from Yvonand can be compared with those from Twann. As at Twann it can be seen that the majority of the Red deer were fully adult, with the third molars erupted and in wear, when they were killed. The next most frequent age for slaughter was in the second year of life, when the second molar was erupted but not the third.

The selected bone measurements are given in the Appendix (p. 90-2) where the material from Yvonand is compared with the Red deer remains from Twann.

Until the present time no species of deer, except for the Reindeer *(Rangifer tarandus)* had been domesticated, probably because the temperament and behaviour patterns of the Cervidae do not conform with the attributes necessary for a symbiotic relationship with humans and they will not breed well when held in close captivity.

Table 17: Epiphysial fusion in the limb bones of Red deer (*Cervus elaphus*) from Yvonand IV.

Bone	Numbers of bone Horgen	Lüscherz	LBA
Distal ph1	pf	-	-
Scapula	f (2)	f	-
Distal humerus	f (7), uf	f (6)	-
Proximal radius	f (5)	f (2)	f
Distal radius	f (4), uf (2)	f, uf	-
Proximal ulna	uf (2)	uf (2)	-
Distal metacarpal	f (9), uf	f (3), uf (2)	-
Proximal femur	f	f	-
Distal femur	f (2), uf	-	-
Proximal tibia	uf	f	-
Distal tibia	f (10)	f (9), uf	-
Proximal calcaneum	f (2), uf(2)	f (4), uf	-
Distal metatarsal	f (7), uf (9)	f (5)	-
Distal metapodial	f	f	-
Proximal ph1	f (21)	f (9), uf	-
Proximal ph2	f (4), uf	f (6)	-

Note: f - fused, pf - part fused, uf - unfused
Numbers greater than one in brackets.

Table 18: Ageing of the mandibles and lower teeth of *Cervus elaphus* from Yvonand IV. Isolated teeth in brackets. The ageing sequence follows that of Becker & Johansson (1981).

Stage of tooth eruption	Numbers of mandibles and teeth Horgen	Lüscherz	LBA	Unstrat.
1. Dec. premolars part erupted < 2 months				
2. Dec. premolars erupted 2-5 months	1	(1)		2
3. M1 part erupted 4-5 months				1
4. M1 erupted 5-12 months		1	(1)	1
5. M2 part erupted 11-12 months				1
6. M2 erupted 12-24 months	(2)	(4)		2 (3)
7. M3 part erupted Premolars in change 24-28 months		2		2 (1)
8. M3 erupted Premolars erupted 27-30 months	5 (1)	1 (4)	(1)	2 (5)
8+. M3 worn Adult		1		

However the species of deer have all been exploited by humans in a number of different ways and the Red deer in particular has been consistently hunted for many thousands of years. In the early prehistoric period the Red deer was the principal source of meat on almost all archaeological sites throughout Europe (Jarman, 1972) and the value of the antlers has already been stated.

The Red deer is an inhabitant of deciduous woodland and woodland-edge, and its natural range covers the whole of Europe, southern Asia, and North America (where it is called the Wapiti or Elk). This ubiquitous and successful deer has been able to survive severe hunting pressures without undue restriction of its range, since the end of the Pleistocene. In Switzerland Fatio (1869) claimed that it had prospered in the country until about 80 years previously when the deer had begun to dwindle in numbers until in Fatio's time there were very few wild animals remaining. It is probable that in Neolithic Switzerland Red deer abounded in all the deciduous woodland areas which would have included the lake shores.

Capreolus capreolus Roe deer

The number of fragments of bones of Roe deer in the total assemblage will be somewhat higher than the 141 elements that have been identified with certainty. There will be further elements within the category of small ruminant, because they could not be distinguished from bone fragments of sheep and goat, and as with all the other taxa there will be Roe deer bone with the unidentified fragments (Tables 4-8).

Table 19 Epiphysial fusion in the limb bones of Roe deer (*Capreolus capreolus*) from Yvonand IV.

Bone	Numbers of bone		
	Horgen	Lüscherz	LBA
Proximal humerus	-	f	-
Distal humerus	f (2)	f (5)	-
Proximal radius	f (6)	f (3)	-
Distal radius	f	-	-
Proximal ulna	f (2), uf	f (2), uf	uf
Distal metacarpal	-	uf	-
Proximal femur	f	f (2)	-
Distal fęmur	-	f (3)	-
Proximal tibia	f	-	-
Distal tibia	f (3)	-	-
Proximal calcaneum	f	-	-
Distal metatarsal	f (2), uf	f	-
Proximal phl	-	f (3)	-

Note: f - fused, uf - unfused
Numbers greater than one in brackets

Table 19 shows that only a very small number of the bones were identified as immature (that is with unfused epiphyses) and even with the additional number that will be included amongst the small ruminant category it is probable that the remains are those of deer that were hunted for their meat and possibly also for their hides

PLATE 17.

a, Sheep/goat, *Ovis/Capra,* right mandibular ramus, 737 NSX. b, Roe deer, *Capreolus capreolus,* right mandibular ramus, 1633 N80.

PLATE 18.

Roe deer, *Capreolus capreolus,* skull with deformed base of antler, 476 NSX.

and antlers. Plate 17 shows the right mandibular ramus of an adult Roe deer to compare with that of a sheep or goat. Plate 18 shows the posterior view of a skull of a Roe deer stag in which both antlers had been damaged during life. The antlers appear to have been broken off near to the pedicle whilst still in the period of growth. The left antler failed to grow any further, possibly because the burr was damaged, but the right antler grew abnormally downwards for about 4 cm and it was then rebroken, either before or after the animal's death. The antlers of deer can be broken or damaged during the rut when the stags are fighting, or it is conceivable that this was a captive animal whose antlers were cut off by its human owner to prevent it becoming a troublesome pet. A third alternative to be considered is that the antlers in velvet were removed for some medicinal or other purpose, as is common in eastern Asia at the present day.

In the Appendix (p. 92-3) summaries are given of selected bone measurements for comparison with the remains of Roe deer from Twann. The report of Becker & Johansson (1981, Table 3) shows that at Twann Roe deer was represented in approximately the same proportionate numbers as at Yvonand, that is only between two and four percent of the total assemblage which is slightly lower than the proportion for domestic sheep and goat.

Bos primigenius and *Bos taurus* Aurochs and domestic cattle

The remains of cattle greatly outweigh the remains of all other taxa from Yvonand (Table 4). However, in terms of the numbers of elements and minimum numbers of individuals the cattle fall below those of swine, *Sus scrofa* and *Sus domesticus,* from the site as a whole (Tables 5 and 8). When the assemblage is divided into the separate periods it is seen that cattle are nearly equal with swine in the Lüscherz but are markedly fewer in numbers in the Horgen. Thus in the earlier period there may well have been a concentration of pig herding whilst by the Lüscherz, cattle-keeping had become dominant. These counts accord well with other lake sites of the Horgen and Lüscherz periods where swine-keeping is seen to be a characteristic of the Horgen (Sakellaridis, 1979, p. 51; Higham, 1967).

Tables 20 and 21 indicate that there is no uneven distribution in the age classes of the domestic cattle remains. Very few bones and teeth are from calves of less than one year, and most of the unfused bones come from young animals of between 18 months and 3 years which is the optimum age of slaughter for meat. However most of the bones of domestic cattle are fully fused (69%) and therefore from animals of more than 3 years which agrees with information on the age of cattle from other sites (see Becker & Johansson, 1981, Tables 19, 20, Fig. 31).

Most of the bones identified as *Bos primigenius* are from adult animals (Table 22). No positive evidence was found for the presence of Bison at Yvonand, using the osteological characters described by Boessneck *et al.* (1963), and on which

Table 20: Epiphysial fusion in the limb bones of domestic cattle (*Bos taurus*) from Yvonand IV.

Bone	Fusion times (from Silver, 1969)	Numbers of bone Horgen	Lüscherz	LBA
Scapula tuberosity	7 - 10 months	f, pf, uf	f (2)	-
Distal humerus	12 - 18 months	f (5), pf (2), uf (2)	f (3)	-
Proximal radius	12 - 18 months	f (11), uf (2)	f (8)	f
Proximal ph1	18 months	f (17), uf (3)	f (8), uf(3)	f
Proximal ph2	18 months	f (10), uf (2)	f (7)	f (2
Distal metacarpal	2 - $2^1/_2$ years	f (8), uf	f (3), pf, uf (2)	-
Distal tibia	2 - $2^1/_2$ years	f (11), uf (3)	f (5), uf (2)	-
Distal metatarsal	$2^1/_4$ - 3 years	f (7), uf (8)	f (5), uf (2)	f
Distal metapodial	-	uf	-	-
Proximal calcaneum	3 - $3^1/_2$ years	f (5), uf (6)	f (4), uf	-
Proximal femur	$3^1/_2$ years	f (3), uf (2)	f, uf (3)	-
Distal femur	$3^1/_2$ years	f (3), uf	f, uf (3)	-
Proximal humerus	$3^1/_2$ - 4 years	pf	-	-
Distal radius	$3^1/_2$ - 4 years	f (2), uf (3)	uf	-
Proximal ulna	$3^1/_2$ - 4 years	f, uf	-	-
Proximal tibia	$3^1/_2$ - 4 years	f, pf, uf (5)	f (3), uf	-

Note: f - fused, pf - part fused, uf - unfused
Numbers greater than one in brackets.

Table 21: Ageing of the mandibles and lower teeth of *Bos taurus* from Yvonand IV. Isolated teeth in brackets. The ageing sequence follows that of Becker & Johansson (1981).

Stage of tooth eruption	Numbers of mandibles and teeth Horgen	Lüscherz	LBA	Unstrat.
1. Dec. premolars unerupted < 3 weeks				(1)
2. Dec. premolars erupted < 3 months	3 (3)	1		4 (1)
3. M1 part erupted 4-6 months	4 (2)	1		1
4. M1 part erupted 7-14 months	1 (2)	(1)		5 (1)
5. M2 part erupted 15-18 months	1 (6)	(5)		(3)
6. M2 erupted M3 unerupted 19-24 months	(1)	2 (3)	(1)	3
7. M3 part erupted P3 in change 25-28 months	2 (4)	(2)		2
8. P3/P4 in change 29-34 months	(2)	(1)		1
9. M3 and Premolars erupted Over 3 years	2 (15)	3 (21)		1 (13)
9+. M3 worn Aged	1 (1)	1 (2)		(1)

these authors identified a few elements as Bison from Burgaschisee-Sud. In view of the many finds of Bison at other Swiss Neolithic sites it is probable that some of the Yvonand large cattle bones and teeth are from this wild bovid but the majority are certainly *Bos primigenius.*

Table 22: Epiphysial fusion in the limb bones of Aurochs (*Bos primigenius*) from Yvonand IV

Bone	Numbers of bone Horgen	Lüscherz	LBA
Proximal ph1	f (11), uf	f (4)	f
Proximal ph2	f (9)	-	-
Distal metacarpal	f (3)	uf	-
Distal tibia	f, uf	f	-
Distal metatarsal	f, uf	f	-
Distal metapodial	uf	-	-
Proximal calcaneum	f (3), uf	uf (3)	-
Proximal femur	f	-	-
Distal femur	f, uf	uf	-
Proximal ulna	f (3)	-	-
Proximal tibia	f, uf	uf	-

Note: f - fused, uf - unfused
Numbers greater than one in brackets

Distinction between the wild and domestic cattle on the Swiss sites, as with the swine, has to be based on the arbitrary divisions of large and small size. This cannot be definitive because the bones of large domestic bulls will overlap those of wild cows, and it is also possible that some interbreeding took place, either unintentionally or by intent of the Neolithic farmers, between the wild and the domestic herds.

The overall measurements of selected cattle bones are given in the Appendix (p. 93-7) to show the whole range in size in comparison with those from Twann.

The horn cores and frontal of *Bos taurus* in Plate 19 show that the domestic cattle were small with the typical horn shape of the Neolithic period throughout Europe. From the flattened shape of the horns it is probable that this animal was a small adult bull (Armitage & Clutton-Brock, 1976).

Plate 20 shows the range in size of the humeri and metacarpals of *Bos primigenius* and *Bos taurus* as do the phalanges in Plate 21.

The extensive exostoses of the phalanx in Plate 21*d* and the malformation of the distal end of a metatarsal in Plate 22*b* suggest that the cattle may have been used as draught animals, either for carrying loads or for ploughing. Plate 22*a* is a very large proximal end of a *Bos primigenius* metatarsal.

Plate 23 shows three mandibles from adult domestic cattle; 23*a* is from a very aged animal. All three mandibles have been butchered in the standard way by removing a piece of bone so that the little bit of marrow underlying the teeth could be extracted.

The only complete limb bone of cattle in the entire assemblage from Yvonand is a single metatarsal bone (length 208.1 mm, giving an estimated withers height of 110.9 cm). It is therefore not possible to calculate the withers heights of either the

PLATE 19.

Domestic cattle, *Bos taurus*, frontlet with horn cores, 1524 NSX.

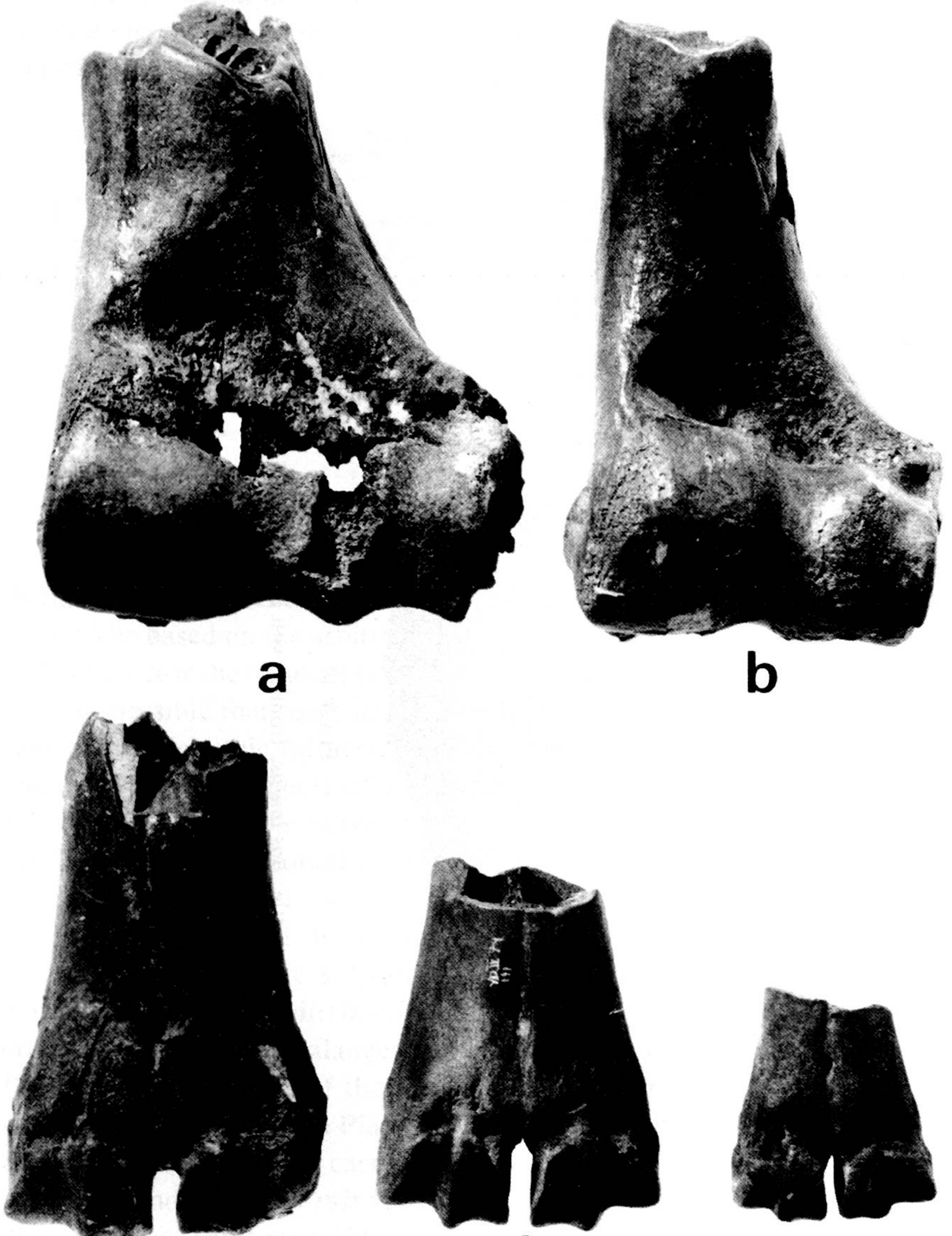


PLATE 20.

Aurochs, *Bos primigenius:* a, and b, distal ends of left humeri, 4 N60 and 1785 N80; c, distal end of metacarpal 1415 N80; d, Aurochs/domestic cattle, *Bos primigenius/Bos taurus,* distal end of metacarpal, 1204 NSX; e, domestic cattle, *Bos taurus,* distal end of metacarpal, 1218 NSX.

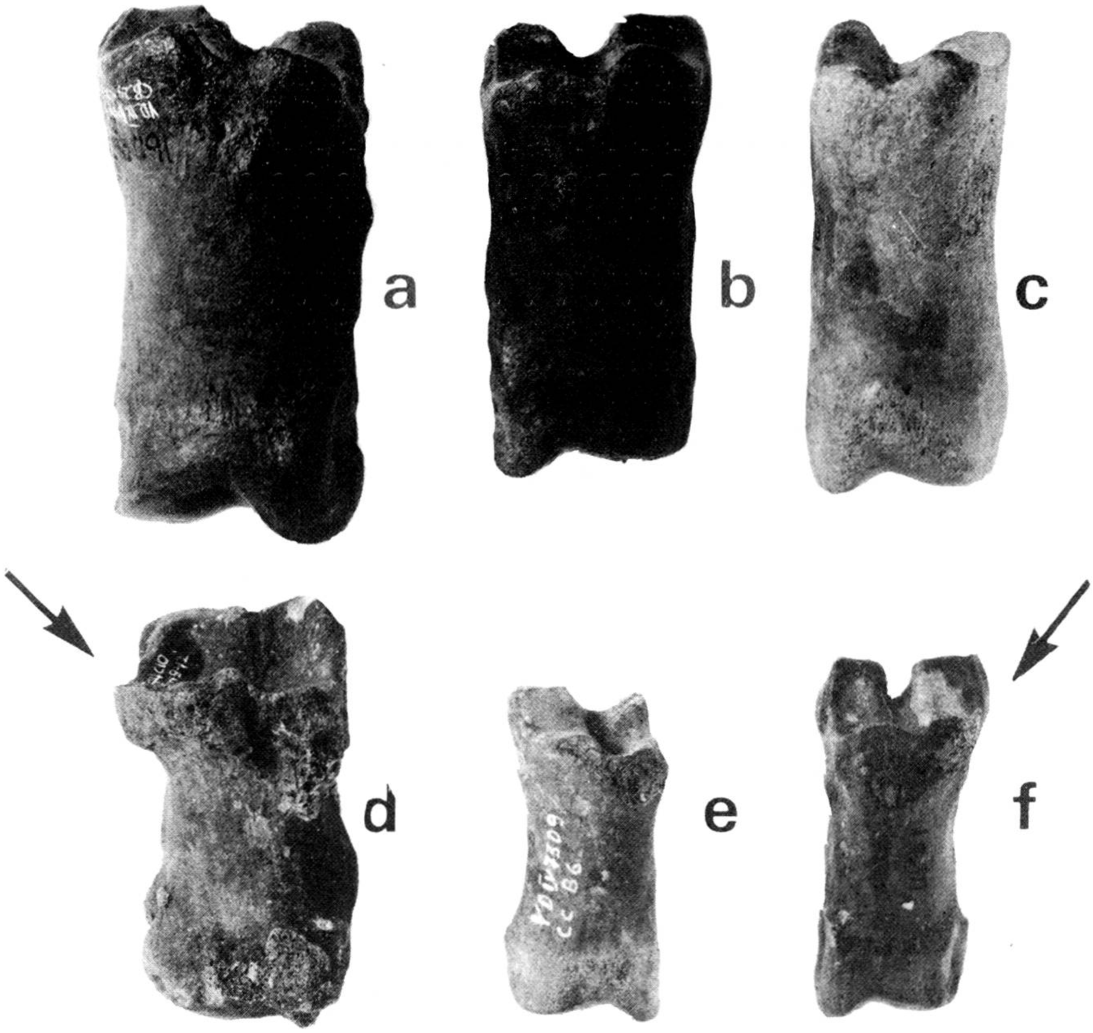


PLATE 21.

Aurochs, *Bos primigenius,* phalanx 1 (fore): a, probably male, 1609 N80; b, and c, probably female, no number NSX and 1074 N60. Domestic cattle, *Bos taurus:* phalanx 1; d, with extensive exostoses (arrowed), 399 N60; e, (fore) 1076 N60; f, (hind) slightly splayed (arrowed), 1431 N80.

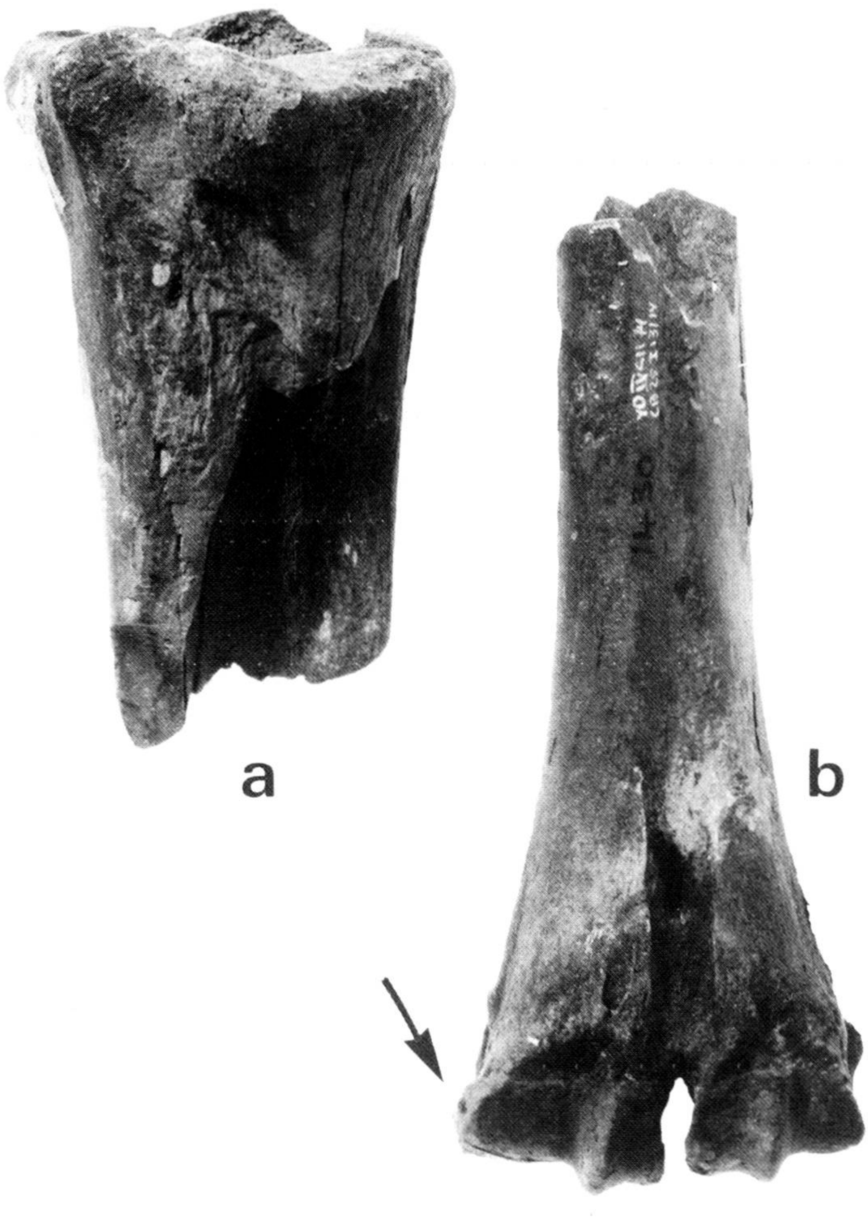


PLATE 22.

Aurochs, *Bos primigenius;* a, proximal end of metatarsal, 3 N60. Domestic cattle, *Bos taurus,* distal end of metatarsal to show exostoses (arrowed), 1430 N80.

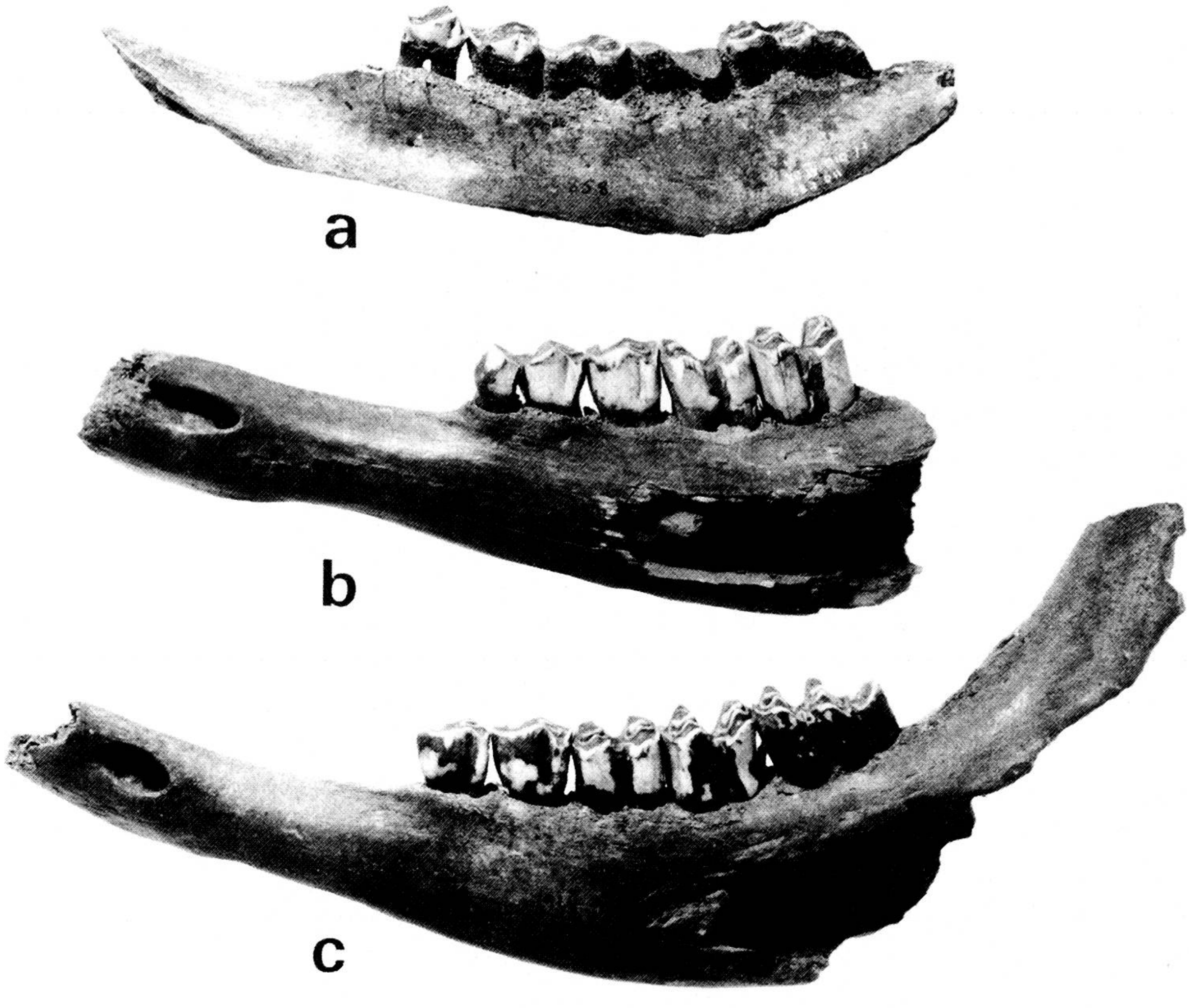


PLATE 23.

Domestic cattle, *Bos taurus,* to show butchery of the mandibular rami (left): a, 858 N40; b, 1422 N80; c, 1914 N80.

Bos primigenius or the *Bos taurus*. However the measurements do show that the range in sizes is similar to that of Twann where the withers heights ranged from 96.4-121.2 cm for the domestic cattle from the Cortaillod, and 110.9-114.4 in the Horgen.

Sexing of the bones was not attempted as there were not enough measurable elements to indicate bimodal distributions within the groups identified as *Bos taurus* and *Bos primigenius.* There is no way of knowing whether cow's milk formed an important part of the Neolithic economy in Switzerland. Claims such as that of Barker (1985, p. 120) that, because at St Aubin and Twann-Bahnhofer cattle and sheep were killed either in the first six months or as mature animals, this strongly suggests a dairying system, are very dubious. Except with highly improved cattle, if the calf is killed before weaning the mother's milk will dry up and in no primitive community is there a tradition of the routine killing of sucking calves. If the cow is milked then the milk is shared between the family and the calf. On the other hand the mortality of young animals can be high as a result of natural causes such as starvation of the mother during a hard winter, or the calves and lambs may be killed for meat in a non-dairying community. In either case it is improbable that milk had become the very important component in the diet that it is today in Switzerland and other parts of northern Europe.

Capra hircus and *Ovis aries* Domestic goat and sheep

The goat and sheep remains from Yvonand are presented under four categories in the Tables, and in addition there will be fragments of bone from these taxa amongst the unidentified elements. The categories are: goat, sheep, goat/sheep, and small ruminant, these groups being made necessary by the difficulty of separating small fragments of bone into goat and sheep, and the further difficulty of distinguishing undiagnostic pieces from Roe deer. The goat and sheep remains, within these categories, make up 6.8% of the total assemblage from all the levels at Yvonand (Table 5), which compares with 2.8% for the Roe deer, an animal that would have produced about as much meat as a goat or sheep.

The small percentage of goat and sheep remains from Yvonand, compared to that of the other domestic livestock, pigs and cattle, must be due to a number of factors, both environmental and economic. Presumably there was still fairly dense woodland around the shores of Lake Neuchâtel during the Neolithic period, although this may have decreased in favour of pasture-land by the Lüscherz, and woodland is not suitable for the keeping of large numbers of caprines. At this period goats and sheep were still in a primitive stage of domestication in central and northern Europe and they were not the efficient suppliers of meat, milk, and tallow that they were later to become. Also, it is improbable that wool was used to any great extent for clothing during the Neolithic although the higher percentage of sheep at Auvernier-La Saunerie may imply that the inhabitants of this site were using wool

Table 23: Epiphysial fusion in the limb bones of sheep/goat (*Ovis aries/Capra hircus*) from Yvonand IV.

Bone	Fusion times (from Silver, 1969 for sheep)	Numbers of bone Horgen	Lüscherz
Distal metacarpal	18 - 24 months	f (3), uf (3)	f
Distal tibia	18 - 24 months	f (3)	f (2)
Distal metatarsal	20 - 28 months	uf (6)	uf
Proximal ulna	$2^1/_2$ years	uf	uf
Proximal calcaneum	$2^1/_2$ - 3 years	f (2), uf (3)	f (2)
Distal radius	3 years	f, uf	f (3), uf (3)
Proximal humerus	3 - $3^1/_2$ years	uf (2)	-
Proximal tibia	3 - $3^1/_2$ years	f	f, pf

Note: f - fused, pf - part fused, uf - unfused
Numbers greater than one in brackets

Table 24: Ageing of the mandibles and lower teeth of *Capra/Ovis* from Yvonand IV. Isolated teeth in brackets. The ageing sequence follows that of Becker & Johansson (1981).

Stage of tooth eruption		Numbers of mandibles and teeth Horgen	Lüscherz	LBA	Unstrat.
1. Dec. premolars erupted. Permanent premolars unerupted 1-2 months	1-2 months	2			2 (4)
2. M1 part erupted 3 months		1	1		2
3. M1 erupted M2 unerupted 4-8 months	3-9 months	4 (3)	2 (2)	(1)	4
4. M2 part erupted 9 months		4 (1)	1		1
5. M2 erupted M3 unerupted 10-17 months	10-24 months	2 (3)	1 (6)		2 (2)
6. M3 part erupted Premolars in change 18-24 months			1		1 (1)
7. M3 erupted Over 3 years	> 28 years	3 (2)	1 (1)		2 (1)
7+ M3 worn Aged		1			

(Table 25). Certainly by the late Bronze Age at Yvonand, spinning must have become widespread although the wool would have been plucked from the sheep in the Spring as the fleece was shed, rather than being shorn. There is a significant increase in the numbers of sheep from the Lüscherz at Yvonand over the number of goats which

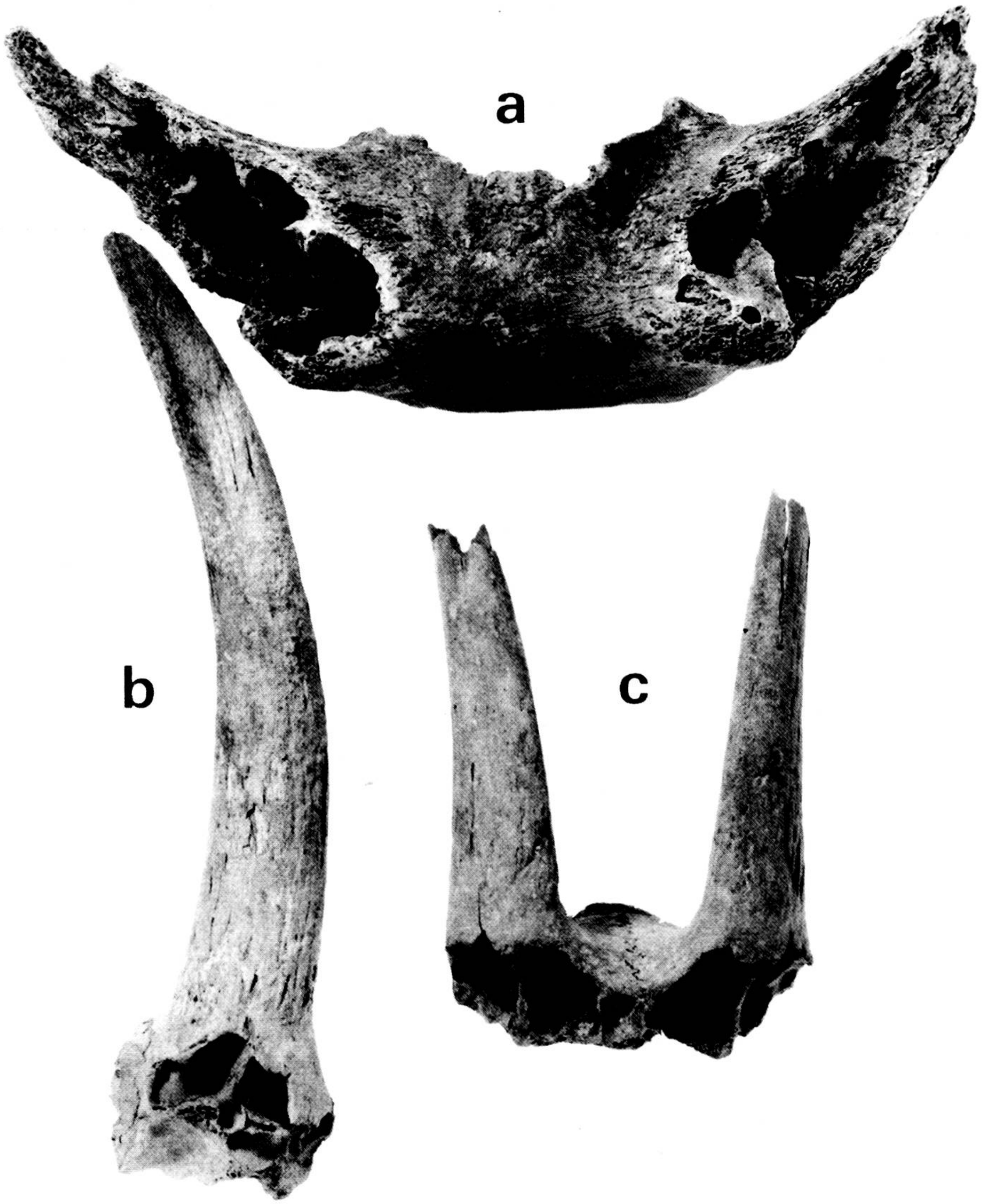


PLATE 24.

Domestic sheep, *Ovis aries,* frontlet and horn cores: a, 14 N80. Domestic goat, *Capra hircus:* b, horn core 681 N80; c, frontlet and horn cores, 4425 NSX.

could be connected with the collection of wool but it is more likely to be a reflection of clearance of the land. As pasture was opened up, perhaps as a result of the foraging of the very large number of pigs kept by the inhabitants during the Horgen period, sheep would become more successful as grazing livestock in comparison with goats which are essentially browsers.

The domestic caprines at Yvonand were very small animals that would have differed little from their wild progenitors except in their diminished size. The sheep would have resembled the present day Soay breed (feral sheep from the islands of St Kilda, Scotland) and were smaller than the European Mouflon. The back of a skull of a ram from Yvonand with the bases of the horn cores is shown in Plate 24 whilst the horn cores of two goats, which were also very small animals, are shown in this Plate as well. Summaries of certain measurements of the caprines are given in the Appendix (p. 97).

As is usual with domestic animals a high proportion of the sheep and goat remains are from juvenile animals, as shown in Table 23 for the states of epiphysial fusion of the bones. Table 24 shows the stages in eruption of the teeth and it can be seen that more than half of the caprines at Yvonand were killed at nine months old or younger (57%).

Discussion

Study of the animal remains from the excavation at Yvonand IV substantiates what is known of the Horgen and Lüscherz cultures from previous reports and from the extensive review of Sakellaridis (1979). Materials from the Late Bronze Age levels was too limited for analysis to reveal any new information on this period. In Table 25 the absolute numbers and percentages of the bones and teeth of the primary food animals are presented together with those from a selection of other late Neolithic sites and it can be seen that as at these sites the economy of Yvonand was based on cattle and pigs supplemented with meat obtained from hunted animals. In Tables 26 and 27 the taxa represented by the numbers of elements and their weights are expanded to include all the taxa used for the supply of meat from the Horgen and Lüscherz. From a count of the numbers of the identified elements it appears that domestic pigs are represented by nearly 36% of the total during the Horgen and that this is reduced to 25% in the Lüscherz (Table 26). However, if the weights of bone for each taxon are compared as in Table 27 it can be seen that pigs are represented by 10.6% of the total weight and cattle by 45.8% (*Bos taurus* and cow size) in the Horgen, whilst in the Lüscherz the proportions are 6.9% for pig and 51.6% for cattle. These figures support the findings from other sites that pigs were important in the Horgen but that cattle (and also sheep and goats) increased in relative numbers in the Lüscherz. The most ready explanation for this change is that it was correlated with phases of forest growth and then clearance.

Table 25: Absolute numbers and percentages of elements of the principal food animals from Swiss Neolithic sites to compare with YVONAND IV

Taxon	Burgäschisee-Sud[1]		Twann[2]		Feldmeilen-Vordenfeld[3]						Yvonand IV						Auvernier La Saunerie[4]	
	Late Cortaillod		Cortaillod		Pfyn		Horgen		Horgen		Lüscherz		Late Bronze Age		All periods		Auvernier	
	no.	% of total	no.	% of total	no.	% of total	no.	% of total	no.	% of total	no.	% of total	no.	% of total	no.	% of total	no.	% of of total
Sus scrofa	1875	9.3%	4954	7.7%	71	1.6%	56	1.2%	211	8.5%	64	6.9%	-	-	350	7.0%	130	1.1%
Sus dom.	243	1.2%	6137	9.6%	977	22.6%	1556	32.5%	802	32.2%	269	29.1%	3	7.1%	1340	26.7%	4183	34.4%
C. elaphus	9948	47.8%	24,607	38.2%	599	12.9%	1059	22.2%	345	13.9%	185	20.0%	8	19.0%	838	16.7%	417	3.4%
Bos prim/Bison	2021	10.2%	339	1.0%	-	-	2	0.04%	152	6.1%	54	5.9%	1	2.4%	240	4.8%	63	0.5%
B. taurus	365	1.9%	15,209	23.6%	2,238	51.8%	1054	22.1%	409	16.4%	276	29.9%	15	35.7%	947	18.8%	1902	15.7%
Capra/Ovis	224	1.1%	4957	7.7%	273	6.3%	188	3.9%	119	4.8%	75	8.1%	3	7.1%	285	5.7%	1937	15.9%

Note :
1. From Boessneck et al, 1963
2. From Becker & Johansson, 1981
3. From Förster, 1974
4. From Stampfli, 1976

Table 26: Absolute numbers and percentages of elements of the principal meat-producers from the Horgen and Lüscherz of Yvonand IV.

	Horgen		Lüscherz	
	No.	%	No.	%
Sus scrofa	211	9.4	64	6.0
Sus dom.	802	35.8	269	25
Sus sp.	103	4.6	70	6.5
C.elaphus	345	15.4	185	17.2
Capreolus	43	1.9	40	3.7
Bos prim.	152	6.7	54	5.0
Bos taurus	409	18.3	276	25.7
Large rum.	32	1.4	30	2.8
Sheep/goat	119	5.3	75	7.0
Small rum.	23	1.0	9	0.8

Table 27: Absolute weights and percentages of elements of the principal meat-producers from the Horgen and Lüscherz of Yvonand IV.

	Horgen		Lüscherz	
	Wt. in gm	%	Wt. in gm	%
Sus scrofa	7875	5.6	2320	4.3
Sus dom.	14715	10.6	3720	6.9
Sus sp.	1320	0.9	1475	2.7
C.elaphus	13835	9.9	5110	9.5
Capreolus	495	0.3	430	0.8
Bos prim.	20055	14.4	6010	11.2
Bos taurus	21609	15.5	13330	24.9
Large rum.	1435	1.0	1560	2.9
Sheep/goat	1380	0.9	705	1.3
Small rum.	145	0.1	165	0.3
Cow size	42165	30.3	14305	26.7
Sheep size	14060	10.1	4390	8.2

The Horgen people with their pigs may have preferred sites where there was an abundance of mixed oak woodland and when this was reduced, perhaps in part as a result of activity by the pigs, the Lüscherz culture, with a greater dependence on cattle, took over.

Although the numbers of elements in the faunal assemblage from Yvonand is large, with more than 5000 elements individually categorised, the 29 taxa represented, divided between the four phases, Horgen, Lüscherz, late Bronze Age and undifferentiated, means that there are rather few elements for each part of the skeleton, for each taxon. Therefore it has not been possible to make general deductions about the practices of livestock husbandry and patterns of slaughter. Neither is it possible to make claims from the animal remains about the length of occupation of the site during the different periods nor whether habitation was seasonal or continuous. The archaeological evidence indicates, however, that occupation during the Horgen was spread over about 150 years and that the Lüscherz extended over 200 years, and it seems reasonable to assume that during this time there was a mixed farming economy on the narrow band of pasture land between the lake and the forest.

As no study of the bird and fish remains has been included, this report cannot provide a comprehensive account of the meat resources but it is evident that wild animals played a major role in the economy. Whether hunting was a necessity because there was not enough grazing land to support sufficient livestock or whether it was merely an enjoyable pastime is impossible to determine but hunted animals certainly provided a high proportion of the meat, with 33% of the identified elements in the Horgen and 32% in the Lüscherz being from wild ungulates.

As at all prehistoric sites butchery and fragmentation of the bones of both wild and domestic animals indicates that marrow was a most highly valued resource and indeed it is probable that it was the major source of animal fat, not only as an essential part of the diet, but also for lighting and the softening of leather. The question of whether marrow was supplemented, as a source of fat, by milk products from domestic cows, ewes and nanny goats cannot be decided from the animal remains at Yvonand.

The mixed oak and beech forests inland from the lake shore must have supported large populations of Wild boar, Red deer and wild cattle, both Aurochs and Bison. Killing these animals, as well as the carnivores that preyed upon them, probably presented no great problems to the humans who had inherited traditions and strategies to aid them in the ancient lores of hunting.

No Bison remains have been identified from Yvonand but this does not mean that these cattle were absent from the forests. The separation of wild *Bos* and *Bison* is extremely difficult without a large series of elements and further study may reveal that bison is represented in the assemblage, or it may be that only the Aurochs was hunted at this particular site. In other respects the proportions of domestic livestock, dogs, and wild animals at Yvonand in the Horgen and Lüscherz reflect what has been found at other lake shore sites, as summarised by Sakellaridis (1979).

The exceptionally well-preserved animal remains from Neolithic sites on the shores of the Swiss lakes continue to provide unique material for the study of faunal history in Europe at a period when the impact of human activity becomes evident in every palaeontological record. Domestic livestock were taking over the available pasture and wild ungulates were increasingly hunted, probably not only for meat but also because they raided valuable crops. All wild animals were becoming reduced in numbers and at least some interbreeding took place between wild and domestic pigs and between wild and domestic cattle. The domestic dog was ubiquitous, sheep and goats, originally exotics from western Asia, were rapidly moving north with the clearance of forests, and the killing of wild carnivores was changing the balance of predators with their prey. Considering this onslaught on the natural world, which has continued remorselessly for the last 5000 years, it is remarkable that, of all the species represented at Yvonand, only the Aurochs has been totally exterminated. Surely it is an irony that the Aurochs' descendant, the domestic cow, is probably the most economically important of all domestic animals, worldwide, today.

CONCLUSIONS

Les études concernant les restes d'animaux découverts à Yvonand IV étayent les connaissances publiées antérieurement au sujet des cultures de Horgen et de Lüscherz, ainsi que les résultats de la revue exhaustive (compilation) élaborée par Sakellaridis (1979). Le matériel provenant des niveaux de l'Age du Bronze final était trop pauvre pour apporter de nouvelles informations pour cette période. Le tableau 26 présente les nombres absolus et les pourcentages des os et des dents des principaux types d'animaux destinés à l'alimentation, en comparaison avec ceux d'un choix d'autres sites du néolithique final. Il démontre que l'économie de l'ensemble des sites en question était basée sur l'élevage des bovidés et des porcs, complétée par la chasse. Les taxons figurant sur les tableaux 26 et 27, représentés par le nombre des éléments recueillis et leur poids, sont associés aux différents genres et espèces utilisés pour l'alimentation et retrouvés dans les niveaux de Horgen et de Lüscherz. Le comptage des éléments identifiés révèle que le porc domestique représente presque 36% de la consommation de viande pendant la période de Horgen et que ce pourcentage se trouve réduit à 25% pour la période de Lüscherz (cf. tabl. 26). En revanche, si l'on compare le poids des os de chaque taxon, on peut conclure qu'à Horgen le pourcentage du porc s'élève à 10,6% du total (cf. tabl. 27) et celui des bovidés à 45,8%. (*Bos taurus* et bovidés de la taille d'une vache); Lüscherz par contre révèle respectivement 6,9% de porc et 51,6% de bœuf. Ceci confirme les constatations qui ont été faites sur d'autres sites, à savoir que le pourcentage du porc était important durant la période de Horgen, tandis que la part des bovidés (y compris le mouton et la chèvre) augmentait pendant la période de Lüscherz. L'explication la plus cohérente pour ce changement consiste à le mettre en rapport avec une phase d'expansion forestière, suivie de défrichements.

Il est probable que les populations de l'époque de Horgen s'établissaient avec leurs porcs de préférence dans des régions où ils trouvaient une bonne forêt de chênaie mixte. Lorsque la forêt se clairsemait, en partie peut-être par suite d'une surexploitation par les porcs, la culture de Lüscherz, préférant les bovidés, devenait prédominante.

Malgré le nombre important d'éléments de l'association faunistique d'Yvonand — plus de 5000 ossements ont été déterminés individuellement, où 29 taxons sont représentés et se répartissent dans 4 subdivisions chronologiques (Horgen, Lüscherz, Bronze final et indifférencié) —, les éléments de chaque partie du squelette pour un taxon donné sont peu nombreux. De ce fait, il est difficile, voire impossible de tirer des conclusions générales concernant les pratiques d'élevage du bétail ainsi que les modes d'abattage et de boucherie pour ces différentes cultures.

Ces restes osseux ne fournissent pas de renseignements au sujet de la durée de l'occupation et de son caractère, à savoir si cette dernière était permanente ou limitée à certaines saisons durant les périodes en question. D'après les données archéologiques, il est cependant possible de dire que l'occupation Horgen dura cent cinquante ans environ et celle de Lüscherz près de deux cents ans. Une économie rurale mixte pratiquée sur l'étroite bande de pâturage entre la forêt et le lac semble être un modèle de fonctionnement assez probable.

TABLEAU 26.

Chiffres absolus et pourcentages des ossements recueillis des principaux types d'animaux destinés à l'alimentation pendant les périodes de Horgen et Lüscherz à Yvonand IV.

TABLEAU 27.

Poids absolus et pourcentages des ossements recueillis des principaux types d'animaux destinés à l'alimentation durant les périodes de Horgen et Lüscherz à Yvonand IV.

Aucune recherche concernant les restes de poissons et d'oiseaux n'a été entreprise dans le cadre du présent travail et celui-ci ne saura donc être exhaustif quant aux diverses espèces d'animaux destinés à l'alimentation; il est néanmoins certain que les animaux sauvages jouaient un rôle primordial dans l'économie de cette époque. Il est par contre impossible de dire si la chasse s'imposait faute de pâturages suffisamment grands pour nourrir de grands troupeaux, ou s'il s'agissait plutôt d'un passe-temps agréable; il est sûr en revanche que la chasse fournissait une grande partie de la viande consommée, étant donné que le nombre de fragments de débris d'os identifiés provenant d'ongulés sauvages s'élève à 33% pour la phase Horgen, respectivement à 32% pour la phase Lüscherz.

Comme dans tous les sites préhistoriques, la boucherie et la fragmentation d'os d'animaux domestiques et sauvages montrent que la moëlle était une source précieuse, voire principale de graisse animale; on ne l'utilisait pas uniquement comme aliment, mais également pour traiter et assouplir le cuir. Par contre, les restes animaux du site d'Yvonand ne fournissent pas de renseignements au sujet des autres sources de graisse animale; on ne saurait dire si des produits laitiers provenant des vaches domestiques, des brebis et des chèvres complétaient l'apport en matières grasses.

De grandes populations d'animaux sauvage — de sangliers, de cerfs, d'aurochs et de bisons — vivaient vraisemblablement dans les forêts mixtes de hêtres et de chênes qui s'étendaient le long de la rive du lac. Les peuplades indigènes n'éprouvaient sans doute guère de difficultés à chasser ces animaux, ni à tuer les carnivores qui en faisaient leur proie, à leur tour, puisqu'ils connaissaient fort bien les méthodes et rites de chasse hérités de leurs ancêtres.

On n'a pas identifié de restes de Bisons à Yvonand, ce qui ne veut pourtant pas dire qu'il n'y en avait pas dans cette région. Il est en effet extrêmement difficile de faire la distinction entre le *Bos* sauvage et le *Bison* sans un échantillonnage d'éléments suffisamment grand; il est possible que des études ultérieures révèleront la présence du Bison dans l'association, mais on peut penser également que seul l'Aurochs a été chassé dans la région.

En général, les proportions entre animaux domestiques, chiens et animaux sauvages à Yvonand durant les phases Horgen et Lüscherz correspondent aux données recueillies dans d'autres sites lacustres et résumées par Sakellaridis (1979).

Les restes d'animaux provenant des sites néolithiques lacustres suisses sont particulièrement bien conservés et ils continuent à fournir un matériel exceptionnel pour l'étude faunistique de l'Europe à une époque où l'impact de l'activité humaine se marque sur tous les caractères paléontologiques. Le bétail domestiqué prenait possession des pâturages disponibles et, en même temps, la chasse aux ongulés sauvages s'intensifiait, d'une part pour couvrir le besoin en viande et d'autre part pour protéger les cultures de leurs dévastations. Toutes les espèces d'animaux sauvages diminuaient en nombre et les croisements intervenaient de temps à autre entre porcs domestiques et sauvages, et de même entre bovidés domestiques et sauvages.

Le chien domestique était partout présent; les moutons et les chèvres, originaires de l'Asie occidentale, progressèrent rapidement vers le nord en suivant les défrichements de la forêt. La chasse aux carnivores sauvages modifiait l'équilibre entre les prédateurs et leurs proies. Il est remarquable de constater que, malgré une intervention humaine constante sur la nature, qui n'a connu aucune trève depuis cinq mille ans, l'Aurochs est la seule espèce parmi celles qui étaient représentées à Yvonand qui a été complètement exterminée aujourd'hui. Et par ironie du sort, c'est aujourd'hui la vache domestique, descendante de l'Aurochs, qui joue le rôle économique le plus important parmi les animaux domestiques et ceci dans le monde entier.

(Traduction: L. Wildi/D. Weidmann)

REFERENCES

ANDERSON, E. (1970). Quaternary evolution of the genus *Martes* (Carnivora, Mustelidae). *Acta zool. fenn. 130,* 132 pp.

ARMITAGE, P. L. and J. CLUTTON-BROCK (1976). A system for classification and description of the horn cores of cattle from archaeological sites. *J. archaeol. Sci. 3,* 329-348.

BARKER, G. (1985). *Prehistoric Farming in Europe.* Cambridge University Press, 327 pp.

BECKER, C. (1981). *Die neolithischen Ufersiedlungen von Twann. Band 16. Tierknochenfunde.* Staatlicher Lehrmittelverlag, Bern.

BECKER, C. and F. JOHANSSON (1981). *Die neolithischen Ufersiedlungen von Twann. Band 11. Tierknochenfunde.* Staatlicher Lehrmittelverlag, Bern.

BOESSNECK, J., J.P. JEQUIER and H. R. STAMFLI (1963). Seeberg Burgäschisee — Süd; Die Tierreste. *Acta bernensia II,* 3, 5-215.

BÖKÖNYI, S. (1974). *History of Domestic Mammals in Central and Eastern Europe.* Akadémiai kiado, Budapest, 597 pp.

BULL, G. and S. PAYNE (1982). Tooth eruption and epiphysial fusion in pigs and wild boar. In Wilson, B., Grigson, C. & Payne, S. (eds.) *Ageing and Sexing Animal Bones from Archaeological Sites.* BAR British Series 109, pp. 55-71.

CHAIX, L. (1976*a*). La faune de la fouille Yverdon-Garage Martin. *Cahiers d'Archéologie romande de la Bibliothèque historique vaudoise 8,* 181-228.

——— (1976*b*). Les restes fauniques de la station de Châble-Perron I and II. *Jahrbuch der Schweizerischen Gesellschaft für Urgeschichte 59,* 35-42.

——— (1976*c*). La faune de la station d'Yvonand III (Cortaillod récent). *Jahrbuch der Schweizerischen Gesellschaft für Urgeschichte 59,* 35-42.

——— (1976*d*). *La faune néolithique du Valais (Suisse).* Document du Département d'Anthropologie 3. Genève.

——— (1977). La faune de la station de Pont-de-Thielle (Néolithique récent). *Arch. Sc. Genève 30,* 3, 433-464.

CLASON, A. T. (1967). Animal and man in Holland's past. *Palaeohistoria 13* A, 247 pp. and J. B. Wolters, Groningen.

DEGERØL, M. (1933). Danmarks pattedyri fortiden i sammenligning med recente former I. *Vidensk. Meddr. dansk. naturh. Foren. II,* 641 pp.

DRIESCH, A. VON DEN (1976). A guide to the measurement of animal bones from archaeological sites. *Peabody Museum Bulletin 1,* Harvard University, USA, 137 pp.

FATIO, V. (1869). *Faune des Vertébrés de la Suisse. I. Mammifères.* H. Georg, Genève et Bâle.

FÖRSTER, W. (1974). Die Tierknochenfunde aus der neolithischen Station Felmeilen-Vorderfeld am Zurichsee II Die Wiederkäuer. Diss. München.

GRUNDBACHER, B. and H. R. STAMPFLI (1977). *Die neolithischen Ufersiedlungen von Twann. Band 2. Tierknochenfunde.* Staatlicher Lehrmittelverlag, Bern.

HARDING, A. F. (1980). *The lake dwellings of Switzerland retrospect and prospect.* University of Edinburgh, Department of Archaeology. Occasional paper No. 5.

HATTING, T. (1969). Er baeverens taender benyttet som redskaber i stenalderen i Danmark. *Saertryk af Aarbøger for Nordisk Oldkyndighed og Historie,* 116-126.

HIGHAM, C. F. W. (1967). The earlier Neolithic culture in Switzerland. *Vjschr. naturf. Ges. Zürich, 112,* 123-136.

JARMAN, M. R. (1972). European deer economies and the advent of the Neolithic. In E. S. Higgs (ed.). *Papers in Economic Prehistory.* Cambridge University Press, pp. 125-147.

JEANNERET, R. and J.-L. VORUZ (1974). Les stations littorales de la baie d'Yvonand (synthèse des fouilles et sondages 1973-1974). Unpublished manuscript.

JEANNERET, R. (1977). La station littorale d'Yvonand IV. Rapport des Fouilles Geilinger, 1977. Unpublished manuscript.

KELLER, F. (1866). *The Lake Dwellings of Switzerland and Other Parts of Europe.* Translated by J. E. Lee. London, Longmans, Green & Co. Ltd., 424 pp.

KURTÉN, B. (1967). Some quantitative approaches to dental microevolution. *Journal of Dental Research 46,* 5, 817-828.

MAYHEW, D. F. (1979). Evolution of a dental character in the beaver *Castor fiber* L. (Mammalia: Rodentia). *Zool. J. Linn. Soc. 65,* 177-184.

MILLER, G. S. (1912). *Catalogue of the Mammals of Western Europe in the Collection of the British Museum.* Trustees of the British Museum, London, 1019 pp.

REVERDIN, L. (1927). Recherches sur les mandibules de chien du niveau inférieur néolithique lacustre. *Verh. schweiz. naturf. Ges. 108,* 215-216.

RÜTIMEYER, L. (1861). *Die Fauna der Pfahlbauten in der Schweiz, Untersuchungen über die Geschichte der wilden und Haus-Säugethiere Mitteleuropas.* Basel.

—— (1866). Results of the investigation of animal remains from the lake dwellings. In F. Keller, *The Lake Dwellings of Switzerland and Other Parts of Europe.* Translated by J. E. Lee. London, Longmans, Green & Co., 424 pp. (355-362).

SAKELLARIDIS, M. (1979). *The Mesolithic and Neolithic of the Swiss Area.* BAR International Series 67, 433 pp.

SAUTER, M.-R. (1943). Lampe ou gobelet? Au sujet d'un objet néolithique en corne de cerf. *Annuaire de la Société suisse de préhistoire. 34*: 158-163.

SILVER, I. A. (1969). The ageing of domestic animals. In Brothwell, D. and Higgs, E. (eds.), *Science in Archaeology,* 2nd edition, 283-302. Thames and Hudson. London.

STAMPFLI, H. R. (1976). *Osteo-archaeologische Untersuchung des Tierknochenmaterials der spätneolithischen Ufersiedlung Auvernier-La Saunerie.* Solothurn, Switzerland. 188 pp.

SUMNER-SMITH, G. (1966). Observations on epiphyseal fusion of the canine appendicular skeleton. *Journal of Small Animal Practice.* Oxford. *7*: 303-311.

TROYON, F. (1860). *Habitation lacustres des temps anciens et modernes.* Lausanne, éd. Georges Bridel.

VORUZ, J.-L. (1984). *Outillages osseux et dynamisme industriel dans le Néolithique Jurassien.* Cahiers d'Archéologie romande, N° 29, Bibliothèque historique vaudoise, Lausanne. 533 pp.

WILLBURGER, L. (1983). Tierknochenfunde von der Heuneburg einem Frühkeltischen Herrensitz bei Hundersingen an der Donau (Grabungen 1966 bis 1979). Die Schweine. Inaugral-Dissertation zur Erlangung der tiermedizinischen Doktorwürde der Tierärztlichen Fakultät der Ludwig-Maximilians-Universität München. 215 pp.

Table 2 : Identifications of the artefacts and worked bones from Yvonand IV, described by Voruz (1984)

Period	Canis familiaris	Ursus arctos	Meles meles	Felis silvestris	Sus scrofa	Sus domesticus	Sus sp.	Cervus elaphus bone	C. elaphus antler	Cervidae antler	Capreolus capreolus	Bos taurus
Lüscherz				1 ulna			1 tooth 3 tusks 2 fibulae	1 metacarpal	7	8	5 metapodials 2 metatarsals	1 metacarpal
Total	-	-	-	1	-	-	6	1	7	8	7	1
Horgen		2 canines	1 fibula		1 tusk 1 fibula	1 fibula	1 tusk 3 fibulae	1 metatarsal 1 sternal bone 1 metatarsal	6	6	1 limb bone 1 antler 3 metacarpals 1 acc metacar. 7 metatarsals 2 metapodials	
Total	-	2	1	-	2	1	4	3	6	6	15	-
Unstra-tified	1 fibula	1 fibula				2 tusks	1 metapodial 1 fibula	1 metatarsal	13	5	1 metacarpal 3 metatarsals 1 acc. metacarp. 1 antler 5 metapodials	1 metacarpal 1 metapodial
Total	1	1	-	-	-	-	3	2	13	5	11	2
Grand Total	1	3	1	1	2	1	13	6	26	19	33	3

Note : 1. A small percentage of the elements do not show any signs of morking.

2. This table does not include the worked bones that were amongst the faunal remains sent on loan to the BM(NH).

Table 2 : (cont'd) Identifications of the artefacts and worked bones from Yvonand IV described by Voruz (1984)

Period	Large ruminant	*Capra hircus*	*Ovis aries*	*Capra/Ovis*	Small ruminant	Unidentified1)	Unindentified dog-size	Unidentified cow-size2)	Unidentified sheep-size2)	Totals
Lüscherz			3 metacarpals		1 limb bone 14 metapodials	7 ribs 1 limb bone 25 unid.		13 ribs 15 limb bones 1 metapodial 6 unid.	4 ribs 30 limb bones 4 unid.	
Total	-	-	3	-	15	33	-	35	39	156
Horgen			1 metacarpal 1 metapodial		3 metatarsals 12 metapodials	16 ribs 2 limb bones 11 unid.	1 fibula	37 ribs 16 limb bones 5 unid.	33 ribs 14 limb bones 2 unid.	
Total	-	-	2	-	15	40	1	58	19	175
Unstrati-fied	1 metapodial	2 metapodial	1 metapodial	2 metatarsals 1 metacarpal	3 ulnae 1 metacarpal 2 metatarsals 10 metapodials	14 ribs 2 limb bones 28 unid.	1 limb bone	39 ribs 10 limb bones 3 unid.	14 limb bone 4 unid.	
Total	1	2	1	3	16	44	1	52	18	176
Grand total	1	2	6	3	46	117	2	145	76	507
						1) Mostly bone needles and small bone points		2) Mostly large bone points and some scrapers		

Table 3 : Worked and cut antlers, bones and teeth from faunal assemblage of YVONAND IV (not described by Voruz, 1984)

Period	*Castor fiber*	*Ursus arctos*	*Equus*	*Sus scrofa*	*Sus domesticus*	*Sus sp.*	*Cervus elaphus*	*Capreolus capreolus*	*Bos primigenius*	*Bos taurus*	Large ruminant	*Capra/Ovis*	Small ruminant	Unidentified	Unidentified Cow size	Unidentified sheep size	Totals
Lücherz	1 md & teeth			1 tusk 2 scapulae	2 incisors	1 tusk 1 ulna	17 antlers 1 mtc 1 femur 1 mtt		1 scap. 1 tib 1 ph.1	1 scap. 1 ulna 1 radius 1 mtc 1 mtt	1 mandible	1 radius		3 ribs	1 unid. 1 rib	1 limb bone	
Total	1	-	-	3	2	2	20	-	3	5	1	1	-	3	2	1	44
Horgen		1 canine	1 incisor	1 incisor 2 scapulae 1 radius + ulna 1 tibia 3 fibulae	3 incisors 2 scapulae	2 tusks	17 antlers 6 skull + antler 1 ulna 1 radius 4 mtt	1 mtp	1 radius	3 scap. 1 innom. 1 femur 1 mtt	1 tibia 1 mtp	1 tibia	1 tibia	2 limb bone 5 ribs	7 rib 1 limb bone	1 rib 1 unident.	
Total	-	1	1	8	5	2	29	1	1	6	2	1	1	7	8	2	75
Unstratified		1 canine	-	1 tusk 1 fibula	1 incisor 1 radius		12 antler 3 skull + antler 1 humerus 1 innom. 1 mtt 1 mtp.	1 mtt	1 mtc	1 mtc 2 mtt	1 mtp	1 ulna	1 radius	1 ch.tooth 2 ribs 1 limb bone 1 unid.		1 rib	
Total	-	1	-	2	2	-	19	1	1	3	1	1	1	5	-	1	38
Grand Total	1	2	1	13	9	4	68	2	5	14	4	3	2	15	10	4	157

Table 4 : Weights in gm and percentage weights of the mammalian remains from Yvonand IV.

Period	*Erinaceus europaeus*	*Lepus* sp.	*Sciurus vulgaris*	*Castor fiber*	*Canis lupus*	*C. lupus/ familiaris*	*Canis familiaris*	*Vulpes vulpes*	*Ursus arctos*	*Mustela putorius*	*Martes* sp.	*Meles meles*	*Lutra lutra*	*Felis lynx*	*Felis silvestris*	*Equus*
Late Bronze Age												70 (5.47%)				310 (24.22%)
Lüscherz		10 (0.03%)	5 (0.01%)	175 (0.48%)	10 (0.03%)		100 (0.28%)	145 (0.40%)	265 (0.73%)	20 (0.06%)	25 (0.07%)	410 (1.14%)	20 (0.06%)		40 (0.11%)	50 (0.14%)
Horgen	5 (0.01%)			55 (0.06%)		15 (0.2%)	380 (0.45%)	190 (0.22%)	670 (0.79%)		130 (0.15%)	940 (1.10%)	5 (0.01%)		25 (0.03%)	30 (0.04%)
Unstratified				75 (0.16%)	20 (0.04%)		195 (0.41%)	35 (0.07%)	895 (1.89%)	5 (0.01%)	15 (0.03%)	675 (1.43%)		20 (0.04%)	20 (0.04%)	75 (0.16%)
Totals	5 (0.003%)	10 (0.01%)	5 (0.003%)	305 (0.18%)	30 (0.02%)	15 (0.01%)	675 (0.40%)	370 (0.22%)	1830 (1.08%)	25 (0.01%)	170 (0.10%)	2095 (1.23%)	25 (0.01%)	20 (0.01%)	85 (0.05%)	465 (0.27%)

Table 4 : cont. Weights in gm and percentage weights of the mammalian remains from Yvonand IV

Period	*Sus scrofa*	*Sus domesticus*	*Sus sp.*	*Cervus elaphus*	*Capreolus capreolus*	*Bos primigenius*	*Bos taurus*	Large ruminant	*Rupicapra rupicapra*	*Capra hircus*	*Ovis aries*	*Capra/Ovis*
Late Bronze Age		50 (3.91%)	15 (1.17%)	150 (11.72%)	10 (0.78%)	50 (3.91%)	590 (46.09%)	15 (1.17%)				20 (1.56%)
Lüscherz	2320 (6.43%)	3720 (10.30%)	1475 (4.09%)	5110 (14.16%)	430 (1.19%)	6010 (16.65%)	13330 (36.93%)	1560 (4.32%)		50 (0.14%)	315 (0.87%)	340 (0.94%)
Horgen	7875 (9.23%)	14715 (17.25%)	1320 (1.55%)	13835 (16.22%)	495 (0,58%)	20055 (23.51%)	21609 (25.33%)	1435 (1.68%)		250 (0.29%)	265 (0.31%)	865 (1.01%)
Unstra-tified	3160 (6.69%)	4865 (10.29%)	1045 (2.21%)	12250 (25.92%)	685 (1.45%)	5485 (11.60%)	15260 (32.29%)	1045 (2.21%)	25 (0.05%)	425 (0.90%)	160 (0.34%)	600 (1.27%)
Totals	13355 (7.86%)	23350 (13.74%)	3855 (2.27%)	31345 (18.44%)	1620 (0.95%)	31600 (18.59%)	50789 (29.88%)	4055 (2.39%)	25 (0.01%)	725 (0.43%)	740 (0.44%)	1825 (1.07%)

Table 4 cont. Weights in gm and percentage weights of the mammalian remains from YVONAND IV.

Period	Small Ruminant	Totals identified	Unidentified	Unidentified dog-size	Unidentified cow-size	Unidentified sheep-size	Totals Unidentified	Grand Totals
Late Bronze Age		1280			180 (75.00%)	60 (25.00%)	240	1520
Lüscherz	165 (0.46%)	36100	50 (0.27%)	5 (0.03%)	14305 (76.29%)	4390 (23.41%)	18750	54850
Horgen	145 (0.17%)	85309	100 (0.16%)	5 (0.01%)	42165 (74.85%)	14060 (24.96%)	56330	141639
Unstratified	230 (0.49%)	47265	50 (0.19%)	20 (0.08%)	20390 (79.42%)	5215 (20.31%)	25675	72940
Totals	540 (0.32%)	169,954	200 (0.20%)	30 (0.03%)	77040 (76.28%)	23725 (23.49%)	100,995	270,949

Table 5 : Absolute numbers and percentages of the identified elements of mammalian taxa from Yvonand IV

Period	Erinaceus europaeus	Lepus sp.	Sciurus vulgaris	Castor fiber	Canis lupus	C.Lupus/ familiaris	Canis familiaris	Vulpes vulpes
Late Bronze Age								
Lüscherz		2 (0.17%)	1 (0.08%)	7 (0.59%)	1 (0.08%)		13 (1.1%)	28 (2.4%)
Horgen	1 (0.04%)			4 (0.16%)		1 (0.04%)	41 (1.6%)	43 (1.7%)
Unstratified				6 (0.45%)	2 (0.15%)		20 (1.5%)	8 (0.61%)
Totals	1 (0.02%)	2 (0.04%)	1 (0.02%)	17 (0.3%)	3 (0.06%)	1 (0.02%)	74 (1.5%)	79 (1.6%)

Period	Ursus arctos	Mustela putorius	Martes sp.	Meles meles	Lutra lutra	Felis lynx	Felis silvestris	Equus
Late Bronze Age				6 14.3%				2 4.8%
Lüscherz	8 (0.68%)	1 (0.08%)	5 (0.42%)	38 (3.2%)	1 (0.08%)		6 (0.5%)	1 (0.08%)
Horgen	20 (0.8%)	1 (0.04%)	35 (1.4%)	95 (3.8%)	1 (0.04%)		5 (0.2%)	2 (0.08%)
Unstratified	13 (1.0%)	1 (0.08%)	6 (0.45%)	67 (5.1%)		1 (0.08%)	6 (0.45%)	
Totals	41 (0.8%)	3 (0.06%)	46 (0.91%)	206 (4.1%)	2 (0.04%)	1 (0.02%)	17 (0.3%)	5 (0.09%)

Table 5 : cont. Absolute numbers and percentages of the identified elements of mammalian taxa from YVONAND IV

Period	Sus Scrofa	Sus domesticus	Sus sp.	Cervus elaphus	Capreolus capreolus	Bos primigenius	Bos taurus	Large ruminant	Rupicapra rupicapra	Capra hircus	Ovis aries	Capra/ Ovis	Small ruminant	Totals
Late Bronze Age		3	1	8	2	1	15	1				3		42
		(7.1%)	(2.4%)	(19.0%)	(4.8%)	(2.4%)	(35.7%)	(2.4%)				(7.1%)		
Lüscherz	64	269	70	185	40	54	276	30		5	32	38	9	1184
	(5.4%)	(22.7%)	(5.9%)	(15.6%)	(3.4%)	(4.6%)	(23.3%)	(2.5%)		(0.42%)	(0.42%)	(3.2%)	(0.76%)	
Horgen	211	802	103	345	43	152	409	32		15	17	87	23	2488
	(8.5%)	(32.2%)	(4.1%)	(13.9%)	(1.7%)	(6.1%)	(16.4%)	(1.3%)		(0.6%)	(0.68%)	(3.5%)	(0.92%)	
Unstratified	75	266	69	300	56	33	247	26	2	15	17	56	22	1314
	(5.7%)	(20.2%)	(5.3%)	(22.8%)	(4.3%)	(2.5%)	(18.7%)	(2.0%)	(0.15%)	(1.1%)	(1.2%)	(4.3%)	(1.6%)	
Totals	350	1340	243	838	141	240	947	89	2	35	66	184	54	5028
	(7.0%)	(26.7%)	(4.8%)	(16.7%)	(2.8%)	(4.8%)	(18.8%)	(1.8%)	(0.04%)	(0.7%)	(1.3%)	(3.7%)	(1.1%)	

Table 6 : Numbers of the skeletal parts for the identified mammalian taxa from the Horgen of Yvonand IV

Bone	Erinaceus europaeus	Lepus sp	Sciurus vulgaris	Castor fiber	Canis lupus	C.lupus/ familiaris	Canis familiaris	Vulpes vulpes	Ursus arctos	Mustela putorius	Martes sp.	Meles meles	Lutra lutra	Felis lynx	Felis silvestris	Equus	Sus scrofa	Sus domesticus	Sus sp.	Cervus elaphus
Horncore/antler																				83
skull							1					3					9	46	12	7
premax + max							1					2					8	67	5	4
mandible	1			3			14	7			8	12	1		1		4	90	8	6
teeth				1				3	2		1					2	13	90	23	19
hyoid																				
atlas												2						6		3
axis												1					1	1		2
vert + sacrum							3										2	19	3	16
rib									2											
scapula							1				1	5					12	56	5	13
innominate								3				7					7	31	3	15
humerus							1	8			5	15			2		13	61	10	9
radius						1		3	1			11					15	41	1	13
ulna							4	2	1	1	7	11			1		21	40	9	7
carpal									2								4	2	2	6
metacarpal							5					1					15	11	1	27
femur							3	6	2		5	11					11	17	5	5
patella																	2	1		2
tibia							3	1	2		6	6			1		12	57	7	11
fibula							1	1			1	7					4	40	2	
talus																	7	18	1	3
calcaneum								1				1					14	22	1	6
tarsal									1								1			6
metatarsal							4	6	5								14	9	3	41
metapodial								2			1						14	54	1	8
phalanx 1									1								7	16	1	22
phalanx 2																		4		6
phalanx 3																	1	3		4
sesamoid																				1
Total	1			4		1	41	43	20	1	35	95	1		5	2	211	802	103	345

Bone	*Capreolus capreolus*	*Bos primigenius*	*Bos taurus*	Large ruminant	*Rupicapra rupicapra*	*Capra hircus*	*Ovis aries*	*Capra/Ovis*	Small ruminant
Horn core/antler	2	1				1	2		
Skull		3	3	2			2		
Premax + max	2	3	9	2				5	1
Mandible	5	1	31	1				22	3
Teeth	1	9	88	2				16	
Hyoid			1						
Atlas		1	2						
Axis		1	6						
Vert. + sacrum	3	20	17	3				4	2
Rib		1	3						1
Scapula	4	6	13	1			1	4	
Innominate	2	6	5	3				1	
Humerus	3	2	11			3	6	3	1
Radius	6	10	19			2	3	3	
Ulna	3	2	3	1				2	1
Carpal		7	10	1					
Metacarpal		6	34			4	1	7	
Femur	1	8	13	5					3
Patella		1	2						
Tibia	4	5	21	3				5	7
Fibula		4	2						
Talus		6	14	2					1
Calcaneum	2	6	20			2	1	4	2
Tarsal		3	6	2					
Metatarsal	4	5	26	1		1	1	11	
Metapodial	1	4	6	1					1
Phalanx 1		12	23			1			
Phalanx 2		10	13						
Phalanx 3		6	8	1		1			
Sesamoid		3		1					
TOTAL	43	152	409	32		15	17	87	23

Table 6 : cont'd Numbers of the skeletal parts for the identified mammalian taxa from the Horgen of YVONAND IV

Table 7 : Numbers of the skeletal parts for the identified mammalian taxa from the Lüscherz of YVONAND IV

Bone	Erinaceus europaeus	Lepus sp.	Sciurus vulgaris	Castor fiber	Canis lupus	C. lupus familiaris	Canis familiaris	Vulpes vulpes	Ursus arctos	Mustela putorius	Martes sp.	Meles meles	Lutra lutra	Felis lynx	Felis silvestris	Equus	Sus scrofa	Sus domesticus	Sus sp.	Cervus elaphus
Horncore/antler																				44
Skull									1	1		1					2	15	8	1
Premax + max.								1				1						20	1	3
Mandible		1		5			4	10	1		3	11	1				1	24	6	6
Teeth				1			2										15	65	15	21
Hyoid																				
Atlas																	1	1		2
Axis																				2
Vert + sacrum												1					3		1	5
Rib																				
Scapula								1				1					2	16	9	4
Innominate								1				3			1		2	8		2
Humerus		1		1			1		1		1	10			1		8	26	2	7
Radius							1	3	1								2	3	5	5
Ulna							2	1				5			1		6	24	4	4
Carpal																	2	2		3
Metacarpal								2									2	13	1	9
Femur			1				1	1			1	3			3		1	3	4	3
Patella																				
Tibia							1	7				1					4	14	5	4
Fibula																	1	5		
Talus																	3	4	2	5
Calcaneum												1					2	7	1	5
Tarsal																				3
Metatarsal					1		5		2									5		21
Metapodial								1									3	6	3	5
Phalanx 1																1	2	4	2	12
Phalanx 2								1	1								1	2	1	5
Phalanx 3									1								1	2		2
Sesamoid																				
Total		2	1	7	1		13	28	8	1	5	38	1		6	1	64	269	70	185

Bone	*Capreolus capreolus*	*Bos primigenius*	*Bos taurus*	Large ruminant	*Rupicapra rupicapra*	*Capra hircus*	*Ovis aries*	*Capra/Ovis*	Small ruminant
Horn core/antler	2						1		
Skull	1	1	2						
Premax + max.	1	2	2					1	
Mandible	3	1	16	1				8	1
Teeth	2	6	62	1				16	
Hyoid									
Atlas			1	1			1	1	
Axis			1	1			1		
Vert. + sacrum	2	4	9	2					4
Rib				2					1
Scapula	2	4	11	4				1	2
Innominate	3	2	2	1					
Humerus	6	1	5	2		1	4	1	2
Radius	3		13	2		3	6	8	1
Ulna	3	3	9	1				1	
Carpal		1	11						
Metacarpal	1	2	16	2			1	3	
Femur	3	3	14	4					2
Patella		2							
Tibia		2	13	3			2	2	5
Fibula		1							
Talus		1	15						
Calcaneum	1	4	10				3		
Tarsal			7						
Metatarsal	2	5	17	1		1	3	1	
Metapodial		1	5						
Phalanx 1	5	5	21	2			4	1	
Phalanx 2			8						
Phalanx 3		2	6						
Sesamoid		1							
TOTAL	40	54	276	30		5	26	44	18

Table 7 : cont'd **Numbers of the skeletal parts for the identified mammalian taxa from the Lüscherz of YVONAND IV**

Table 8 : Minimum numbers of individuals of the identified mammalian taxa from YVONAND IV.

Period	*Erinaceus europaeus*	*Lepus* sp.	*Sciurus vulgaris*	*Castor fiber*	*Canis lupus*	*C. lupus/ familiaris*	*Canis familiaris*	*Vulpes vulpes*	*Ursus arctos*	*Mustela putorius*	*Martes* sp.	*Meles meles*	*Lutra lutra*	*Felis lynx*	*Felis silvestris*	*Equus*
Late Bronze Age												2				1
Lüscherz		1	1	2	1		3	5	2	1	1	7	1		2	1
Horgen	1			3		1	8	5	4	1	6	10	1		3	1
Unstratified				1	1		4	1	1	1	1	8		1	3	1
Totals	1	1	1	6	2	1	15	11	7	3	8	27	2	1	8	4

Table 8 : cont'd Minimum numbers of individuals of the identified mammalian taxa from YVONAND IV

Period	Sus Scrofa	Sus domesticus	Sus sp.	Cervus elaphus	Capreolus capreolus	Bos primigenius	Bos taurus	Large ruminant	Rupicapra rupicapra	Capra hircus	Ovis aries	Capra/ Ovis	Small ruminant	Totals
Late Bronze Age		1	1	3	1	1	2	1				1		14
Lüscherz	7	17	5	10	5	4	8	2		3	4	6	3	102
Horgen	17	42	4	17	7	5	19	2		3	7	11	5	183
Unstratified	4	20	5	14	4	3	12	3	1	3	3	4	4	103
Totals	28	80	15	44	17	13	41	8	1	9	14	22	12	402

APPENDIX

Summaries of the Measurements

The analysis of the animal remains from Yvonand IV was carried out at the British Museum (Natural History). The collection was then returned to Switzerland in 1985 and is held in the Department of Archaeozoology at the Natural History Museum in Geneva. The dimensions of nearly every measurable element were recorded on computer and are held at the British Museum (Natural History), where they are available on request.

Summaries are given here of the most frequently taken measurements, which are in the systematic order of the taxa, as in the main text. The number and the maximum and minimum values are given for all measurements where there are at least five elements. When there are at least ten elements the means and standard deviations are presented as well. For those taxa that had only very few elements, such as the horse, the measurements are incorporated in the text. Where possible comparable measurements from the sites at Twann are included with the summaries. These are listed under *a* for the Middle and Upper levels of the Cortaillod of Twann (Becker & Johansson, 1981), and under *b* for the Lower Cortaillod (Becker, 1981). The Cortaillod period is dated from 3200-2800 bc (uncalibrated), that is it just precedes the Horgen.

No significant differences were found in the dimensions of the elements from the three periods of Yvonand IV, the Horgen, Lüscherz, and Late Bronze Age, perhaps because the sample sizes are too small for discrimination. Therefore the totals are recorded without their level numbers, and they include the unstratified elements, except for those of the domestic pigs and domestic cattle where the elements from the Horgen and Lüscherz are listed separately and together (H = Horgen, L = Lüscherz). The context of each specimen is available on request to the BM(NH).

The measurements, which are all in mm, were taken with Helios dial calipers according to the parameters of Driesch (1976), unless otherwise defined. The numbers or alphabetic abbreviations used in the Driesch manual are given beside the notation of the measurements when relevant. It should be noted that *length* is always taken in the cranio-caudal or proximo-distal direction. *Width* (breadth of Driesch) is always medio-lateral and *height* is the dorso-ventral dimension, whilst *depth* is the antero-posterior dimension (dorso-volar or dorso-plantar of Driesch). Special attention should be paid to the orientation of the scapula, the measurements of which are taken in the same plane as those of the axial rather than the appendicular skeleton.

Castor fiber Beaver

Element	Driesch code	Measurement	n	min.	max.
Mandible	8	Length of cheek tooth row	6	35.6	39.1

Canis familiaris Domestic dog

Element	Driesch code	Measurement	n	min.	max.	mean	s.d.
Lower P3	-	Length	7	8.6	10.5		
Lower P4	-	Length	8	9.4	12.1		
Lower M1	-	Length	14	18.6	21.0	19.1	2.88
	-	Width	10	7.1	8.7	8.0	0.56
Lower M2	-	Length	10	7.0	8.9	8.0	0.59
	-	Width	6	5.2	6.7		
Lower M3	-	Length	7	3.4	4.2		
Mandible	8	Length of cheek tooth row	13	58.5	71.0	66.0	3.46
		b	*18*	*53.1*	*72.9*	*61.8*	*4.92*
	1	Length	5	111.0	129.1		
	-	Depth of horizontal ramus under M1	14	12.6	21.5	17.7	2.37
	18	Height of vertical ramus	11	42.4	52.0	44.4	3.01
	-	Width of condyle	10	16.0	21.3	18.3	1.77
Radius	BP	Proximal width	6	13.3	14.9		
		a	*67*	*13.1*	*18.5*	*15.1*	*1.1*
		b	*6*	*13.9*	*16.7*		
	SD	Shaft width	6	9.0	11.5		
		a	*66*	*8.7*	*13.0*	*10.3*	*1.0*
		b	*5*	*8.8*	*11.2*		
Ulna	LO	Length of olecranon	6	21.2	26.8		
		a	*62*	*21.0*	*32.3*	*24.9*	*2.4*
		b	*8*	*22.9*	*27.3*		
	DPA	Depth olec. at beak of notch	6	16.2	21.3		
		a	*69*	*17.5*	*24.6*	*20.3*	*1.9*
		b	*9*	*17.5*	*22.0*		
	SDO	Minimum depth of olecranon	5	14.4	18.1		
		a	*65*	*14.2*	*22.2*	*17.0*	*1.6*
		b	*8*	*14.9*	*19.5*		
	BPC	Width of proximal articular surface	5	11.1	13.6		
		a	*69*	*10.7*	*18.7*	*13.4*	*1.6*
		b	*9*	*11.6*	*14.4*		

Vulpes vulpes Red fox

Elements	Driesch code	Measurement		n	min.	max.	mean	s.d.
Lower M1	-	Length		16	13.0	15.7	14.3	0.77
	-	Width		11	5.2	6.5	5.7	0.40
Lower M2	-	Length		7	6.4	7.7		
	-	Width		5	4.8	5.6		
Mandible	8	Length of cheek tooth row		6	55.7	59.6		
			a	*5*	*11.0*	*15.2*		
	-	Depth of horizontal ramus under M1		6	10.3	14.1		
	-	Width of condyle		5	11.0	15.2		
Humerus	Bd	Distal width		5	16.4	19.0		
			a	*13*	*16.5*	*20.3*	*18.4*	*1.20*
			b	*10*	*18.2*	*20.2*	*18.9*	*0.69*
	SD	Shaft width		7	6.4	7.8		
			a	*8*	*6.7*	*8.1*		
			b	*5*	*6.4*	*7.1*		
Radius	SD	Shaft width		6	7.0	8.4		
Femur	Bd	Distal width		6	15.0	21.5		
			a	*9*	*18.0*	*23.8*		
	SD	Shaft width		5	5.3	8.6		
			a	*6*	*7.8*	*9.1*		
Tibia	Bd	Distal width		5	12.7	13.8		
			a	*11*	*12.5*	*15.5*	*13.9*	*0.81*
			b	*13*	*13.0*	*14.8*	*14.1*	*0.57*
	SD	Shaft width		8	6.8	8.4		
			a	*11*	*5.6*	*7.9*	*7.2*	*0.60*
			b	*6*	*6.8*	*7.5*		

Martes sp. Marten

Element	Driesch code	Measurement	n	min.	max.	mean	s.d.
Lower M1	-	Length	11	8.9	11.0	10.1	0.70
	-	Width	9	3.8	5.0		
Mandible	-	Length of tooth row	12	34.1	39.1	36.5	1.87
	1	Length	12	50.8	59.5	55.6	2.93
	-	Depth of horizontal ramus under M1	12	7.6	8.8	8.4	0.42
	18	Height of vertical ramus	11	21.0	26.9	24.3	1.88
Humerus	Bd	Distal width	5	12.5	15.0	13.5	1.34
	SD	Shaft width	6	4.2	5.2	4.7	0.43
Ulna	DPA	Depth olec. at beak of notch	8	7.3	9.6	8.8	0.72
	BPC	Width of proximal articular surface	6	6.4	7.4	7.0	0.34
Femur	SD	Shaft width	7	5.2	6.4	5.6	0.50
Tibia	SD	Shaft width	6	4.3	4.8	4.6	0.17

Meles meles Badger

Element	Driesch code	Measurement	n	min.	max.	mean	s.d.
Upper M1	-	Length	6	15.0	17.4		
	-	Width	6	11.2	13.2		
Lower M1	-	Length	32	14.7	17.4	16.5	0.70
	-	Width	29	6.5	8.8	7.5	0.50
Mandible	-	Length of tooth row	18	50.7	57.9	55.3	1.91
	1	Length	17	85.3	96.4	91.4	3.12
	-	Depth of horizontal ramus under M1	29	11.7	16.7	14.9	1.04
	18	Height of vertical ramus	23	35.4	43.3	39.4	2.01
	-	Width of condyle	5	16.5	20.2		
Scapula	SLC	Length of neck	6	18.0	21.8		
	-	Height of neck	5	5.3	7.5		
	GLP	Distal length	6	20.6	23.7		
	BG	Width of glenoid cavity	6	10.3	13.5		
Humerus	GL	Length	9	87.8	115.2		
	Bp	Proximal width	10	21.2	27.1	24.8	1.84
	Bd	Distal width	25	20.9	34.6	31.3	2.80
	SD	Shaft width	21	5.5	12.3	10.2	1.54
Radius	GL	Length	13	87.2	96.4	91.6	2.56
	Bp	Proximal width	16	11.8	15.0	13.2	0.91
	Bd	Distal width	10	17.6	20.5	19.2	0.87
	SD	Shaft width	15	5.3	8.2	6.6	0.81
Ulna	GL	Length	9	105.5	120.4		
	DPA	Depth olec. at beak of notch	20	16.3	19.8	17.9	1.10
	SDO	Minimum depth of olecranon	8	13.2	16.2		
	BPC	Width of proximal articular surface	20	9.3	12.5	10.0	2.87
Femur	GL	Length	5	117.1	124.5		
	Bp	Proximal width	10	30.9	34.2	33.1	1.19
	Bd	Distal width	8	24.5	27.4		
	SD	Shaft width	14	9.0	11.4	10.1	0.69
	-	Head width	7	15.1	17.8		
	DC	Head depth	5	13.8	15.1		
Tibia	GL	Length	7	97.0	109.7		
	Bp	Proximal width	7	21.9	27.0		
	Bd	Distal width	11	16.5	20.6		
	SD	Shaft width	9	7.1	8.0		
Ulna	DPA	Depth olec. at beak of notch	29	31.0	51.0	42.6	5.72
	SDO	Minimum depth of olecranon	17	28.8	40.6	34.9	3.79
		a	*33*	*33.0*	*44.0*	*39.0*	*2.7*
	BPC	Width of proximal articular surface	36	16.8	31.9	25.7	3.73
		a	*33*	*23.8*	*32.0*	*28.6*	*1.9*

Sus scrofa Wild boar

Bone	Driesch code	Measurement		n	min.	max.	mean	s.d.
Upper M2	-	Length		7	21.1	26.5		
	-	Width		7	18.5	20.0		
Upper M3	-	Length		6	32.0	44.8		
			a	*18*	*35.8*	*42.7*	*39.9*	*2.3*
	-	Width		6	18.5	24.0		
			a	*17*	*20.8*	*24.0*	*22.6*	*1.0*
Lower P3	-	Length		5	13.8	16.7		
Lower M2	-	Length		6	21.1	25.1		
	-	Width		6	16.4	21.5		
Lower M3	-	Length		6	43.8	46.9		
			b	*9*	*41.3*	*46.0*		
	-	Width		6	18.2	23.6		
			b	*7*	*16.7*	*19.3*		
Scapula	SLC	Length of neck		13	29.5	35.9	32.5	1.47
			a	*42*	*28.0*	*35.2*	*31.6*	*1.7*
			b	*8*	*27.4*	*34.1*		
	GLP	Distal length		7	42.0	49.6		
	LG	Length of glenoid cavity		7	33.3	37.6		
			a	*45*	*31.2*	*44.5*	*39.0*	*2.1*
			b	*9*	*38.0*	*42.7*		
	BG	Width of glenoid cavity		8	29.4	33.6		
			a	*51*	*28.2*	*37.1*	*32.8*	*2.2*
			b	*9*	*27.4*	*35.7*		
Humerus	Bd	Distal width		11	45.2	56.5	49.6	3.94
			b	*11*	*46.6*	*57.3*	*52.0*	*3.23*
	-	Distal depth		8	43.1	54.5		
	SD	Shaft width		7	21.7	28.0		
Radius	Bp	Proximal width		13	32.5	41.2	37.1	2.43
			b	*8*	*37.0*	*41.9*		
	Bd	Distal width		5	36.9	45.9		
			a	*32*	*40.5*	*49.4*	*44.4*	*2.8*
			b	*6*	*41.5*	*48.2*		
	SD	Shaft width		8	22.1	27.4		
			a	*6*	*23.3*	*26.3*		
Metacarpal 3								
	Bp	Proximal width		11	21.4	29.7	25.9	2.71
	-	Proximal depth		10	16.3	24.2	21.3	2.59
Metacarpal 4								
	Bp	Proximal width		7	15.9	22.1		
Innominate	LA	Length of acetabulum		11	33.2	41.8	37.1	2.70
	-	Width of acetabulum		9	32.3	38.4		
Femur	SD	Shaft width		5	20.4	34.1		
Tibia	Bd	Distal width		11	33.9	42.5	37.5	2.21
			a	*89*	*33.3*	*42.0*	*37.5*	*2.0*
	-	Distal depth		11	28.9	35.7	31.8	2.07
	SD	Shaft width		5	22.3	30.4		

Sus scrofa Wild boar (cont.)

Fibula	Bd	Distal width	5	20.8	23.6		
	-	Distal depth	5	11.4	13.9		
	SD	Shaft width	5	6.7	12.6		
Talus	GL	Length	12	48.2	54.9	51.2	2.05
			a 52	*46.8*	*57.0*	*51.3*	*2.3*
			b 6	*47.4*	*57.6*		
	Bd	Distal width	11	27.3	33.3	30.4	1.59
Calcaneum	GL	Length	10	95.4	111.4	101.9	5.85
			a 48	*92.0*	*113.0*	*100.6*	*5.0*
	GB	Width	15	22.6	30.3	27.1	2.29
Metatarsal 3							
	Bp	Proximal width	10	15.7	21.3	18.5	1.97
	-	Proximal depth	10	23.2	31.6	27.6	2.46
Metatarsal 4							
	Bp	Proximal width	6	18.3	20.8		
	-	Proximal depth	6	28.5	32.2		
Metapodial splint bone	GL	Length	8	70.5	91.9		
	Bd	Distal width	8	12.9	15.0		
Phalanx 1	GL	Length	7	41.3	51.5		
			a 75	*40.0*	*50.3*	*45.0*	*2.7*
			b 18	*41.1*	*50.3*	*45.1*	*2.6*
	Bp	Proximal width	7	20.5	22.7		
			a 74	*16.1*	*21.1*	*18.9*	*1.3*
			b 18	*19.1*	*23.0*	*20.5*	*1.2*
	-	Proximal depth	7	20.5	24.6		
	Bd	Distal width	6	17.7	20.6		
			a 75	*17.3*	*23.0*	*20.5*	*1.3*
			b 18	*17.0*	*21.2*	*18.7*	*1.1*
	SD	Shaft width	7	14.8	17.9		

Sus domesticus Domestic pig (Horgen and Lüscherz)

Bone	Driesch code	Measurement	n	min.	max.	mean	s.d.
Upper P3	-	Length	H 14	11.4	15.0	13.2	1.10
			L 8	10.0	13.6		
Upper P4	-	Length	H 30	11.5	15.8	13.5	1.14
			L 16	12.1	20.8	15.7	3.31
Upper M1	-	Length	H 33	13.8	20.8	17.2	1.64
			L 19	12.8	19.6	17.6	1.70
	-	Width	H 31	11.9	15.5	14.4	2.47
			L 17	11.0	14.5	12.5	1.14
Upper M2	-	Length	H 27	20.2	24.9	22.6	1.28
			L 8	19.7	23.0		
	-	Width	H 27	15.2	20.1	17.5	1.78
			L 8	13.3	17.4		
Upper M3	-	Length	H 17	32.2	40.4	35.0	2.95
			L 9	29.6	38.8		
	-	Width	H 17	16.0	21.0	19.1	1.27
			L 9	14.3	20.6		
Lower P4	-	Length	H 45	13.0	22.9	17.8	2.84
			L 5	14.6	20.5		

Sus domesticus Domestic pig (Horgen and Lüscherz, cont.)

Lower M1	-	Length	H 47	13.0	20.4	17.5	1.62
			L 9	14.1	18.5		
	-	Width	H 42	10.0	13.8	11.4	0.68
			L 8	9.8	11.5		
Lower M2	-	Length	H 34	20.5	24.9	22.5	1.14
			L 12	17.3	25.0	21.9	2.19
	-	Width	H 34	12.2	15.8	14.2	0.84
			L 11	11.6	15.2	14.1	1.10
Lower M3	-	Length	H 18	33.8	39.9	36.8	1.79
			L 7	33.2	38.9		
	-	Width	H 19	15.4	21.1	16.6	1.36
			L 8	14.6	16.8		
Scapula	SLC	Length of neck	H 27	18.4	30.9	23.6	2.99
			L 8	18.8	26.0		
Humerus	Bd	Distal width	H 10	35.5	42.4	38.8	2.05
			L 7	34.2	38.4		
		Distal depth	H 7	35.5	41.7		
			L 6	36.4	38.4		
Ulna	DPA	Depth olec. at beak of notch	H 17	23.7	39.3	32.3	4.15
			L 7	28.7	37.2		
	BPC	Width of proximal articular surface	H 24	16.8	21.8	19.4	1.41
			L 10	17.2	25.1	19.9	2.23

Sus domesticus Domestic pig (All periods)

Bone	Driesch code	Measurement	n	min.	max.	mean	s.d.
Upper P1	-	Length	7	7.4	9.3		
Upper P2	-	Length	19	8.8	13.8	11.2	1.32
Upper P3	-	Length	27	10.0	15.0	12.8	1.18
Upper P4	-	Length	51	11.5	20.8	14.5	2.29
	-	Width	7	8.6	14.4		
Upper M1	-	Length	61	12.8	20.8	17.3	1.66
	-	Width	56	11.0	15.5	13.8	2.13
Upper M2	-	Length	41	17.9	24.9	22.3	1.43
	-	Width	40	13.3	20.1	17.3	1.92
Upper M3	-	Length	31	29.6	40.4	35.1	2.83
			a 24	*29.2*	*37.1*	*32.3*	*2.0*
	-	Width	31	14.3	21.0	18.7	1.66
			a 23	*17.3*	*21.2*	*18.9*	*1.1*
Lower P2	-	Length	15	9.0	12.5	11.2	1.12
Lower P3	-	Length	26	9.2	14.7	12.9	1.45
Lower P4	-	Length	71	13.0	22.9	18.1	2.70
	-	Width	39	8.2	10.1	9.0	0.50
Lower M1	-	Length	71	13.0	20.4	17.4	1.56
	-	Width	62	9.8	13.8	11.4	0.77
Lower M2	-	Length	55	17.3	25.6	22.4	1.48
	-	Width	54	11.6	17.1	14.3	0.97

Sus domesticus Domestic pig (All periods, cont.)

Lower M3	-	Length	30	32.8	39.9	36.3	1.97
			b 5	*32.8*	*38.1*		
	-	Width	32	14.6	21.1	16.3	1.19
			b 5	*14.4*	*17.2*		
Maxilla	-	Length of molar row	7	67.0	74.3		
			a 17	*60.1*	*71.2*	*65.6*	*2.8*
Mandible	16b	Depth of horizontal ramus	12	33.9	49.0	40.8	4.93
	15	Height of vertical ramus	5	107.0	125.7		
Scapula	SLC	Length of neck	35	18.4	30.9	23.3	2.88
			a 16	*20.6*	*26.0*	*23.7*	*1.1*
	GLP	Distal length	16	29.5	39.4	34.4	2.47
			a 13	*27.0*	*30.3*	*28.7*	*1.0*
	BG	Width of glenoid cavity	22	19.0	28.0	23.4	2.53
			a 16	*22.4*	*28.0*	*24.4*	*1.3*
	HS	Height	8	74.1	180.4	162.3	35.8
Humerus	Bd	Distal width	26	34.2	45.8	38.8	2.90
			b 7	*36.6*	*41.1*		
	-	Distal depth	17	35.5	42.3	38.5	2.04
	SD	Shaft width	12	15.4	20.3	17.2	1.37
Radius	BP	Proximal width	25	25.8	36.9	30.0	3.15
	-	Proximal depth	20	18.5	24.9	20.4	1.91
	SD	Shaft width	7	16.1	20.7		
Ulna	DPA	Depth olec. at beak of notch	30	23.7	39.3	32.8	3.71
	SDO	Minimum depth of olecranon	7	21.9	28.2		
	BPC	Width of proximal articular surface	44	16.6	25.1	19.5	1.66
Metacarpal 3	Bp	Proximal width	12	14.1	21.0	26.7	2.02
Metacarpal 4	Bp	Proximal width	6	14.5	18.9	16.4	1.75
Innominate	LA	Length of acetabulum	23	25.7	35.3	30.8	2.62
	-	Width of acetabulum	18	24.3	35.7	29.1	3.23
Femur	Bd	Distal width	12	33.9	45.0	41.9	2.93
			a 5	*41.0*	*46.0*		
	SD	Shaft width	5	14.8	20.7		
Tibia	Bd	Distal width	30	23.7	39.8	30.3	3.52
			a 25	*26.7*	*32.5*	*28.9*	*1.6*
	-	Distal depth	30	21.4	32.7	25.5	2.69
	SD	Shaft width	10	16.5	21.9	19.3	1.73
Talus	GL	Length	19	38.1	50.0	42.3	3.60
			a 19	*36.8*	*42.4*	*40.1*	*1.7*
	Bd	Distal width	19	21.5	29.7	24.4	2.29
Calcaneum	GB	Width	19	16.7	26.2	21.0	2.40

Sus domesticus Domestic pig (All periods, cont.)

Metatarsal 3							
	Bp	Proximal width	6	13.6	16.7		
Metatarsal 4							
	Bp	Proximal width	9	12.5	15.2		
Metapodial splint bone	GL	Length	12	55.4	70.4	59.3	4.29
	Bd	Distal width	12	8.9	12.3	12.3	0.94
Phalanx 1	GL	Length	11	23.7	43.9	37.4	5.76
			a 26	*30.5*	*40.5*	*35.4*	*2.2*
	Bp	Proximal width	11	11.4	21.4	17.5	3.15
			a 25	*13.1*	*16.1*	*14.4*	*0.7*
	Bd	Distal width	11	8.3	18.5	15.4	2.85
			a 26	*14.5*	*17.0*	*15.6*	*0.7*

Cervus elaphus Red deer

Bone	Driesch code	Measurement	n	min.	max.	mean	s.d.
Upper P4	-	Length	6	14.6	25.1		
Upper M1	-	Length	5	21.3	25.0		
Upper M2	-	Length	8	23.5	27.3		
	-	Width	8	20.4	26.7		
Upper M3	-	Length	9	10.6	25.5		
			b 5	*22.5*	*25.9*		
	-	Width	8	11.6	23.4		
			b 5	*18.5*	*25.8*		
Lower P3	-	Length	6	15.7	31.9		
Lower P4	-	Length	9	16.6	27.0		
Lower M1	-	Length	7	20.6	24.8		
Lower M2	-	Length	7	23.1	27.5		
Lower M3	-	Length	11	29.7	34.0		
			a 184	*28.4*	*37.6*	*32.3*	*1.6*
			b 11	*28.7*	*35.3*	*31.6*	*2.1*
	-	Width	9	13.2	15.9		
			a 179	*12.2*	*16.6*	*14.6*	*0.7*
			b 11	*12.9*	*15.8*	*14.2*	*0.9*
Mandible	7	Length of cheek tooth row	6	119.0	135.0		
			a 73	*111.0*	*138.6*	*123.6*	*5.7*
	8	Length of molar row	7	51.1	81.0		
			a 96	*68.5*	*86.8*	*76.7*	*3.3*
	- 15b	Depth of horizontal ramus under M1	5	36.6	42.8		
	14	Height of vertical ramus	5	20.2	25.4		

Cervus elaphus Red deer (cont.)

Scapula	SLC	Length of neck		9	30.1	42.0		
			a	59	26.8	43.2	34.3	3.8
			b	7	34.1	42.1		
	-	Height of neck		8	34.5	45.0		
	GLP	Distal length		7	48.9	66.0		
	LG	Length of glenoid cavity		5	37.8	50.7		
			a	153	40.0	54.3	45.8	3.2
			b	9	44.2	51.3		
	BG	Width of glenoid cavity		8	31.1	50.7		
			a	153	34.9	51.8	42.4	4.0
			b	9	41.2	48.8		
Humerus	Bd	Distal width		14	45.3	62.4	53.9	5.24
			b	13	53.2	63.1	57.7	3.48
	-	Distal depth		13	45.4	58.9	52.4	4.61
	SD	Shaft width		10	23.0	28.7	25.6	2.44
Radius	Bp	Proximal width		12	50.5	61.0	55.7	2.96
			a	280	50.4	66.0	57.1	3.4
			b	18	51.9	63.9	57.2	3.88
	-	Proximal depth		11	27.3	32.5	29.9	1.42
	Bd	Distal width		14	44.5	59.3	53.2	4.87
			a	275	50.4	66.0	57.1	3.5
			b	11	46.1	58.2	53.0	4.30
	-	Distal depth		14	28.3	43.8	37.0	3.94
	SD	Shaft width		10	29.0	36.2	32.4	2.62
Ulna	DPA	Depth olec. at beak of notch		6	43.0	56.3		
	BPC	Width of proximal articular surface		9	26.6	34.3		
			a	123	27.9	35.8	31.3	2.1
Metacarpal	Bp	Proximal width		20	31.9	45.6	41.5	3.32
			a	182	35.4	47.9	42.4	2.7
			b	13	37.3	46.5	41.2	3.5
	-	Proximal depth		18	25.5	32.6	29.6	2.00
			a	183	25.6	33.7	30.7	2.1
			b	13	27.1	32.4	29.2	2.09
	Bd	Distal width		17	37.2	45.6	42.0	2.86
			a	181	36.9	48.2	42.0	2.7
	-	Distal depth		16	25.1	30.9	28.1	1.89
			a	200	25.0	31.1	28.4	1.5
	SD	Shaft width		13	21.1	29.3	25.1	2.37
			a	4	21.7	24.4		
Innominate	LA	Length of acetabulum		19	44.5	56.0	50.9	3.06
	-	Width of acetabulum		16	37.7	49.6	43.7	4.11
Tibia	Bd	Distal width		11	46.9	53.3	49.4	1.92
			a	372	44.4	57.4	50.5	2.9
	-	Distal depth		12	33.4	41.8	38.1	2.26
	SD	Shaft width		6	27.3	29.3		
Talus	GL	Length		6	53.2	56.8		
			a	360	50.6	64.0	56.9	2.7
			b	24	52.3	62.5	57.3	2.87
	Bd	Distal width		6	30.0	34.2		
			a	362	30.8	41.3	35.7	2.5
			b	24	32.8	39.5	36.0	2.08

Cervus elaphus Red deer (cont.)

Calcaneum	GL	Length		9	97.9	133.7		
			a	*245*	*109.1*	*136.1*	*120.6*	*6.0*
			b	*13*	*113.9*	*138.7*	*119.3*	*8.07*
	GB	Width		11	25.5	37.8	33.4	4.27
Scapho-cuboid	GB	Width		12	39.8	46.6	43.7	2.16
Metatarsal	Bp	Proximal width		19	33.0	40.2	35.4	2.18
			a	*139*	*31.7*	*41.4*	*36.8*	*2.5*
			b	*6*	*33.3*	*40.8*		
	-	Proximal depth		16	24.8	43.4	38.3	4.26
			a	*138*	*34.9*	*46.2*	*40.1*	*2.4*
			b	*10*	*35.2*	*45.8*	*39.2*	*3.04*
	Bd	Distal width		16	36.4	46.3	40.7	2.59
			a	*200*	*37.0*	*48.6*	*42.7*	*2.6*
			b	*13*	*40.4*	*44.9*	*43.2*	*1.44*
	-	Distal depth		15	26.0	31.2	27.5	1.60
			a	*192*	*25.3*	*32.0*	*28.8*	*1.5*
			b	*13*	*27.5*	*30.7*	*29.3*	*0.94*
	SD	Shaft width		5	20.9	27.4		
Phalanx 1 -hind	GL	Length		9	56.2	62.2		
	Bp	Proximal width		9	19.0	21.8		
	-	Proximal depth		8	24.5	28.2		
	SD	Shaft width		8	14.8	19.8		
	-	Shaft depth		9	15.8	21.7		
Phalanx 1	GL	Length		30	51.0	64.1	58.2	3.58
			a	*385*	*49.7*	*65.9*	*57.9*	*3.1*
			b	*27*	*52.4*	*60.4*	*56.9*	*2.47*
	Bp	Proximal width		31	17.6	24.1	21.3	1.72
			a	*389*	*18.4*	*25.1*	*21.5*	*1.3*
			b	*26*	*18.9*	*23.9*	*21.2*	*1.47*
	-	Proximal depth		29	22.6	29.1	26.3	1.59
	Bd	Distal width		33	17.2	22.4	20.1	1.58
Phalanx 2	GL	Length		15	39.8	46.6	43.3	2.17
			a	*429*	*38.0*	*49.3*	*43.2*	*2.2*
	Bp	Proximal width		16	18.0	23.1	20.4	1.48
			a	*425*	*17.7*	*23.2*	*21.5*	*1.2*
	-	Proximal depth		12	16.5	30.0	26.8	3.62
	Bd	Distal width		12	14.3	19.2	17.9	1.37
Phalanx 3	DLS	Length		9	43.5	52.9		
	-	Height		10	23.9	31.0	28.4	2.45

Capreolus capreolus Roe deer

Bone	Driesch code	Measurement		n	min.	max.	mean	s.d.
Lower P4	-	Length		7	10.6	16.4		
Lower M3	-	Length		6	14.1	16.8		
			a	*12*	*12.8*	*17.1*	*15.0*	*1.23*
	-	Width		6	6.6	7.9		
			a	*12*	*7.0*	*9.1*	*7.9*	*0.56*
Mandible	7	Length of cheek tooth row		5	60.5	69.7		
			a	*9*	*63.3*	*73.3*		

Capreolus capreolus Roe deer (cont.)

Scapula	SLC	Length of neck		6	13.6	17.0		
			a	*41*	*15.6*	*19.3*	*17.6*	*0.95*
			b	*14*	*15.7*	*18.1*	*16.9*	*0.79*
	-	Height of neck		5	15.3	20.5		
	BG	Width of glenoid cavity		5	16.6	19.6		
			a	*38*	*18.5*	*22.8*	*20.6*	*1.05*
			b	*14*	*17.9*	*21.6*	*20.5*	*1.08*
Humerus	Bd	Distal width		7	24.5	29.9		
			a	*46*	*23.5*	*30.0*	*27.3*	*1.33*
			b	*17*	*26.0*	*30.7*	*27.8*	*1.38*
	-	Distal depth		5	22.7	27.4		
Radius	Bp	Proximal width		14	22.2	25.5	24.2	0.92
			a	*31*	*23.4*	*27.2*	*25.4*	*0.99*
			b	*6*	*24.0*	*26.2*		
	-	Proximal depth		13	12.9	15.3	14.4	0.81
Ulna	DPA	Depth olec. at beak of notch		7	21.6	25.4		
			b	*5*	*23.6*	*25.1*		
	SDO	Minimum depth of olecranon		5	19.2	21.3		
	BPC	Width of proximal articular surface		8	11.7	15.7		
			a	*18*	*13.4*	*16.4*	*14.7*	*0.88*
Innominate	LA	Length of acetabulum		5	21.0	25.8		
Tibia	Bd	Distal width		5	24.3	28.7		
			a	*25*	*24.1*	*28.3*	*26.4*	*1.38*
			b	*7*	*23.2*	*27.4*		
	-	Distal depth		5	19.1	21.2		
Calcaneum	GL	Length		5	55.7	63.9		
			a	*12*	*54.5*	*67.4*	*63.3*	*3.59*
			b	*6*	*61.6*	*65.0*		
	GB	Width		5	18.2	20.6		
Phalanx 1	GL	Length		6	23.2	41.6		
			a	*34*	*33.3*	*41.5*	*37.3*	*2.68*
	SD	Shaft width		5	7.3	8.0		

Bos primigenius Aurochs

Bone	Driesch code	Measurement		n	min.	max.	mean	s.d.
Upper M3	-	Length		7	29.6	36.0		
	-	Width		7	20.3	26.7		
Scapula	SLC	Length of neck		5	60.1	84.7		
Radius	Bp	Proximal width		6	90.5	111.4		
			a	*5*	*86.3*	*99.5*		
Metacarpal	Bd	Distal width		5	68.5	79.5		
	-	Distal depth		5	33.9	43.5		

Bos primigenius Aurochs (cont.)

Phalanx 1 -fore	GL	Length	10	64.5	79.0	72.2	4.44
	Bp	Proximal width	11	35.7	45.8	41.3	3.33
	-	Proximal depth	8	36.9	47.8		
	Bd	Distal width	9	30.1	41.0		
	SD	Shaft width	7	31.3	38.0		
Talus	GL1	Length	6	73.0	87.8		
			a 10	*72.1*	*82.6*	*78.1*	*3.70*
	Bd	Distal width	6	43.8	52.4		
			a 8	*45.0*	*57.3*		
Calcaneum	GL	Length	5	118.0	183.4		
	GB	Width	7	37.6	62.2		
Metatarsal	Bp	Proximal width	7	50.3	70.1		
	-	Proximal depth	7	46.8	65.9		
Phalanx 1 -hind	Bp	Proximal width	6	32.5	38.7		
Phalanx 3 or hoof core	DLS	Length	6	71.3	96.5		
			a 7	*81.0*	*94.3*		
	HP	Height	7	35.5	58.0		

Bos taurus Domestic cattle (Horgen and Lüscherz)

Bone	Driesch code	Measurement	n	min.	max.	mean	s.d.
Upper M3	-	Length	H 14	25.2	31.3	28.3	1.79
			L 8	25.5	36.0		
Lower P4	-	Length	H 20	19.0	37.8	30.6	6.50
			L 9	19.1	33.3		
Lower M2	-	Length	H 13	23.9	32.0	27.3	2.41
			L 10	23.3	35.9	28.6	3.72
	-	Width	H 12	11.4	17.1	14.2	1.67
			L 7	11.6	14.9		
Talus	GL1	Length	H 11	55.7	64.9	60.3	2.61
			L 9	56.5	65.8		
	Bd	Distal width	H 12	34.2	39.4	37.0	1.59
			L 8	34.5	40.7		
Calcaneum	GB	Width	H 14	30.8	43.4	37.6	3.63
			L 7	32.9	43.7		
Metatarsal	Bd	Distal width	H 6	46.0	59.4		
			L 5	44.3	59.1		
	-	Distal depth	H 6	24.9	32.2		
			L 5	24.8	32.6		
	SD	Shaft width	H 5	24.5	30.3		
			L 5	20.0	29.2		
Phalanx 3 or hoof core	-	Height	H 5	29.4	38.4		
			L 5	29.0	45.0		

Bos taurus Domestic cattle (All periods)

Bone	Driesch code	Measurement	n	min.	max.	mean	s.d.

Bos taurus Domestic cattle (All periods, cont.)

Upper P4	-	Length	13	16.7	26.7	21.0	3.85
Upper M1	-	Length	12	22.1	30.7	26.4	2.69
	-	Width	7	17.4	24.7		
Upper M2	-	Length	6	24.9	32.2		
	-	Width	8	16.7	21.0		
Upper M3	-	Length	26	25.3	36.0	28.1	2.71
			b 7	*25.7*	*29.2*		
	-	Width	8	16.8	22.0		
			b 6	*16.9*	*25.1*		
Lower P3	-	Length	11	16.6	20.0	18.7	1.17
Lower P4	-	Length	44	19.0	39.4	29.5	6.05
	-	Width	24	11.8	14.4	13.3	0.77
Lower M1	-	Length	19	21.7	29.6	24.7	2.28
	-	Width	13	11.7	17.0	14.3	1.58
Lower M2	-	Length	28	23.3	35.9	27.7	2.91
	-	Width	21	11.4	17.1	13.9	1.65
Lower M3	-	Length	24	30.9	40.1	35.6	2.36
			a 124	*31.9*	*42.4*	*36.9*	*2.1*
			b 9	*33.6*	*39.5*		
	-	Width	18	11.5	17.1	14.3	1.56
			a 132	*12.6*	*18.5*	*15.5*	*1.1*
			b 9	*13.9*	*17.3*		
Mandible	7	Length of cheek tooth row	8	123.2	143.1		
			a 43	*112.4*	*147.5*	*136.1*	*6.8*
	15b	Depth of horizontal ramus	10	27.3	53.7	48.2	7.90
	-	Width of condyle	8	28.1	43.9		
Scapula	SLC	Length of neck	6	34.4	59.3		
			a 43	*39.9*	*52.2*	*46.7*	*3.0*
			b 8	*41.4*	*53.2*		
	-	Height of neck	7	35.4	67.9		
	GLP	Distal length	7	51.4	86.7		
	LG	Length of glenoid cavity	7	42.0	66.0		
			a 73	*45.6*	*58.8*	*53.3*	*3.0*
			b 12	*50.9*	*58.2*	*52.8*	*2.42*
Humerus	Bd	Distal width	7	62.2	80.5		
			b 9	*71.0*	*79.9*		
Radius	BP	Proximal width	12	63.2	82.7	71.0	7.22
			a 83	*68.5*	*84.7*	*75.9*	*3.6*
			b 12	*70.1*	*84.8*	*77.8*	*4.44*
	-	Proximal depth	8	30.6	44.3		
	SD	Shaft width	10	31.0	45.0	37.8	4.02
Ulna	BPC	Width of proximal articular surface	6	38.5	45.6		
			a 34	*39.8*	*49.6*	*44.8*	*2.5*
			b 5	*44.8*	*47.2*		

Bos taurus Domestic cattle (All periods, cont.)

Metacarpal	Bp	Proximal width	17	45.9	66.6	53.8	6.21
			a 83	46.5	60.5	53.8	2.2
			b 8	50.2	58.1		
	-	Proximal depth	13	27.7	39.3	32.4	4.24
			a 84	29.2	38.7	33.1	1.8
			b 8	30.7	36.9		
	Bd	Distal width	15	47.1	63.0	52.1	5.10
	-	Distal depth	12	25.1	34.1	28.0	2.74
	SD	Shaft width	15	25.0	37.2	30.1	3.79
			a 9	27.3	30.9		
Phalanx 1 -fore	GL	Length	9	46.9	62.6		
			a 152	47.1	64.9	54.8	1.9
			b 25	50.8	56.1	53.2	1.47
	Bp	Proximal width	12	22.4	33.4	27.8	2.92
			a 152	23.0	30.7	28.6	1.1
			b 25	26.6	34.0	28.5	1.57
	-	Proximal depth	10	25.8	35.6	31.0	3.18
	Bd	Distal width	8	23.5	30.3		
	-	Distal depth	6	19.8	22.2		
	SD	Shaft width	10	20.4	27.6	23.4	2.27
Femur	-	Distal depth	5	74.0	116.6		
Tibia	Bp	Proximal width	8	70.0	91.0		
	-	Proximal depth	8	52.0	83.8		
	Bd	Distal width	17	39.1	61.0	53.7	5.18
			a 118	50.5	64.7	57.6	2.5
	-	Distal depth	16	32.5	44.0	39.7	3.58
Talus	GLl	Length	30	55.4	65.8	59.3	2.63
			a 157	57.3	73.0	63.1	2.8
			b 15	60.7	70.2	63.7	2.67
	Bd	Distal width	29	34.2	40.7	37.0	1.68
			a 158	33.8	45.6	39.3	2.0
			b 15	35.5	45.5	39.0	2.32
Calcaneum	GL	Length	7	113.8	129.2		
			a 97	113.8	137.5	124.9	4.8
			b 5	126.5	130.6		
	GB	Width	29	30.8	47.5	35.7	9.23
			b 5	36.7	43.0		
Metatarsal	Bp	Proximal width	15	35.1	52.4	42.9	4.80
			a 84	38.0	49.2	43.7	2.1
			b 9	41.4	46.2		
	-	Proximal depth	10	34.4	48.4	41.9	5.59
			a 82	37.4	46.2	42.8	2.1
			b 9	39.7	47.3		
	Bd	Distal width	16	43.9	59.4	50.8	5.21
	-	Distal depth	16	24.8	32.6	28.7	2.56
			a 109	24.9	32.7	29.5	1.5
			b 18	26.8	31.9	29.4	1.36
	SD	Shaft width	15	20.0	30.3	25.5	2.79
Phalanx 1 -hind	GL	Length	7	52.0	60.0		
			a 190	49.7	61.0	56.4	2.6
			b 16	48.6	58.3	54.6	2.74
	Bp	Proximal width	7	23.0	28.7		
			a 190	25.7	31.8	26.3	1.4
			b 16	22.9	28.2	25.3	1.54
	-	Proximal depth	7	27.8	32.8		
	Bd	Distal width	7	21.6	26.4		
	SD	Shaft width	7	19.4	23.2		

Bos taurus Domestic cattle (All periods, cont.)

Phalanx 2							
- hind	GL	Length	11	34.2	49.4	43.2	5.17
	Bp	Proximal width	11	24.2	33.4	29.6	3.41
	-	Proximal depth	10	21.8	28.2	25.6	2.62
	SD	Shaft width	11	20.0	26.1	23.6	2.53
Phalanx 1	GL	Length	13	48.6	61.6	55.2	4.10
	Bp	Proximal width	13	23.5	35.8	27.1	3.20
	SD	Shaft width	12	19.4	24.5	22.2	1.57
Phalanx 2	GL	Length	6	31.5	43.6		
	Bp	Proximal width	9	24.1	32.4		
	Bd	Distal width	5	20.3	24.2		
Phalanx 3 or hoof core	DLS	Length	9	47.9	78.0		
			a 157	*54.2*	*84.3*	*68.7*	*6.1*
	-	Width	5	16.6	26.5		
	HP	Height	11	29.4	45.0	34.5	5.31
			a 158	*42.5*	*62.1*	*52.6*	*3.5*

Capra hircus Goat

Bone	Driesch code	Measurement	n	min.	max.	mean	s.d.
Humerus	Bd	Distal width	7	26.5	32.4		
			a 19	*25.8*	*32.1*	*28.8*	*1.4*
			b 7	*26.8*	*30.0*		
	-	Distal depth	5	21.5	27.4		
	-	Height of coronoid	5	15.8	20.2		
Radius	Bp	Proximal width	7	25.5	29.1		
			a 18	*25.3*	*31.8*	*28.5*	*1.9*
Metacarpal	Bp	Proximal width	5	21.1	24.5		
			a 10	*22.5*	*26.6*	*24.0*	*1.4*
	SD	Shaft width	6	11.8	15.7		
			a 5	*14.9*	*16.6*		

Ovis aries Sheep

Bone	Driesch code	Measurement	n	min.	max.	mean	s.d.
Humerus	Bd	Distal width	8	25.4	28.4		
			a 42	*25.5*	*33.6*	*28.0*	*1.7*
			b 17	*25.1*	*31.5*	*27.9*	*1.78*
	-	Distal depth	6	22.1	26.0		