1. Introduction


This thesis deals with the faunal remains from several excavations in the centre of the medieval town of Emden (Lower Saxony, Germany; Figure 1-1). The aim of this thesis is to answer questions concerning the development of animal husbandry and the use of animal products in the medieval period. It is hoped to obtain a better understanding of the functions of a medieval town occupied by different groups of people and the contrast with the countryside over a period of about 900 years (9th-17th century). Preliminary reports of this study have been previously published (Grimm 2005, 2006 & 2008).

Figure 1-1 Location of Emden with river Ems (P. de Rijk).

This study is presented in the form of an introduction (chapter 1) followed by a chapter each on the animal bones from the three main excavations (chapters 2-4; see below), a chapter which
summarises the results from the analysis of the animal bones from Emden (chapter 5) and is followed by a comparison of the results from Emden with other medieval urban assemblages from the area (chapter 6). Chapter 7 presents the summary and conclusions, as well as the initiatives for further research. The thesis and its accompanying database will be published as a whole on the internet (BoneCommons hosted by http://www.alexandriaarchive.org). This study will also be published in the monograph series Probleme der Küstenforschung issued by the Niedersächsisches Institut für historische Küstenforschung, Wilhelmshaven (Germany).

Figure 1-2 Centre of Emden with the positions of the various excavations. 1) Rosenstraße, 2) Schulstraße, 3) Kirchstraße, 4) Pelzerstraße, 5) Große Kirche, 6) Emsstraße and 7) Große Straße (black lines indicate street grid before 1945; modified from BRANDT 1994).

The zooarchaeological study in this thesis deals with the faunal remains from two major excavations conducted in the 1950s in the Emden town centre: Rosenstraße and Schulstraße. Another recent major excavation in the old town centre by the Ostfriesische Landschaft, named Kirchstraße, provided new material to complete and extend the older material. The bones from the small excavations Große Kirche, Pelzerstraße, Emsstraße and a small-scale excavation from 1986 were also incorporated into this study (Figure 1-2). Although not every find spot yielded many bones and so contributed in the same way to this study, I have included them for the sake of extra
information. Together they form a unique and rich collection of material that sheds light on the use of animals and animal products from the 9th to the 17th century in Emden. Short introductions to these excavations are given in chapter 1.3.

1.1 Zooarchaeological methods

Although sporadic analysis of animal bone assemblages was undertaken from the 19th century onwards, zooarchaeology started to develop as a research discipline in its own right from about the 1940s in Germany (BECKER & BENECKE 2001, 163-164). Zooarchaeology developed a little earlier in the Netherlands due to the influential study “Die Fauna der Wurten” by Prof. Dr. A.E. van Giffen in 1913. He became the first director of the Biologisch-Archaeologisch Instituut of the University of Groningen (now Groningen Institute of Archaeology) in 1920 (until 1954). These earlier studies are mainly concerned with the identification of the faunal remains in order to produce a species list. Another important research theme was the origins of domestication through taxonomy and biometrics.

After WWII, important centres of zooarchaeological research were established in Germany. Amongst these were the Institut für Haustierkunde in Kiel in 1947 under the directorship of W. Herre. In 1967 an interdisciplinary research centre, the Archäologisch-Zoologische Arbeitsgruppe, was established at Schleswig led by H. Reichstein and D. Heinrich. Research moved away from species lists and the origins of domestication towards questions regarding food economy, importance of hunting and fishing, husbandry management, self-sufficiency or producing surplus, animal products in trade systems, procurement of raw materials of animal origin, reconstruction of the environment, the role of animals in rituals, etc. The renewed excavations at the Viking settlement of Hedeby, which started in 1963, were an important impetus for these developments (BECKER & BENECKE 2001, 164-166).

Due to the interdisciplinary character of zooarchaeology, zooarchaeologists can have very different backgrounds ranging from anthropology, biology, palaeontology, archaeology, zoology, ecology, veterinary, agricultural science to geology. Naturally, their perspectives, methodologies and research goals differ. This is also reflected in the two names most commonly applied to the field: zooarchaeology and archaeozoology. The former emphasizes its anthropological ties whereas the later emphasizes its biological origins (REITZ & WING 1999, 2-3).

In 1971 the International Council for Archaeozoology was formed to promote communication within the diverse zooarchaeological community, as well as to create an ongoing dialogue with archaeologists, biologists, and others interested in the rich history of human/animal interactions. Zooarchaeologists from all over the world maintain close contact through the conferences organised by ICAZ every four years. Additionally, ICAZ serves as an umbrella for several working groups involved in sub-disciplines like: animal palaeopathology, archaeomalacology, zooarchaeology and genetics, zooarchaeology of Southwest Asia, birds, fish remains and worked bone. National platforms like the Gesellschaft für Archäozoologie und prähistorische Anthropologie in Germany (founded in 1994) and the Professional Zooarchaeology Group in the United Kingdom (founded in 2005) maintain contact and foster research and professional development in between the ICAZ conferences. Increased use of the internet and email has led to the development of a dedicated email list (Zooarch), the ICAZ online community (BoneCommons) and a social network (Zooarchaeology).

Current zooarchaeological research still mainly consists of the identification of animal bone assemblages by comparison with reference material. In addition, new scientific methods like C14-dating, DNA analysis and isotope analysis widen the possibilities for answering questions concerning the origins of domestication, the invention of diary, trade in animals and their products,
meat and dairy components to the human diet, animal diet etc. The methods used to study the animal bones from medieval Emden are outlined below.

**Identification**

The remains of mammals, birds, fish and amphibians were identified as far as possible to species level, with the aid of the recent reference collection of the Groningen Institute of Archaeology, University of Groningen (GIA), a small reference collection of archaeological material housed at the Niedersächsisches Institut für historische Küstenforschung and appropriate literature (SCHMID 1972; COHEN & SERJEANTSON 1996; LEPIKSAAR n.d.). The fish remains, mainly from the soil samples of the excavation Kirchstraße, were identified by Dr D. Brinkhuizen of Monument en Materiaal (Groningen). Dr W. Prummel (GIA) studied the mollusc shells from the same soil samples.

The separation between wild species and their domesticated forms is based on size and thus remains uncertain. For the naming of the wild forms and their domestic derivatives the author followed the rules as proposed by GENTRY et al. (2004).

In most cases, it is difficult to separate the sheep from the goats based on their bones. Cranium, scapula, humerus, radius, ulna, metapodials, femur, tibia, calcaneus and talus provide distinguishing characteristics as described by BOESSNECK (1969) and PRUMMEL & FRISCH (1986). Only the pattern of sutures of the cranium and the horn cores, however, form a solid distinguishing mark between the species. To separate the sheep from the goats based on the other bones, large sets of these bones of adult animals are necessary. As the Emden material lacks suitable material, mostly only the cranium and the horn cores were used for separation. The post-cranial bones of some randomly picked occupation phases showed that none of these bones could be assigned with certainty to goat. The bones listed as goat are all horn core fragments. Although, the possibility exists that there are some goats among the bones listed as sheep/goat, only age and measure data for sheep were applied on the sheep/goat bones.

**Relative frequencies of the species**

There are three major methods to establish the contribution of a species to people’s diet (RENFREW & BAHN 1996, 272-273). The first method is the Number of Identified Specimens (NISP) method and is obtained by simply counting the identified bones. The method is based on the fact that all mammals and birds have more or less the same number of skeletal elements in their body. Thus, the sequence of importance found on the basis of the NISP is identical to the relative numbers of animals present. This method favours species with fragmented bones. The NISP also favours species with skeletal elements with dense bone structure which are less subject to deterioration. Especially on sites with a less suitable soil matrix for the preservation of bone (like sand), this is a real problem. As bone fragmentation and the conditions for bone preservation differ from site to site, it is not really possible to compare these sites on the basis of the NISP. The results of NISP can be biased by the sampling method. On sites where bone material was hand-collected only, bones of small species like rodents, birds, fishes and amphibians can be underrepresented. It is therefore preferable that samples are taken and wet-sieved.

Another point of concern involves comparing mammal and bird NISP figures with those of fish. The numbers of skeletal elements in fish differ from the numbers found in mammals or birds. In addition, BRINKHUIZEN (1989, 147) states that as the number of serial elements (i.e. fin rays, ribs

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1 A fourth method (‘Stetigkeit’), adopted from palaeobotany, compares species presence between different sub-areas within the research area (SCHMÖLCKE 2003, 197). Due to differences in size and structure of the bones and the size of the natural population, a direct comparison between mammals, birds and fishes based on NISP, BW or MNI is invalid, Stetigkeit overcomes these problems. This method could not be employed for the Emden material as the bones were not assigned to features due to the employed excavation technique.
and vertebrae) in fish differs from species to species and within species, the chance of recovery for species with a high number of a particular serial element is higher. However, apart from the vertebrae, the other serial elements are usually not determined to species level. This means that this “adjusted” NISP for fish does not really differ from that of mammals and birds.

Another relatively simple method is the Bone Weight method (BW). This method is based on the fact that about 7% of the life weight of a mammal consists of its skeleton (KUBASIEWICZ 1956). This means that the found sequence of importance is identical to the amount of meat. In comparison to the NISP method it rules out the level of fragmentation and the differences in numbers of skeletal elements between species. Experiments have shown, however, that the relation between bone weight and meat yield in domestic animals differs both between and within modern breeds. UERPMANN (1972, 13) argues that these differences are evened out in an archaeological sample. It is unlikely that, within comparable cultural units, on one site only heavy boned animals and at the other site only light boned animals were kept. The results of a small test carried out by BRINKHUIZEN (1989) on some fish species suggest that the relation between total weight and bone weight is not constant. This means that the BW method is not suitable to establish the contribution of fish to the diet.

The third method is a more complex method with no standardized procedure: the Minimal Number of Individuals method (MNI). The aim of this method is to reconstruct the minimal number of individuals represented in the bone material. This does not mean that the MNI is the actual number of animals that have ever lived or died on the site. Moreover the method delivers relative proportions of kept, collected or hunted animals (UERPMANN 1972, 14). The weakest point of this method is the many different procedures used by the authors to reconstruct the MNI (CLASON 1972, 141; HESSE & WAPNISH 1985, 66; RENFREW & BAHN 1991, 250). Another objection to this method is that it favours those species represented by only a few bones. The MNI and the NISP results approach each other for species with a low NISP-value (a species represented by one bone has a NISP of one and a MNI of one). On the other hand the difference between the NISP and MNI increases when the number of bones per species increases (UERPMANN 1972, 14). The advantage of this method is that it reduces the weak points of the NISP method (differences of fragmentation and different number of skeletal elements between species).

It becomes evident from the above, that all three methods have their strengths and weaknesses. The first two methods do not take into account the effect on a bone of the many different taphonomic processes like fragmentation, preservation and excavation method. They also imply that there is a certain uniformity (all animals have more or less the same number of skeletal elements and there is a constant relation between life weight and bone weight) among species. It is, however, possible to roughly compare sites of the same period and region with the help of these methods. In this study all three methods were applied. Their results were compared and explained in the light of the above. In this way they rule out each other’s weaknesses and provide a general picture on the importance of the different species to the Emden people.

**Fragmentation**

To establish its degree of fragmentation, every long bone, scapula, pelvis and mandibula was described by a code of three ciphers. The bone was theoretically speaking divided into three parts. The proximal part (or mandibula hinge c.q. ilium) was assigned cipher 1, the diaphysis (tooth row, acetabulum) was assigned cipher 2 and cipher 3 was assigned to the distal part (incisivium, ischium). A zero means that the part is missing in the particular fragment.

**Herd structure and management**

Ageing of the animal remains uses sequences of tooth eruption and wear, and epiphysial fusion based on the study of modern populations (SILVER 1969, 283). Zooarchaeological application of
these methods is based on the assumption that the age at which a particular tooth erupts or a particular epiphysis fuses is the same for all specimens of a species in the assemblage. However, this is not necessarily true as factors like breed, age at weaning, nutrition and ingestion of soil influence tooth eruption and subsequent wear (Zeder 2006, 94). In addition, sex and possible castration influences epiphyseal fusion (ibid 2006, 92). Davis (2000, 373) was able to show, based on experimental work with Shetland sheep, that tooth eruption in sheep and goat is not sex dependent. This is likely to be true for cattle, pig and horse as well. Since less factors influence tooth eruption, it is thought of as the more reliable method. Unfortunately, the eruption of the last tooth element takes place much earlier than the fusion of the last epiphysis. Epiphyseal fusion thus provides data on older animals.

<table>
<thead>
<tr>
<th>Tooth eruption</th>
<th>Cattle</th>
<th>Sheep</th>
<th>Pig</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk premolars in eruption</td>
<td>0-3 weeks</td>
<td>0-4 weeks</td>
<td>0-7 weeks</td>
</tr>
<tr>
<td>Milk premolars have erupted</td>
<td>until three months</td>
<td>1-2 months</td>
<td>older than 7 weeks</td>
</tr>
<tr>
<td>P4 has erupted</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M1 in eruption</td>
<td>5-6 months</td>
<td>3 months</td>
<td>4-6 months</td>
</tr>
<tr>
<td>M1 has erupted</td>
<td>7-14 months</td>
<td>4-8 months</td>
<td></td>
</tr>
<tr>
<td>M1 has erupted, I3 and C changing</td>
<td>15-18 months</td>
<td>9 months</td>
<td>6-10 months</td>
</tr>
<tr>
<td>M2 in eruption</td>
<td>10-12 months</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M2 in eruption, I3, C and I1 changing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M2 has erupted</td>
<td>19-24 months</td>
<td>10-17 months</td>
<td>12-16 months</td>
</tr>
<tr>
<td>M2 has erupted, P2-P4, I1 and I2 changing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M3 in eruption, P3 changing</td>
<td>24-28 months</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M3 in eruption, P2-P4 changing</td>
<td>18-24 months</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M3 in eruption, I2 changing</td>
<td>16-24 months</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P2 and P4 changing</td>
<td>29-34 months</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M3 and P2-P4 have erupted, hardly worn</td>
<td>young adult</td>
<td>young adult</td>
<td>young adult</td>
</tr>
<tr>
<td>M3 medium worn</td>
<td>adult</td>
<td>adult</td>
<td></td>
</tr>
<tr>
<td>M3 significantly worn</td>
<td>old adult</td>
<td>old adult</td>
<td>old adult</td>
</tr>
<tr>
<td>M3 heavily worn</td>
<td>senile</td>
<td>senile</td>
<td>senile</td>
</tr>
</tbody>
</table>

Figure 1-3 Tooth eruption and wear for cattle, sheep and pig (after Habermehl 1975).

It is evident that with so many factors (possibly) influencing the maturing of an animal, often differences are seen between the age patterns based on tooth eruption and those based on epiphyseal fusion. Comparing the two systems based on a modern study of wild sheep from Iran and Iraq, Zeder (2006, 97) was able to show that there was an 82% overlap in dental ages and fusion ages. The best correlation was achieved for the younger stages as the older stages are entirely based on tooth wear. However, when a sample contains both sheep and goat, males and females, overlap is only slight and big differences between skeletal and tooth age are seen. It is to be expected that this discrepancy is even more pronounced in archaeological material due to taphonomic processes. Many remains cannot be aged as they lack some teeth or the epiphyses have been chopped off in the butchery process. Since mandibles seem to be little affected by butchery and subsequent burial, even some of the more fragile ones of young animals are likely to be found. The other parts of the skeleton are less likely to be preserved or identified. Thus mortality charts based on tooth eruption show a higher proportion of young animals, whereas charts based on fusion show a higher proportion of older animals.

The age at death of the Emden animals was estimated by tooth development and the fusion of the bones of the post-cranial skeleton (Figure 1-3; Habermehl 1975). Together, these methods provide

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2 See this reference for a discussion on the advantages and disadvantages of the use of the different aging systems as published by a wide range of authors. Combining the literature and her own studies, Zeder (2006) refined existing methods. The last two years sees an increase in studies which try to link the existing methods by Payne (1973) and Grant (1982) to absolute ages. Jones (2006) tested and refined the Payne method by using modern living livestock in the UK. Greenfield & Arnold (2008) tested and refined the Payne, Grant and Jones systems based on a small sample of butchered sheep and goat from Manitoba, Canada. Twiss (2008, 349-350) evaluated several wear methods and concluded that methods based on patterns of occlusal wear are preferable over those which use crown-height measurements.
good insight in the age structure of the different species until adulthood is reached. Establishing stages of advanced age after all epiphyses have fused and all teeth have erupted is less precise however, as it no longer depends on a process which is more or less the same in a given species (Silver 1969, 290; Levine 1982, 227). Although the use of digital cementum luminance analysis can overcome these shortcomings, the technique requires specialist equipment and experience (Wall-Scheffler & Foley 2008). The large proportion of young sheep in the assemblage (see below) cannot be analysed with this method. The total length of foetal bones of cattle and sheep/goat was used to estimate the gestation period (Habermehl 1975, 65 & 114).

Knowing the sex of the animals from which the bones derive can enhance the understanding of the husbandry method used. Sexual dimorphism might be expressed in the bones when there is a difference in size between male and female, the same bone has a different morphology in the sexes or when an extra element is present in one of the sexes. Differences in size are difficult to detect as there is often a considerable size overlap between the sexes. The presence of castrates or different breeds possibly obscures identification. Morphological differences form a good tool to separate the sexes. The different shape of the canines in pig is a good example. Separation based on the form of the pelves (related to the possibility to give birth) is less satisfactory especially in a fragmented assemblage. However, Greenfield (2006) showed that this is possible for cattle and sheep/goat based on the height of the medial wall of the acetabulum. The presence of an extra bone in one of the sexes, like the penis bone in canids, should result in a 100% identification of complete skeletons. Its absence might, however, be due to excavation technique. The spur on the tarsometatarsus in fowl species and the upper canine in horses are mainly seen in the males, but not exclusively.

Sexing young animals is often impossible, as sexual dimorphism has not yet developed. A good example is given by Hatting (1995, 75) as she warns that sexually dimorphic differences in the morphology of the pelvis are not clear in young sheep (less than a year). Furthermore, it seems that early castration especially in large male mammals influences the metacarpals and the pelvis; making them more feminine in appearance. New research on macroscopic bone structure seems able to identify the practice of late castration (Dammers 2006, 28).

In this study the sex ratio of a group of adult cattle was determined by the circumference (measurement 44; Von Den Driesch 1976, 28) and the smallest breadth divided by the largest width (measurement 46/45; Von Den Driesch 1976, 28) of the horn core multiplied by 100 (Ijzerbee, 1981, 42-43). The cross section of a cow’s horn core is almost round, in bulls it is also round but with a flattened base and oxen have the same cross section as cows but are much larger. The differences between the forms of the horn cores can become less obvious because of the diverse shapes of the horn cores, the presences of young animals and the practice of castration (Uerpmann 1972, 16); in the Emden material at least the males could be separated from the females in most cases. The sex of pigs was estimated using the canines of the maxillae and mandibles. The form of these teeth differs in boars and sows. The canines of boars are also larger and have roots that stay open all their lives whereas they close with advanced age in sows (Habermehl 1975, 135).

**Phenotype**

Measurements were taken according to: Von Den Driesch (1976) for mammals and birds and according to Morales & Rosenlund (1979) for fishes. Measurements were taken with digital calligraphers to the nearest 0.1 mm.

Several authors have published multiplication factors or regression formulas for transforming long bone lengths into estimated heights at the withers. These heights at the withers can only give an approximate value as they are based on an ‘average’ obtained from modern material. Ideally, the more bones from the same individual can be taken into account, the more accurate the estimation
will be. However, this situation seldom occurs in a disarticulated assemblage like the one from Emden. Moreover, complete long bones are scarce as intensive butchering techniques meant that they were frequently chopped up. Although the larger bones would give better estimations than the smaller ones (i.e. calcaneus, talus) which suffer more from difficulties in accurate measuring, MAY (1997, 139) states that the mean calculated from a larger sample of these smaller bones can give a good indication of the height at the withers. However, this does not help with the Emden material as, especially in the older assemblages, the suitable smaller bones (calcaneus and talus of sheep; dog and pig metapodials) are underrepresented due to the excavation technique employed. A good alternative would be the use of the metapodials of horse, cattle and sheep. But, metapodials were highly valued as raw material for skates, combs and other bone objects and are thus underrepresented as well.

In the case of cattle, the factors as proposed by VON DEN DRIESCH & BOESSNECK (1974) and MATOLCSI (1970) were used. As it was impossible to sex most of the metapodials, the means of the factors for males and females were used: 6.15 for metacarpals and 5.45 for metatarsals. The heights at the withers for sheep were estimated using the factors of TEICHERT (1975). The algometric formulae of MAY et al. (1996) based on the work by TEICHERT (1969) were used to estimate pig height at the withers. The regression formulae of HARCOURT (1974) and CLARK (1995) were used to estimate height at the withers in dog. The factors as published by VITT (1952), MAY (1985) and the tables as published by KIESEWALTER (1888) were used in establishing the height at the withers of horses.

Calculating the height of the animals neglects other body proportions as slender animals might have the same height as stocky ones, but could differ quite a bit in their appearance. Abandoning the reconstruction of heights at the withers and using (a combination of) single measurements to characterise populations has its problems as well. Generally, early fusing epiphyses show some growth in width after fusion. This is especially true for the scapula (measurement GLP), humerus (BT) and radius (Bp and BFp) and perhaps talus (Bd). As the latter does not have a fusing epiphysis, estimating age beyond a crude, and by no means absolute, separation of adult and juvenile based on bone surface, is not possible (PAYNE & BULL 1988, 30; DAVIS 2000, 384). Furthermore, the width of the shaft of long bones (SD) and of the collum of the scapula (SLC) is very age dependent (ALBARELLA 2002, 54). Molar widths, however, are not age-dependent. The third molar is particularly suitable in this respect as even loose teeth can be identified without doubt as third molars. Loose first and second molars are less distinguishable from each other.

Taking the above restrictions into account the log ratio method was applied on the measurements of cattle, sheep and pig bones. The logarithm of the ratio between a measurement and its standard was calculated (see DAVIS 1996 for a full description and zooarchaeological application of the method). To overcome the small sample size, all length and width measurements were pooled together. DAVIS (1996, 611) was able to show that measurements taken along the same axis (length, medio-lateral width and antero-posterior depth) are strongly correlated.

Butchery

Butchery marks are defined here as those marks which resulted from a metal object damaging the bone between the time of slaughter and the time of consumption. Strictly speaking, marks occurring during food preparation and subsequent consumption are not butchery marks. However, it is impossible to tell them apart as a bone that is filleted just after butchery on the site of butchery looks the same as a piece of meat purchased on the bone and filleted in the kitchen or on the table. Both bones can subsequently end up in the same archaeological assemblage.

Butchery marks can be divided into cut, chopping and shaving marks. Cut marks are linear marks which occur single or in groups and only slightly penetrate the bone. They are caused by knives or
other light implements with a blade. Whoever used these implements would not wish the blade to blunt and so marks seen on the bone are predominantly accidental\(^3\). This means that most of the skinning, filleting and disarticulation of small carcasses can not be seen in the archaeological record. Chopping marks on the other hand damage the bone on purpose as axes and cleavers are used to disarticulate and portion predominantly larger carcasses. Special forms of chopping marks are the so-called scoops, which are superficial blade marks or shaving marks (SEETAH 2006, 10). They occur when the blade was used almost parallel to the bone in order to scrape the meat of the bone.

Pathology
Unlike human palaeopathology, the analysis of animal palaeopathology has only recently moved away from the identification of gross morphological changes (the “interesting specimens approach”; THOMAS & MAINLAND 2005, 1-2). This is due to the fact that the study of animal palaeopathology is hampered by the mostly disarticulated nature of the material. In the case of a grave, a whole human skeleton can be examined and the consequences of a particular condition can be studied throughout the skeleton which is needed to achieve differential diagnosis, particularly when the skeletal responses to disease processes are relatively limited\(^4\). Such links cannot be made with pathological changes found in butchery waste. Related to this are the impact taphonomic factors can have on the appearance of bone material making the recognition of pathological changes difficult. Secondly, most zooarchaeologists are not veterinary surgeons and are thus unfamiliar with the medical side of animal bone analysis. Thirdly, it is often difficult to pinpoint exactly what caused the observed changes in the bone as most conditions lack a single aetiology. This means that distinguishing between old age or over use is often not possible\(^5\). Another major disadvantage is the lack of suitable comparative studies on modern material to establish the prevalence of a particular pathological change. The compilation of such data series is hampered by the fact that the current living conditions for animals are far more extreme compared to prehistoric times (bio industry or modern pets). Furthermore, farmstead animals are generally slaughtered at a (much) earlier age than they were in the past and thus had less time to develop the pathological changes seen in their ancestors.

The above problems have resulted in inconsistent recording, diagnosing and interpretation of pathological conditions seen in animal bone assemblages. The development of a standardised recording protocol for animal palaeopathology by VANN & THOMAS (2006) will hopefully enable detailed studies of regional or temporal trends in the future. Although this system had not yet been developed when the pathological bones in the Emden assemblage were studied, its way of describing the bones was applied in retrospect. However, the calculation of accurate prevalence cannot be undertaken as the zonation system used at Emden does not allow for detailed observations; each bone was split into the proximal part, the shaft and the distal part, with a zone being scored when more than 50% of it was present. This system is cruder than the up to 12-zone system of DOBNEY & REILLY (1988) as recommended by VANN & THOMAS (2006). Minimal numbers of prevalence, using the three-part zonation, were calculated in some instances. While the study of pathological changes encountered in the animal bone from Emden is limited by the same difficulties as described above, some observations made show how a particular species was used, kept or treated.

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\(^3\) Although probably derived from the same principle, Jewish butchers try, in order to keep the meat kosher, to keep contact with the bone to a minimum (COPE 2004, 32). This would result in butchered animal bone assemblages almost without butchery marks!

\(^4\) Most diseases will not leave any traces on the skeleton even when the animal was severely ill.

\(^5\) Infections or degenerative diseases of the joints are called arthritis (infection) or arthrosis (old age or chronic overstress). Although caused by different processes, arthritis and arthrosis cannot be distinguished from the bones alone. The fusion of two bones as a result of arthritis/arthrosis is called ankylosis (WIJGAARDEN-BAKKER 1979, 37-40).
The Emden animal bone assemblage was analysed using cost effective macroscopic methodologies. Human-animal relationships from the 9th to the 17th centuries were investigated, concentrating on the contribution of animal keeping to the town’s economy.

1.2 An introduction to the Emden excavations

The Provinzialstelle für Marschen- und Wurtenforschung im Landesmuseum Hannover had been established in 1938, its interdisciplinary character closely modelled on the Biologisch-Archaeologisch Instituut of the University of Groningen. The institute was moved to Wilhelmshaven in 1947 and renamed Niedersächsischen Landesstelle für Marschen- und Wurtenforschung (Schmid n.d., 64-65). The institute conducted a survey of the dwelling mounds of the East-Frisian coastal region in 1936-37. Before the survey, three types of dwelling mounds were known: round dwelling mounds (Rundwarfen), elongated dwelling mounds (Langwarfen) and farmstead dwelling mounds (Gehöftwarfen). The round mounds and the farmstead mounds are most common and are still populated by settlements. The elongated mounds are much rarer in the coastal area of Lower Saxony and most survive deserted. It was thus unclear what the nature of their original settlements was. The survey from 1936/37 identified still populated elongated mounds in the East-Frisian coastal region. Subsequent auguring showed that the elongated form of the mound resulted from their initial construction on the bank of a tidal creek.

The settlement structure on these elongated mounds, as seen in the survey, consists mainly of small houses occupied by craftsmen, merchants and labourers closely spaced on either side of a road (Straßensiedlung). Farmsteads look out of place on these narrow mounds as they spill over onto their slopes. If these farmsteads reach back until the time before the first dikes were built, they must have been frequently flooded. Round mounds are perfect for agricultural settlements as farmsteads can be arranged radiating from the centre, elongated mounds seem not. Is thus mound form related to settlement type and economic activity?

![Figure 1-4 Three-aisled house as reconstructed for Emden (after HAARNAGEL 1955, 22).](image)

This question was rekindled after WWII with the excavation of the farmstead dwelling mound of Hessens near Wilhelmshaven. The excavation turned up a high proportion of import ceramics and thus showed that its population had been involved in trade activities from the early 10th century onwards. This shows that trade centres existed in the coastal area during this period. Hessens was characterised by the same small houses known from the excavations at the early medieval port of trade Hedeby. The old town centre of Emden was severely bombed during WWII and this offered the opportunity to investigate the dwelling mound of a known mercantile town. By 1951, shortly before rebuilding activities would start, Prof. Dr. Haarnagel of the Niedersächsischen Landesstelle für Marschen- und Wurtenforschung was granted enough financial means to start excavations on the Emden dwelling mound.

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6 The following three paragraphs form a summary from HAARNAGEL 1955, 9-11.
Rosenstraße

The bone material presented in this PhD-thesis comes from several excavations conducted in the old town centre of Emden. The first excavation was conducted in 1951-52 in the Rosenstraße (in the literature it is often referred to as “Emden I”) under the supervision of Prof. Dr. Werner Haarnagel from the Niedersächsische Landesstelle für Marschen- und Wurtenforschung (now Niedersächsisches Institut für historische Küstenforschung), Wilhelmshaven. The trench was laid out E-W and measured 20 x 8 m at the start (+6.0 to +5.6 m above German Ordnance Data (OD)). For safety and technical reasons the excavators had to make stepped section walls, which resulted in a small trench measuring only 15 x 2 m at its deepest point of +0.7 m above OD.

The excavators removed the soil in artificial layers of about 30 cm thick. Find recording started at a depth of +5.2 m above OD, although late medieval buildings had heavily disturbed this occupation phase. An E-W orientated house was situated in the eastern part of the trench from the late 9th/early 10th century until the first half of the 13th century. The location of the house changed several times, but from the 11th century onwards it remained in the N-E corner of the trench. Bearing middle posts were found in three of the six succeeding house plans which made them three-aisled houses (Figure 1-4). The thick layers of dung from the late 9th/early 10th century were not encountered in later periods. This indicates that the earlier versions of the house probably had a stable, the later phases

Figure 1-5 The Rosenstraße excavation at a depth of +1.90 m OD showing part of a three-aisled-farmhouse bottom right (from West, NlhK).
Until the 11th century only one house was found per occupation phase. According to HAARNAGEL (1955, 32), this meant that population density was low at that time. A second E-W orientated house was found in the S-E corner of the trench in the late 10th/early 11th century occupation phase (Figure 1-5). The oldest form of this house had wattle-and-daub walls, but subsequent walls were made of planks (Stabbauten). Smaller buildings with an N-S orientation were added from the 11th century onwards. Population density became so high that the houses stood only about one metre apart. These smaller houses were of the Firstpfetten type and too small to be divided into a living part and a stable (Figure 1-6). Their function was probably limited to living and working. Most of the posts in the 11th century occupation phase were burnt (BRANDT 1994, 28-33).

Figure 1-6 Firstpfetten house as reconstructed for Emden (after HAARNAGEL 1955, 22).

Although no more house plans were unearthed, the excavation was extended to a depth of -0.5 m below OD and partly to a depth of -0.8 m below OD. No virgin soil was reached at this depth. Auger sounding demonstrated that at a depth of −1.25 to −1.45 m below OD virgin soil was met. This means that the artificial dwelling mound (German: Wurt and Dutch: terp or wierde) had at this particular spot a height of about 6.85 to 7.45 m³. As no occupation phase was found beneath +0.7 m above OD and the virgin soil was not reached until a depth of −1.25 till 1.45 below OD, it is evident that, according to the results of this excavation, Emden did not evolve from a Flachsiedlung to a dwelling mound. Instead, about 2 metres of soil were accumulated before people built their homes on it (HAARNAGEL 1955, 32).

Schulstraße

The second excavation was conducted in the Schulstraße (in the literature referred to as “Emden II”) in 1953 also under the supervision of Prof. Dr. Werner Haarnagel. The trench was laid out N-S and measured 18 x 9 m at the start (+6.0 m above OD). For safety and for technical reasons they had to make trench walls in the same way as at the Rosenstraße (Figure 1-7). The trench measured only 10 x 3 m at its deepest point of ± 0.0 m OD. The excavators removed the soil in artificial layers of about 30 cm. Concrete cellars of the former stone houses, air-raid victims of WWII, had

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7 The Firstpfette is the purlin in the ridge of a timber roof.
8 HAARNAGEL (1955) mentions a height of 7.85 m (+6.40 m to −1.45 m) on page 32. On page 15 however, he states that the excavation started at a height of +6.00 m at the western and +5.60 m at the eastern end of the trench. This wrong calculation was adopted by STILKE (1995, 15). However, RASINK (2005a, 3) also mentions c 8 meters.
heavily disturbed the upper occupation phases. Find recording started at a depth of +3.9 m above OD (HAARNAGEL 1955, 33).

The occupation history of the Schulstraße starts in the mid 9th/early 10th century. Most houses had an E-W orientation until the 11th century. They might have been of the Firstpfetten-type as they were about 2.6 m to 3.3 m wide. This means that they had probably a living function and/or were workshops. Three of these houses stood with their façade along the street. The many pieces of charcoal found in the 11th century occupation phase indicate a fire. The houses were N-S orientated and stood with their façade along the street in the 12th century. Between the houses were 0.3-1.5 m broad alleys. Although these houses had a width of 6.5-6.8 m and might have been three-aisled, the absence of dung or stable boxes indicates that they had a living and/or workshop function. The houses of the 13th century were of the Firstpfetten-type again (BRANDT 1994, 29-33).

The oldest predecessor of the Schulstraße was encountered in the occupation phase dating to the 10th century at a depth of +0.90 m above OD. In all later occupation phases the street was renewed and broadened. In the 14th century it was 2.4 m wide and made up of planks over an artificial layer of mussel shells.
Layers of clay were found underneath the oldest occupation phase, whereas an old soil without features or finds was encountered in the southern part of the trench. Virgin soil was met at a depth of –1.25 m below OD (HAARNAGEL 1955, 33-45).

**Große Kirche**
Prof. Dr. Werner Haarnagel also excavated in the nave of the Große Kirche in 1953. The trench was laid out N-S and measured 14.5 x 4.7 m at the start (church floor: +3.45 m above OD). Three building phases of the church could be distinguished from the remains of stone walls. The oldest belonged to a stone Romanesque one-aisled church. Underneath the Romanesque foundations at +1.17 m above OD, the remains of two possible preceding wooden churches were found9. Due to the many younger graves inside the church as well as transformations made to the church, none of the finds were found *in situ* (HAARNAGEL 1955, 46-56).

**Pelzerstraße**
In 1959 Dr Waldemar Reinhardt from the Niedersächsische Landesstelle für Marschen- und Wurtenforschung, excavated in the Pelzerstraße and tied the levels met with in his excavation with those in the older excavations by a set of auger soundings. He had hoped to get a better insight in the oldest part of the dwelling mound here. The trench was laid out SE-NW and measured 10 x 8 m at the start (+3.0 m above OD). He also had to make stepped trench walls, which resulted in a very small trench measuring 4.6 x 1.6 m at its deepest point of -1.5 m below OD.

The excavator identified four occupation phases. A fifth layer on top of the others was not with certainty distinguished. Virgin soil was reached at a depth of approximately –0.8 m below OD. Two ditches marked the old soil above. The information on the buildings in this part of the town is limited, as a huge pit covered about two-thirds of the excavated area. Only a small area in the northern and western part of the trench (+2.2 to +0.2 m above OD) yielded wooden posts and wattle-and-daub walls. A part of a three-aisled building from the 12th century was reconstructed from these remains. Striking is the fact that all remains paralleled the course of the modern-day Pelzerstraße. The oldest part of the dwelling mound was not met in this excavation. It must have been situated between the Pelzer- and Schulstraße. In addition, this excavation and adjacent auger soundings showed that the ancient harbour was situated at the Ratsdelft, a tidal channel of the Ems (REINHARDT 1970; BRANDT 1994 14-15, 40-41).

**Große Straße**
The Niedersächsische Landesstelle für Marschen- und Wurtenforschung under took a small-scale excavation as the pedestrian area was enlarged in 1986. Two parallel N-S orientated trenches were dug and their c 2 m deep west section documented. The northern section showed accumulated layers of sods and humus clay at a depth of +1.8 to +0.4 m above OD. It is anticipated that the virgin soil lies underneath. The southern section showed a heavy disturbance until a depth of +0.9 m above OD. An accumulated layer of clay and a humus layered with dung lies beneath the disturbance at a depth of +0.5 m above OD. Auger sounding showed that these clay and dung layers extended to a depth of –1.8 m below OD. Integration of the finds of this excavation to the Rosen- und Schulstraße excavations is impossible as the trenches were very small and the distance between these and the other excavations is too large (STILKE 1995, 19). The oldest potsherds date to the 13th/14th century (BRANDT 1994, 23).

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9 New excavations in 1990-91 and 1993 by the Ostfriesische Landschaft, Aurich determined that the second wooden church was built in AD 966 and that this one was most likely preceded by a wooden church built after AD 941. The first stone church (Romanesque) was probably built after AD 1200. In the late 13th or early 14th century the stone church was transformed into a cruciform church. Before AD 1453 the church was transformed into a three-aisled building (BÄRENFÄNGER & KRONSWEIDE 2004, 609-610).
Emsstraße
The Ostfriesische Landschaft, Aurich, obtained some archaeological information during the canal renewing in 2002. Most finds were of late medieval and modern date (RASINK 2003, 25).

Kirchstraße
The Kirchstraße is of great archaeological interest as it forms the transition area between the town’s dwelling mound and the mound on which the church was erected. This leads to the main research question: was the transition area between the two mounds filled-in gradually or at once as part of a structured development act directed by the ruling party?

The Ostfriesische Landschaft was able to excavate this site due to a sewage renewing programme in 2001-03. The excavation took place under the supervision of Bernd Rasink (BÄRENFÄNGER & KRONSWEIDE 2002, 21-22; RASINK 2003, 25-26; RASINK 2004a, 23; RASINK 2004b, 672-676; RASINK 2005a). The sewage renewing was supervised archaeologically from half way between the Große Burgstraße and former Rosenstraße. A section with a depth of about 2.5 m (from c +3.0 m above OD) was recorded over the course of the Rosenstraße till halfway Große Burgstraße. The foundations of the former Kirchstraße 11 were found at the corner of the Kirchstraße and the Schulstraße beneath the modern pavement. The northern wall of the cellar was built upon an older wooden construction.
An excavation was undertaken south of the mouth of the Schulstraße till past the mouth of the Pelzerstraße. Just beneath the pavement, a 24 m long row of three houses was uncovered. The northern part of the excavation yielded late medieval wooden features at almost exactly the same depths as their modern counterparts. It is further assumed that a wooden predecessor of the building on the corner Kirchstraße-Schulstraße was found. In front of its façade at the western side, a pathway, up to 0.9 m wide and 3.6 m long, built of timber planks secured by upright parts, was uncovered (Figure 1-8).

In 2002 the excavated area was deepened from +3.42 m above OD to +1.80 m above OD. The remains of the buildings Kirchstraße 11 and its wooden predecessor were excavated further. Both buildings match with old town plans. In the northern part of the excavation, the remains of at least one burnt-down Firstpfetten building with its façade facing the Kirchstraße was uncovered. A small pathway besides the northern wall of this building, probably made of brushwood and staves, formed a corridor between this and the adjacent house. In the southern part of the excavated area a water-filled well was found. It goes as deep as the base of the church’s mound at –1.65 m below OD. The discovery of leather shoes and scraps suggests that a leather workshop existed near the excavated area.

In the southern part of the excavated area, beneath the burnt house(s) a wattle-and-daub wall surrounded a rectangle pit (6.0 m long, 3.4 m wide and 1.3 m deep). This dung pit was filled with two rich organic layers containing scraps of textile and leather, archaeobotanical material and entomological material. The feature was extensively sampled for zooarchaeological material (see 4.9). At a depth of –2.0 m below OD two ditches were found filled with shell-tempered ware from the second half of the 10th century.

The area covered by the Kirchstraße excavation was tossed up at least three times between the time of the ditches and the time of the burning of the house(s). The property boundaries seem to have been very consistent over the centuries. Even before buildings were erected, the allotments were marked by a ditch or a fence of birch posts. The area where the town’s dwelling mound touches the church’s mound was filled up abruptly10 in the 12th century with a c 2 m layer of dung and clay.

Publication record and future excavations in Emden

The current zooarchaeological analysis, including the small finds made of bone and antler, form part of an ongoing effort to shed light on medieval Emden. Haarnagel’s publication of the archaeological results of the excavations Rosenstraße, Schulstraße and Große Kirche in 1955 was only intended as an interim statement. And although Brandt wrote a synthesis of the Emden excavations in 1994, including the older Haarnagel excavations and the excavation Pelzerstraße, no integrated site report for the Rosenstraße or Schulstraße excavations exists. So far, Stilke’s publication in 1995 on the pottery from the Emden excavations and Tidow’s publication on the textile fragments in 2007 are the only material groups published. The leather finds, metal objects, various categories of small finds and the botanical samples still await analysis and publication. The human skeletons from the Große Kirche form part of a PhD by Katherina Stech of the University of Berlin. An integrated site report for the Kirchstraße excavation which includes brief comments on all material groups, except the botanical samples, was published by RASINK (2005a).

Due to the built up nature of urban centres and a change in archaeological practise it seems unlikely that research excavations like those at the Rosenstraße, Schulstraße, Pelzerstraße and Große Kirche will be conducted in the near future in Emden. It is likely that future excavations in the city centre will have the character of rescue excavations like the one at the Kirchstraße when the mains were replaced. This means that building development will dictate future excavation sites.

10 Potsherds of the same pots were found spread vertically in this homogeneous layer.
1.3 Landscape and historical background of Emden

Landscape and situation
As Emden was established in the 8th century, the town lay in-land as the Dollart had not yet been washed out by the Marcellus flood of AD 1362. Before the flood, the Dollart area was drained towards the river Ems by the rivers Aa and Tjamme. The surrounding marshland was filled with many peasant villages and several early economic centres. The villages Hatzum and Groothusen for instance, which developed in the 8th century and were overpowered in the 10th century by Emden, lay only about 11 km away from Emden (STILKE 1995, 119). These early economic centres participated in a network of trading places connecting the Emden area with Hedeby and Dorestad. The trading ships would navigate orientating on the coast line. The favourable situation of Emden at the mouth of the river Ems allowed it both maritime trade routes and a route inland via the river (BRANDT 1994, 48-49).

Charlemagne (768-814 AD) granted the town to the earls of Westphalia. The estuary of the Ems had become part of the East-Frankish Empire in AD 870 when Emden was established as a regional market. (VAN LENGEN 1994, 61). Frankish politics were beneficial to the trading network along the North Sea coast as it expanded in order to supply inland Westphalia (HODGES 1999, 229). Whereas before mentioned Hatzum was ruled by a local chief, Emden was ruled directly by the king or his representative. This explains why Emden was allowed to mint and collect toll. The Vikings left Emden more or less alone. These favourable conditions contributed to Emden’s success and soon the town dominated its surrounding trading places (VAN LENGEN 1994, 61; compare VERHULST 1999, 10-14)11.

Prosperity and decline
Emden was governed by the earls of Werl from around AD 900. Expansion of the settlement during the 10th century called for a larger re-building of the church12. A peaceful time followed until the earls of Werl lost Emden to the archbishop of Bremen in AD 1063. After the earls of Werl, the ruling parties of Emden were weak and from the 12th century onwards the Landesgemeinde (rural assembly) would have formed a political force that was to be reckoned with. The Landesgemeinde prohibited the expansion of the bishop’s influence as well as an emancipation of the bourgeois of Emden. Although trade flourished in the 13th century, due to these special political arrangements Emden was not able to join the Hanseatic League.

The noble family of Abdena, representatives of the bishop of Münster, started to become more independent rulers of Emden at the end of the 12th century. The Landesgemeinde had lost her grip on Emden by the mid 14th century. Due to its prime position and its urban character, Emden became a victim of the rivalry between the Frisian chiefs and their use of the Vitalienbrüder (pirates) at the end of the 14th century. Pirate activities hampered trade along the Frisian coast and resulted in the Hanseatic League becoming involved in the conflict. As a result of the struggles in Friesland, the ruling Abdena family had to flee in AD 1413 and the tom Brok family became the ruling party. The following peace allows Emden to once again become important in regional and interregional trade. However, as the influence of the tom Brok family clashed with the idea of the Frisian independence, they lost their power base and the Abdena family was restored in AD 1427.

Pirate activity supported by the Abdena family harmed hanseatic trade, particularly in Bremen, Hamburg and Lübeck. This led Hamburg and several East-Frisian parties to lay siege on Emden in AD 1433. Emden surrendered and was governed by Hamburg for the following six years. Hamburg enforced Emden as a staple port for all trade on the river Ems. Although this lead to more revenue

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11 The fact that Emden was an important trading place is proven by the many coins minted here since the 11th/12th century which are found as far away as Scandinavia and eastern Europe (BRANDT 1994, 49).
12 The information in the following three paragraphs is a brief summary of VAN LENGEN 1994, 62-130).
income, it also threatened older trade interests in the region and resulted in an influx of merchants from Westphalia. This immigration changed Emden’s social structure in the mid 15th century. Hamburg installed the Frisian Cirksena family as their agents in Emden in AD 1339. When it looked as if the Cirksena family would become too powerful, Emden was again directly governed by Hamburg in AD 1447. As it proved difficult for Hamburg to hold on to power in East-Frisia, the Cirksena family was once more installed as the ruling party in Emden in AD 1453. Ulrich Cirksena was made earl of Emsgo by emperor Friedrich III in AD 1464.

The importance of Emden as a trading place declined at the beginning of the 16th century as the river changed its course in AD 1509. It no longer flowed directly in front of the town, but moved about 3.5 km away (HAARNAGEL 1955, 11-12). As a result, the port silted up and dredging was difficult and expensive. The second half of the 16th century brought a brief period of wealth when Dutch refugees of the Dutch revolt established themselves in this Calvinist town. In AD 1744, after the death of the last remaining ruler of Eastern-Friesland, a descendant of the Cirksena family, the Prussian army occupied the kingdom of Eastern-Friesland. A new period of wealth began as Emden was the only port of Prussia on the North Sea and Friedrich I declared the town to be a duty free zone and cleared out its port and channel (DE GRAAF 2001, 145).

The following paragraphs combine the results of all the excavations in order to reconstruct the origins of Emden. Emden started as three separate dwelling mounds that eventually grew together to a large mound, which had an area of approximately 250 x 300 m (about 7.5 ha) and a height of 8.0 m (HAARNAGEL 1955, 12; RASINK 2004b, 672).

The dwelling mound at the Klunderburgstraße
The results of the excavation at the Rosenstraße suggest that one of these mounds was situated at the northern part of the Klunderburgstraße (Figure 1-2). Although it was not possible to reach virgin soil, the excavation sections and level’s drawings showed that the older layers run down in an E-W direction. This means that the eastern part of the Rosenstraße excavation included the edge of this 9th century dwelling mound. In the late 9th/early 10th century the first house was erected on this spot. Until the 11th century, the soil layers were still sloping E-W and the area was then gradually levelled with alternately cast clay and thin humus layers (HAARNAGEL 1955, 57; BRANDT 1994, 20-22).

The dwelling mound between Schulstraße and Pelzerstraße
A second dwelling mound was situated halfway between the Schulstraße and the Pelzerstraße. The periphery of this mound was found in the northern edge of the Schulstraße excavation at OD. The excavation at the Pelzerstraße showed that this dwelling mound was about 40 m wide in its N-S direction. A ditch (0.8 m wide) surrounded this settlement around AD 800. Even in the next building phase, as the mound was raised to a height of +0.2 m above OD, the ditch marked the settlement’s border. Postholes and planks show that this steep area was indeed inhabited. In the mid 9th/early 10th century, the mound was enlarged in a northerly direction by adding more clay sods. At the same time, a predecessor of the Schulstraße was constructed. North of this street, traces of one or two houses were found. The excavation showed that the edge of this settlement was situated at the northern end of the excavation trench until the 10th century and was marked by a wooden palisade. The excavation at the Pelzerstraße located the southwestern edge of a 12th century enlargement phase of this dwelling mound. Before this southern enlargement, the area had been in use as ditches were found in this area. This means that the dwelling mound between Schulstraße and Pelzerstraße was not situated directly alongside the Ems, but was separated from the river by a strip of unoccupied land until the 12th century (BRANDT 1994, 17-20).

HAARNAGEL (1955, 72-73) supposed, on the basis of only the Rosen- and Schulstraße excavations that the oldest part of Emden was situated beneath the Pelzerstraße. After the 1959 Pelzerstraße excavation this idea proved to be incorrect.
The excavation inside the Große Kirche in 1953 showed that a wooden church was built on a mound at the very beginnings of Emden. As the first missions by Wilfrid of York to Frisia took place no sooner as AD 678 (KEIFER 2005) and eastern Frisia became only a part of the Frankish empire after the battle of Bordena in 734 AD, the establishment of Emden could not have taken place sooner than mid 8th century or around the transition from 8th to 9th century (HAARNAGEL 1955, 72). It seems that a small mound for a wooden church and a graveyard was erected in the 9th century (BRANDT 1994, 23). The excavations at the Kirchstraße showed that in the 12th century the area between the dwelling mound Schul-/Pelzerstraße and the church/churchyard mound was filled up rather rapidly (RASINK 2004b, 675).

In summary, the dwelling mounds of the Klunderburgstraße and the Schul-/Pelzerstraße met from the 10th century onwards. Although the two were growing together, the western part of the Rosenstraße was not incorporated until the 12th century. Before the 13th/14th century the dwelling mound was enlarged as far as the Große Straße. The dwelling mound was enlarged in southern direction as far as the Pelzerstraße by the end of the 10th century. The first occupation here, however, started no sooner than the 12th century and until the 13th century this was a peripheral area. The excavation at the Pelzerstraße also shows that the Ems eroded the settlement’s southern edge which originally reached farther south past the Emsmauerstraße. The 12th century seems to be a period of busy enlargement and levelling activities which might have begun after an 11th century town fire suggested by the remains of burnt houses.

Peasants versus merchants

Haarnagel proposed the following hypothesis: Emden did not evolve from a peasants’ settlement to become a merchant’s settlement, but was established by Christian tradesmen in the 8th century as a trading settlement (HAARNAGEL 1955, 11, 56, 61, 74, 77). Arguments in favour of this thesis are: (1) many small houses of a type only suitable for merchants and craftsmen and known from other merchant settlements like Hedeby and Dorestad were found, (2) few three-aisled farmhouses were found in Emden as defined from other peasant settlements on dwelling mounds (BRANDT 1994, 36), (3) no thick layers of dung were found, (4) the early and rich import finds, and (5) the longitudinal form of the dwelling mound (HAARNAGEL 1955, 74). According to RASINK (2004b, 673) however, the earliest settlement of Emden might have been seasonal as the early medieval Frisian merchants travelled with their goods from place to place. It is likely that soon afterwards a small village emerged which main economic activities were trading as well as farming.

The trading component is supported by the two portable balances and accompanying weight found on the 13th century predecessor of the Schulstraße (BRANDT 1994, 39). Evidence for farming was however unearthed. Three-aisled farmhouses dating from the mid 9th/early 10th until the first half of 13th century were found at the Rosenstraße (HAARNAGEL 1955, 61). One of these houses, dating to the 11th century, might have had a stable as beams lying at right angles to the wall indicate boxes (HAARNAGEL 1955, 25). The part of Emden covered by the excavation at the Schulstraße did not yield parts of floor plans from three-aisled houses. Only floor plans from the smaller merchant’s and craftsman’s houses were found. However, the large farmhouses might have been built at the periphery of the settlement instead of seaming the streets (HAARNAGEL 1955, 62).

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14 According to HAARNAGEL (1955, 61) the excavated types of houses (i.e. Stabbau and Flechtwerkhäuser with Pfettenkonstruktion) were not found at traditional village terps where typical three-aisled farmhouses predominated. Instead, these smaller houses were only known from the early medieval port of trade Hedeby. And so he concluded: “Nach Freilegung der Häuser wurde den Ausgräbern klar, daß Emden von vorneherein keine bäuerliche Siedlung, sondern eine Handelsleistung war.”

15 The excavators found no dung inside three of these houses that would define them clearly as dwelling-stable houses as was stated by RASINK (2004b, 673). Only in the first occupation layer at the Rosenstraße (+0.7 m above OD, mid 9th/early 10th century) layers of dung were found, but no floor plan was found here (HAARNAGEL 1955, 32).
The structure of settlement at the Rosenstraße changed in the second half of the 11th/early 12th century when this part of the town became dominated by houses that were too small for a primarily agrarian way of life. However, some evidence of animal keeping was found as several dung pits were found in an occupation phase dating to the 14th century. Some of them had a rectangular form. According to HAARNAGEL (1955, 17) these pits show that small-scale animal keeping must have taken place. Caution must prevail as it should be kept in mind that without further examination layers described as dung might not contain animal excrements as some might be filled entirely with other organic waste. But, HAARNAGEL (1955, 39) suggested that the rectangular dung pit found inside a house at the excavation Schulstraße in an occupation phase dating to the first half of the 13th century was a small stall which could have housed a single cow.

As the number of imported ceramics was lower for the Rosenstraße than for the Schulstraße, STILKE (1995, 123-125) postulated that the people of the Rosenstraße were probably peasants. Stilke worked with the old hypothesis of Emden being a classic Langwurt with its harbour bordering the short side (i.e. running parallel with the Emsmauerstraße). He thus argued that as the area captured by the Rosenstraße excavation was dominated by the three-aisled houses and bordered the free space to the north, which would have been ideal for agricultural activities, people mainly occupied in the agricultural sector must have lived there. In contrast, with the harbour close by and having an excavation area dominated by small houses typical of mercantile activities, the Schulstraße area must have been the domain of people involved in mercantile and craftsmanship activities. However, research by and summarized in BRANDT (1994, 13-15, 40-41) has shown that Emden was not a classical Langwurt and its harbour was probably at the Ratsdelft, then a tidal creek. This leaves both areas at equal distance from the harbour. In addition, the actual North-South distance between the two excavation trenches is only c. 15 metres.

Emden has not been the subject of systematic archaeological investigations due to the limits a built up area inhibits. However, Haarnagel’s post-war research excavations and a series of rescue excavations that continue to the present day have resulted in a coherent picture of medieval Emden.

1.4 Zooarchaeological research on medieval assemblages

Research of medieval animal bone assemblages is characterised by stand-alone specialist reports. The nature of habitation and the often pristine condition of the bone result in large assemblages being dug up. Often, financial implications led to the analysis of only a sub-sample of the material. These sub-samples are often not large enough to answer research questions with confidence. A recent change from research excavations to rescue excavations led to smaller plots being excavated with limited possibilities for their archaeological interpretation. This in turn hampers the zooarchaeologist in an attempt to place the animal bone results in context. If excavations have been conducted over a long period of time in the same town, the collection and study of animal bones might not always have had priority. Seldom, all animal bone assemblages will have been published in an overview study to characterise the use of animal products during the medieval period. The present study of the animal bones from medieval Emden proved a rare opportunity to analyse whole assemblages from different sites within a medieval town. It combines the results from older research excavations and a modern rescue excavation.

The results of the Emden material will be mainly compared to the zooarchaeological material from early medieval Hedeby and her successor Schleswig, medieval Bremen on the North German coast as well as early medieval Dorestad in the Dutch river area and Dokkum and Groningen in the North of the Netherlands. Furthermore, material from Late Saxon Thetford, England was used. These sites were chosen as comparatives as, on the one hand the North German sites are from the same geographic area and all sites are (partly) comparable chronologically and on the other hand because
(large) animal bone assemblages were analysed and published from these sites. Material from other sites has been referred to where applicable.

Several excavations in Hedeby and Schleswig yielded large quantities of excellently preserved animal bone. The earlier of the two, Hedeby, was situated on the bank of the Schlei fjord in the north-eastern part of Schleswig-Holstein, Germany. The Viking settlement of Hedeby was a powerful port of trade in the Baltic region in the early medieval period. Following several raids by Slavonic bands the settlement was finally destroyed in AD 1066. By AD 1050 the town has already been moved to the opposite bank of the Schlei on the spot of present day Schleswig. The new settlement continued Hedeby’s trading tradition and became the new key player in the east-west trade for the next two centuries. Schleswig lost this position eventually to Lübeck in the early 13th century (ELSNER 1989, 13-16).

From 1978 to 1980 part of the harbour area of Hedeby was excavated. During the excavation 417.625 animal bone fragments were hand recovered. Of these, 87.860 fragments supplemented by all horse, dog, cat and bird remains were subject to detailed analysis by HÜSTER PLOGMANN (2006, 25-156). Detailed sieving of quadrant 64 yielded a total of 16.491 identified mammal, 241 identified bird and 17.294 identified fish remains (HEINRICH 2006b, 195-239). The assemblage consists of bone waste dumped from the wooden quays into the waters of the Heddebyer Noor (tributary of the Schlei) during the early medieval period. The bone material near the shore mimics that of the settlement, whereas the bone deposited further out (near the landings) differs in species proportions, age-at-death profiles, sex ratios and skeletal element representation. HÜSTER PLOGMANN (2006, 127-129) postulates that merchants stayed in Hedeby for weeks or months, primarily during the summer, and traded their goods for high quality meat. These animals or parts of their carcasses would have been butchered near the ships on the seaward side of the landings.

A large area in Schleswig known as “Schild” was excavated during 1971-1975. Schild is situated on the northern side of the Rathausmarkt. The area revealed settlement activities from the 11th-14th century AD. The 111.893 cattle, sheep/goat and pig bones excavated by hand (excluding costae and vertebrae) were analysed by HÜSTER (1990). Detailed studies of the horse bones (HEINRICH 1995, 115-177), cat and dog remains (SPAHN 1986) and wild mammals (HEINRICH 1991) are also available. Furthermore, 8.428 hand-collected bird bones (PIEPER & REICHSTEIN 1995, 9-113) and hand-collected fish bones (HEINRICH 1987) were the subject of detailed studies.

Southward along the north German coast near the mouth of the river Weser lies the town of Bremen. In 2002, the Marktplatz (central market square) was refurbished and archaeological excavations were carried out. The bone material found dates to the 6th-18th century, however, the bulk of the bones dates to the 13th and 14th centuries. So far, only the hand collected material (n=5710) has been analysed and most of the costae and vertebrae were not assigned to species. The bones mainly derive from garbage lying around on the market square which eventually became embedded into the soil (KÜCHELMANN 2007).

The towns of Groningen and Dokkum are both situated in the northern part of the Netherlands. In 1990 publisher Wolters-Noordhoff relocated to a location outside the Groningen town centre. Archaeological excavations were conducted in the area formerly occupied by its buildings. Their analysis was able to shed light on the development of medieval Groningen (BROEKHUizen et al. 1992; ZEILER & LomMert 1992). In 1973-74 a series of rubbish pits was excavated in the centre of Dokkum. The material dates to the 13th century, 14th century, c 1600 and 14th-16th centuries respectively. In total 1219 hand collected bones were found (VAN GEELDER-OTTWAY 1978). Early medieval Dorestad (AD 700-850) was situated on the Rhine in the centre of the Netherlands. Situated on one of the most important water ways of western Europe, Dorestad was an important
port of trade and coins prove that its merchants traded as far as Germany, England and Scandinavia. Large parts of Dorestad were excavated between 1967 and 1977 as a result of the development of Wijk bij Duurstede. These excavations yielded 6433 identified hand-collected animal bones and numerous remains found in the soil samples (PRUMMEL 1983). The decline of Dorestad can be attributed to the frequent Viking raids in the 9th century, changes in the course of the river which became too impractical in the second half of the 9th century, rivalry with other centres of commerce and the disintegration of the Frankish empire at the end of the 9th century resulting in local leaders taking over centralised power from the king (VAN TENT 1978, 214). Its successor, Wijk bij Duurstede was given a charter in AD 1300 (HALBERTSMA 1978, 324).

The Saxon period (5th-11th centuries) of Thetford is well known through the many excavations conducted in this English market town in the county of Norfolk (A.K.G. JONES 1984, G. JONES 1984, A.K.G. JONES 1993, G. JONES 1993, NICHOLSON 1995, WILSON 1995, HUTTON MACDONALD 1999, ALBARELLA 2004, LOCKER 2004 and WALLIS 2004). Thetford developed at the conflux of the rivers Thet and Little Ouse. As well as being situated on a major north-to-south route, there was access by water to the Fens, Wash and the North Sea. The town also formed a staple for goods intended to be traded across the Fens into the heart of East Anglia (DALLAS 1993). A large animal bone assemblage from an excavation at Bury Road conducted by Wessex Archaeology in 2006 was analysed by the author (GRIMM, in prep.). The bones date to the Late Saxon/early medieval period (mid 9th-11th century) and mainly derive from a series of inter cutting pits containing butchery waste. One pit was filled with several complete skeletons of puppies and cats. The assemblage is particularly suitable for comparison with the material from Emden as the bones are excellently preserved and many measurements could be taken.

The present study on the animal bone assemblage from medieval Emden stands in a long tradition of zooarchaeological research. The much larger assemblages from Hedeby, Schleswig, Thetford and Dorestad were dug more recently using further advanced excavation techniques. Including the animal bones from the recent excavation at the Kirchstraße will improve compatibility. Research on the Hedeby, Schleswig and Thetford assemblages has grown organically and overview studies are lacking. The results from Emden provide such an overview and will form a bench mark on which future assemblages from Emden can be tested.

1.5 Research questions

Although zooarchaeology is able to give answers to many questions related to animal management in a broad sense, we are foremost dealing with people’s food remains. In fact, even questions concerning wool trade, traction and breeding in earlier times can only be answered through the study of bones that mainly derive from animals that were slaughtered after having served as wool producer, work force or reproduction facility. The research questions can be grouped on three levels. The first level is formed by questions relating to basic zooarchaeological analysis. Which animal products were used in medieval Emden? How were the herds managed? What did the animals look like? Were the animals healthy and was veterinary care provided? Were the medieval people involved in fishing, hunting and/or gathering activities and does this allow for a reconstruction of the environment? Were leather, bone, horn, antler and teeth used as raw materials? How was animal related waste disposed off?

The second level of research questions concerns the relationship between Emden and its hinterland. The situation of Emden on the right bank of the mouth of the river Ems made it a favourable place for merchants and manufacturers of trading products. These people had to be fed. As the excavations of Haarnagel in the 1950s let to the hypothesis that the town was predominantly mercantile in nature from the start with little or no participation in agricultural production, where did the animal products come from? Was Emden supplied from the hinterland or were its
inhabitants more heavily involved in agricultural production than previously thought? Did Emden start out as a mercantile settlement or an agricultural community or was the settlement involved in both activities from the start? Can changes be detected in production and supply of animal products in the course of the medieval period? Were animals slaughtered privately at home or was a butcher’s guild involved? Were animals and animal products part of mercantile activities? Can social groups in medieval Emden be identified by their food waste?

The third level of research questions will explore Emden’s place among the other urban coastal sites in the medieval period. Can these coastal sites be characterised as production or consumption sites? Does the emphasis on either production or consumption change in the course of the medieval period? Does the structure of the herds in the vicinity of these sites primarily reflect food supply preferences for these sites? Or do they hint at the production of surplus for mercantile activities? Is the production of certain animal products dictated by the local landscape? Was Emden a typical medieval urban coastal site based on the results from the zooarchaeological analysis?

Questions concerning the first level will be dealt with in chapters 2-4, those of the second and third level in chapter 5 and 6.