Summaries

Ad sanctos – placing the dead in the Middle Ages

By Anders Andrén

Social analysis of graves is a recurring and problematic question in all kinds of archaeology. The question is also present in analyses of the often simple and uniform Christian graves from the Middle Ages. In contrast to pagan burials, in which social differences were mainly expressed through form and layout, it was above all the location of the grave that had social significance in the Christian Middle Ages. Normative sources like church laws clearly show that the fundamental principle in medieval burial customs was a principle of spatial closeness to holy spaces such as churches, altars, and relics. Ideas of closeness to the holy guided the principle of burial place in canon laws and Scandinavian church laws. According to Norwegian ecclesiastical laws the dead should be buried in different social zones in the churchyard, from slaves in the periphery to the king's men by the church walls.

Analyses of several almost completely excavated medieval cemeteries in Lund show that the normative principle of closeness to the holy functioned in practice, although the actual spatial setting changed successively through time. In the 11th century no burials took place inside the churches, except maybe in one case, but in the surrounding cemeteries the graves were placed in different zones. Wooden coffins on charcoal were placed around the church, whereas more simple graves without coffins and graves containing lepers were placed in the periphery, along the border of the churchyard.

In the 12th and 13th centuries some people were buried in stone or brick tombs inside the churches, above all in the naves. Some dead were also buried in stone tombs placed close to the churches. The people buried in the tombs inside and outside the churches probably represented the urban elite of the 12th and 13th centuries.

In the 14th, 15th and early 16th centuries the burial customs were more uniform. Above all a difference between burials inside and outside churches can be discerned. Besides, members of the elite were buried by altars in the cathedral, and some archbishops even had a special grave chapel erected by the cathedral. Thus, the access to the holy was successively expanded during the Middle Ages in Lund.

Finally, it is important to stress that the principle of spatial closeness to the holy was a principle not only for placing the dead but also for placing the living. Access to the cemetery, the church and parts of the church was regulated by church laws and customs. The differentiated access was also stressed by the very layout, architecture and furnishing of the church. Thus, graves were part of a large spatial configuration of the church, and consequently should be analysed in relation to the church building and its adornment.

The landscape of the dead. Was burial at the parish churchyard an obligation in the Middle Ages?

By A. Jan Brendalsmo

Too often one finds that scientists doing research on the skeletal material found in parish churchyards draw firm conclusions about the people who once inhabited the adjoining areas. This probably arises from the assumption that it was obligatory in the Middle Ages, after the establishment of geographically delimited parishes, for people to receive burial at the local parish church. However, analyses of contemporary written sources concerning the see of Nidaros in Northern Norway shows that this cannot

have been the case. The only thing that can be stated with certainty is that all law-abiding Christian members of society were to receive burial at a church, while those who had committed certain severe crimes were to be buried "where sea meets land". Furthermore, it seems that common and more or less private cemeteries coexisted in the area throughout the Middle Ages, and that the location of a particular individual's grave depended to a large extent on the social and economic standing of the deceased, rather than on his or her place of domicile. As a result, the author argues that – in addition to the familiar (and later) geographical parish – there were two other kinds of parish in the Middle Ages: the "social parish" and the "religious parish". The main conclusion is thus that the "landscape of the dead" reflects the complexity of the world of the living, and that it is not possible, a priori, to regard the physical remains found in a local churchyard as directly representative of the area's contemporary population.

The farm and church structure in Island until c. 1200

By Jón Viðar Sigurðsson

Scholars generally agree that the settlement of Iceland was initiated during the second half of the ninth century. A process of adaptation and the subdivision of farms into smaller holdings followed the colonisation of the island, a process that continued into the eleventh century. From the eleventh century onwards, Icelandic settlement has been characterised by stability and continuity.

At an early stage, between the early-tenth and the early-eleventh century, Icelandic settlements were divided into social and territorial units called hreppir (singular, hreppr). These hreppir may very well have been modelled on European medieval guilds. The main function of the hreppr was to mutually secure its members economically.

Some decades after the introduction of tithe, the bishops started founding parishes. It was natural that the borders of the hreppir were used as the borders of the parishes, even if there were two or more churches within the boundaries of one hreppr.

Why were churchyards blessed?

By Jørgen H. Jensenius

The question asked in this article is why churches were dedicated and churchyards were solemnly blessed in the Middle Ages. Five possible reasons are proposed. Firstly, because a possible pagan place of worship had to be purified by exorcism and blessing before it was suitable for Christian worship. Secondly, because a priest was not allowed to celebrate mass in a church before the altar was dedicated to God in the name of a Saint. By this action the whole place was reserved for Christian worship perpetually. Thirdly, because the dedication ceremony was meant to create awe and respect for the holy place so fugitives seeking sanctuary should be left unharmed. Fourthly, because the public and circumstantial rite was meant to make visible the transfer of property and the new property boundaries. Finally, because the ritual should inculcate into the public respect for the property of the Church. Dedication of churches and solemnly blessing of churchyards were therefore both mean and aim. The aim was to promote respect for the site and the people residing there. The mean was to create awe by connecting it to holiness. In a predominant oral culture this had to be done by actions and statements.

Guilds and burial in the Middle Ages

By Lars Bisgaard

Among the many religious duties of the guilds the guild laws contain most information about the funeral. This consisted of a wake, a funeral procession, a mass offering for the dead, and interment. Generally, the funeral seems to have taken place the day after a member's death. Wake and a funeral feast did not form a single occasion on the first night after the death, and they were not connected until after the Reformation. It is possible to show that some of the guilds had their members buried at religious houses and not in the parish church. Not all types of guilds took care of funerals, and among the higher classes burial was probably arranged by the family. The importance of the burial is seen from the fact that during the Middle Ages the Church made it one of the Seven Acts of Mercy.

“Profane graves” in medieval Lund

By Peter Carelli

More than 10,000 medieval graves have been documented in one way or another in connection with excavations in what was once cemetery ground in the town of Lund. The material from the graves shows relatively large uniformity regarding burial practices. About thirty burials, however, differ significantly from the great mass of graves in that they were found outside the cemeteries in purely profane contexts. Since these graves differed so strikingly from the normal Christian burial customs, which were regulated by generally known standards and rules, there must have been very special reasons for the choice of this “profane” style of burial. In this connection it is important to emphasise that the choice of burial form was influenced by the deeds of the deceased and by the choices and actions of the people who buried the body. By studying the profane grave material contextually and morphologically, it has been possible to divide the graves into two main groups, depending on whether they were occasioned by private or public motives. The private motives are of a purely personal character: a murderer who tried to hide his victim, a mother who hid her stillborn child, or relatives who buried a suicide. What they have in common is that the individual events made it impossible to have a normal Christian burial. The public motives are instead an expression of the punitive rights of the executive powers. Mutilations, executions, and desecrations were punishments that could be meted out for particularly serious crimes against society, such as counterfeiting.

Amulets and coins from 11th century cemeteries on Bornholm

By Hanne Wagnkilde

Investigations of early Christian burial sites on the island of Bornholm show that the pagan burial customs continued well into the 11th century, although they were declining. The article presents a burial site with 516 graves situated by the farm of Ndr. Grødbygård in the Åker parish. The grave goods and coins from the graves throw light on the exact time for the introduction of Christianity on the island. The grave goods mirror the gradual “amuletization” which the rich heathen equipment undergoes. Whereas the pagan Viking graves contained women with magnificent jewellery and fine clothing and wealthy men buried with weapons, wagons, and horses, the Christians islanders are just given the odd frail buckle, bead, knife, or coin. The systematic use of stereotype amulets as grave goods is a Baltic Sea phenomenon, which – in a Danish context – is only known from the early Christian graves on Bornholm. The many stereotype grave items lead one to ask whether the prayers said at the funerals went to the pagan gods or to The Almighty. This is a difficult question to answer, as the burial site has no certain traces from a church or a fence or other demarcation. However, some grave items have a cross ornament, which must reflect the faith of the deceased.

The grave goods indicate the sex of the buried person, and anthropological analyses confirm the archaeological evidence of a burial place with special areas for either sex. In spite of poor preservation conditions for skeleton material, an identification of sex and age was made using skull features and teeth. The results were compared to the grave goods combination.

The grave goods indicate that the population had a close contact with the pagan Slavs in Mecklenburg and Pomerania. Thus, silver beads and “Schläfenringe” (Slavic temple rings) are identical with the broken silver jewellery found in contemporary hoards. Knives with Slavic sheath mounts are also found in the graves. The relations with the Slavs is a central issue in the silver hoard research, as the hoards are often thought to have been buried as a result of raids by the Wends. However, this theory does not agree with the peaceful grave finds.

The burial sites are finally fitted into a larger settlement context including the settlements of the 11th century, the hoard finds, and the structure of the contemporary society.

Rosaries in graves. The backround, dating, and perspectives of the grave custom

By Hanne Dahlerup Koch

The subject of the article is the use of rosaries as grave gifts. The author explains the background for the development of the rosary prayers with an emphasis on its Danish history. Danish religious literature and wall-paintings from the Middle Ages are included in the review. Following a critical analysis of the basis on which arm position B has been dated, the author concludes that rosaries were not used as grave gifts until the 1400s and later, in spite of the fact that some have been found in graves of arm position B and A. The probable explanation to this is that the arm position chronology was disintegrated already before the reformation, and not, as is commonly thought, after the reformation. In the light of a survey of rosary graves found within present Denmark the author argues that the observance movement, which in Denmark was especially active within the Franciscan order , was of great significance to the introduction of the rosary prayers in Denmark, whereas the Dominican order – as opposed to common belief – apparently played no significant part in this. Further it is argued that people of the late Middle Ages preferred to be buried somewhere else than in the parish churchyard, for instance in monastery churchyards or in churchyards of pilgrim chapels or pilgrim churches. This theory will have vast consequences for the interpretation of archaeological and anthropological material from excavated medieval churchyards.

The bishop's last resting-place? Medieval bishops' seal matrices found in cemeteries

By Michael Andersen

When a medieval seal matrix is found in a cemetery or under the floor of a church the conclusion will usually be that the owner of the matrix was buried in this specific burial ground. It was common to bury a person together with his seal matrix, broken or intact.

A group of five bishops' seal matrices found in Danish, Norwegian and Swedish cemeteries form an exception, however. It is remarkable that none of them was found within the diocese of the bishop in question. Most of them were actually found outside the country, where the bishop functioned. Furthermore it is strange that all the matrices are made of lead, a poor material for a bishop's seal. The matrices cannot be regarded as proper seals, and it is not reasonable to see these finds as indications of bishops' graves.

For what purposes were these matrices made? A number of solutions are discussed in brief. They could be trial pieces, seals to send along with the bishop's substitute, seals for exchange with partners abroad so they could know the correct seal for correspondence, sigilla citationis, fakes, special seals for letters of indulgence, burial seals. It is not the aim here to reach a final solution, only to indicate that these seals were made for a special purpose different from the conventual sealing of deeds.

Why are they found in churchyards? It is suggested that they after fulfilling their original purposes were used as amulets. A seal matrix with the picture of a bishop could be a fine amulet, and it is reasonable to believe that they were placed in graves as religious amulets.

Archaelogical perspectives of the derelict churchyard of Westerhus at Frösön in Jämtland, Sweden

By Lars Redin

The excavation of the churchyard of Westerhus Church in Jämtland, Sweden, which was undertaken in the early 1950s, created the basis of epoch-making research into humane osteology (see for instance N.-G. Gejvall, 1960). The carefully stored and well-preserved skeleton material has made it possible to study the composition and life conditions of the population concerned. Unfortunately, the archaeological documentation has not enabled a corresponding research into the morphology of the grave material or the stratigraphical details, which could have thrown light on the relation-

ship between the graves and the excavated church ruin. This has meant a considerable deficiency of the Westerhus material regarding source value and applicability, when compared with data from other excavated churchyards in Scandinavia.

The present article attempts at compensating for this limitation. Using 71 photos kept in the cardboard boxes containing the skeleton material at the Statens Historiska Museum in Stockholm, a study in burial custom was undertaken. Creating a typological chronology concerning part of the grave material using a previously developed method was possible (see L. Redin 1976 and J. Kieffer-Olsen 1993). From the arm positions of the dead, a division into four types A, B, C, and D was possible. ^{14}C dating of samples led to the conclusion that the churchyard was used for *c.*200 years, from the early 12th century until *c.*1300. A more thorough test of the ^{14}C datings as compared the datings suggested by the arm positions is nescesary.

The author rejects the theory that the stone church had a wooden predecessor.

An appendix (by O. Kyhlberg and U. Strucke) discusses the possibilities and problems concerning the use of ^{14}C dating.

The diet for adults and children at Westerhus. Data from trace element and carbon isotope analyses and odontology

By Elisabeth Iregren, Högne Jungner, Jyrki Räisänen and Verner Alexandersen

The individuals from Westerhus were randomly selected to cover all age groups and both sexes. Bone samples were taken from 94 skeletons (25%) of the population. Different skeletal elements have been used in the PIXE (Proton Induced X-ray Emission) analyses. The following elements were studied: Ca (calcium), the earth metals Mn (manganese) and Fe (iron); the trace elements Zn (zinc), Sr (strontium) and Cr (chromium); the heavy metal Pb (lead) and further Cu (copper), Br (bromine), Ni (nickel), Mo (molybdenum), Zr (zirconium). Soil samples were examined as well as several bone samples of a few individuals.

In Westerhus no severe influence of heavy metals has been traced. Lead is found in small amounts in the skeletons.

Compared to other medieval people the values of zink indicate a low intake of animal protein in the Westerhus population. Copper is also found in very low amounts. This proves that they did not consume any marine food at all. When using the definitions by Johansen et al. (1986) for evaluating the values of the carbon isotopes, we may conclude that the individuals were presumably consumers of mainly terrestrial food. Thus, the data on carbon isotopes, zinc, and copper verify one another.

Results on the Sr/Ca in the diet and the bearing on weaning are presented. It is highly likely that most children in Westerhus were given human milk until the age of 2 years. Single individuals show, however, signs of enamel hypoplasia, which indicates that a few children were given supplementary food earlier. Above the age of two the variation between individuals increases, hinting to different feeding practices in different families. We believe that some children were not weaned until the age of 3-4 years, but above the age of 5 the children show Sr/Ca-values similar to the adults.

Swärdstedt (1966) studied adults and found that the number of enamel hypoplasia increased markedly in Westerhus during the years 2.5-4. Evidently, this period in life was critical even to those who survived infancy.

Westerhus. The dentitions of the children

By Verner Alexandersen and Elisabeth Iregren

In Westerhus on the island of Frösö in Jämtland the childhood was a stressful period with high mortality. In this study the living conditions of the children are discussed on the basis of the age distribution of infants, the prevalence of enamel hypoplasia and the tooth size of deciduous and permanent teeth. Gejvall's age distribution of infants dying in the neonatal and the postneonatal periods was confirmed using both the atlas and the metric method of age assessment although the peak mortality in the age interval from 3-6 months was not as pronounced as suggested by Gejvall. The mortality in the postneonatal period is ascribed to infectious diseases and early supplement to breast-feeding with complementary foods. Various types of enamel hypoplasia were observed in deciduous

teeth. Chronologically the hypoplasias occurred in the intrauterine, the neonatal and the postneonatal periods. Linear enamel hypoplasia in the permanent teeth was also noticed and related to malnutrition and systemic diseases after weaning. The prevalence was higher in the juvenile-adult age group than in the samples of children or mature individuals. Tooth size in the permanent dentition was reduced in comparison with samples of teeth from modern Nordic populations suggesting deficits in physical growth in early childhood. The sex dimorphism of the teeth was utilised to show that children buried North and South of the chapel tended to be distributed like the adult persons with the boys buried South of the chapel and the girls to the North of it. East of the chapel the children in mass graves belonged to both sexes.

Björned – bone analysis and historical interpretations. Investigations of an early medieval burial place in northern Sweden

By Leif Grundberg, Anders Götherström and Barbro Hårding

In the small village called Björned in Torsåker parish, in the county of Ångermanland in northern Sweden, an early medieval cemetery was investigated. The investigation forms part of the Styresholm project, which involves the study of the area adjoining the lower part of the Ångermanälven river during the Middle Ages and the Iron Age.

The Björned cemetery measures only *c.* 25×12 m. It is not mentioned in historical sources and nothing above the surface reveals that this is a cemetery. During the excavation more than fifty graves were identified, which all followed Christian burial customs. ^{14}C-analyses of human bones suggest that the cemetery was used from the 10th century until the 13th century, although an adjoining settlement existed from the early Iron Age. Most of the bone material from the graves is well preserved and suitable for scientific investigation. The present study has been directed towards problems connected with the change of religion, the parish organisation, the family structure, the social organisation, and the power structures. These are topics that arise when the results from the excavation are compared with other ancient remains, existing churches, placenames and the topography of the region.

The article presents the research in progress, including molecular analyses and studies of epigenetic traits. One of the main questions dealt with is whether Björned was a family cemetery. The anthropological analyses suggest that several individuals are closely related. This theory is supported by the molecular analyses. A Y-chromosomal short tandem repeat, DYS388, was extracted and amplified from some individuals from Björned. Alleles could be identified in six individuals. The composition of the alleles was such that the individuals could not be regarded as a sample of a Swedish population in a genetic sense. More likely they represent a sample drawn from a Same population or a Swedish family with a Same element.

A short introduction is also given to further investigations that have started recently, including comparative studies of the Viking Age cemeteries at Björkå and Holm in Överlännäs parish.

The importance of relating the results with a local and regional historical context is stressed in the article, which also deals with the early Christianisation, the Same influence and gender perspectives. Using medieval churches, Viking Age silver-hoards, and rich chamber-women graves as the point of departure, it is argued that Björned was situated in a settlement area of central importance. The centrality is thought to have been based on transit exchange and transport of products from the interior of Norrland.

Demographic structure in the village of Tirup

By Jesper Boldsen

The people of Tirup are by far the best known medieval population in the world. This knowledge is not founded on an exceptionally large sample of skeletons or written documentation but on the analyses that the total excavation of the cemetery has facilitated. The Tirup skeletons have been published in many different, mostly international journals and no comprehensive summary of recent research into this population is available. The present paper attempts to compensate this a little.

The Tirup cemetery was in use during a critical phase of the history of the European population. It covers a period of rapid change of the mortality pattern – the demographic transition from the

Peasant Ages to the Early Modern Period. This period and thus the Tirup population was characterised by an extreme level of age independent mortality most clearly visible in the high ration of older to younger pre-adult mortality. The high level of pre-adult mortality forced fertility to its natural maximum, and as most of the children who did not make it to adulthood died after weaning, the reproductive burden on the women exceeded the level seen in any other period. The result was a substantial female surplus mortality in the reproductive ages. The effect of these difficult living conditions is reflected by the sharp decline in population size in the whole of Western and Northern Europe during the 14th century.

Burials in a cathedral churchyard: The Hamar cathedral ruin

By Berit J. Sellevold

Archaeological excavations during the 1990's around the medieval cathedral ruin at Hamar in Southeast Norway have brought forth skeletal remains of *c.* 1200 individuals: *c.* 600 from undisturbed graves and *c.* 600 in the assemblage of dispersed bones from disturbed graves.

Analyses of the skeletal remains show that the cathedral cemetery was a high status churchyard used by the ecclesiastical community of Hamar. The age and sex distributions in the material differ from the expected distributions of a parish churchyard: ¾ of the sex determined individuals were men, most of whom had died in young adult age and middle age. The age profile of the buried female population was different: most females had died in middle age and old age, and there were few young adult females. More than ¼ of the males had statures over 180 cm. The distribution of, *i.a.*, tall individuals in the churchyard points to status as a determining factor with regard to the location of graves, suggesting an adherence to the regulations given in the medieval provincial laws.

The results of the analyses of the Hamar cathedral cemetery and skeletal remains clearly demonstrate that demographic data from medieval churchyards do not provide information about medieval society in general. The data only applies to the particular sector of society which is represented in the buried population in a given cemetery.

A medieval mass grave from Sigtuna, Sweden. An interpretation and discussion about several individuals with signs of skeletal trauma

By Anna Kjellström

During the winter and spring of 1998 an archaeological excavation of a medieval churchyard was carried out close to the ruins of the St Lars church in the centre of Sigtuna, Sweden. Remains of several skeletons were found in what seemed to be a large pit. The pit was 4 by 2.5 metres with a depth of 0.3 metres, but the grave had been disturbed by later interference and was probably larger and deeper in its original state. The bodies seemed to have been thrown on top of each other and no direct efforts to arrange the individual body positions could be observed. During the anthropological analysis at least seventeen individuals were identified, men (10 or 11), women (5), and children (1). The individuals were aged from 8-9 to 60 years. The analysis shows that a majority (9) of the skeletons have cut lesions. The answer to the questions about who these people were, what caused their death and why they had to share the same grave are difficult to establish but some clues do exist. Considering that both sexes in a variety of ages are identified without any signs of healed slice wounds, the interpretation of these individuals as representatives of ordinary citizens who lacked earlier experience in combat is possible. The fact that they were buried in a churchyard close to the walls of the southeast corner implies that time was taken to arrange a grave in holy ground, *i.e.* they were probably not criminals. Probably they all died at the same occasion, possibly during an attack against the town or its surroundings. The frequency of violence lesions makes the hypothesis of an epidemic or a major accident causing the death of the individuals less likely.

The remains of these individuals, probably members of the same community, are suited for a variety of different analyses. For instance, DNA-tests on the skeletons may provide information about family relationships. Analyses of stable isotopes and trace elements are planned to be conducted in the future so that standard values and variations within an absolutely contemporary group can be registered. Hopefully the forensic investigation may yield more information about which weapons were used and whether there is a detectable pattern in the way the wounds are located.

The Osteological Paradox. An Identification Problem

By Hans Christian Petersen

In studies of human skeletal material from medieval cemeteries one of the main objects of study is the health and wellbeing of the population represented by the skeletons. Often comparisons between social, regional or chronological groups are attempted. As studies of this kind try to make inference about the once living people by looking at their skeletal remains, the possibility of reaching wrong conclusions is present. One obvious problem is the possibility that the most healthy will live long enough to develop skeletal lesions specific to a certain disease investigated, whereas the more frail ones die before they develop these lesions. A straightforward – and wrong – conclusion would be that the healthy population is more affected by the specific disease than the less healthy population. However, other more intriguing aspects of the osteological paradox exist, basically leading to the risk of obtaining wrong estimates of the parameters describing the health status of the population(s) in question. With wrong parameter estimates one will also get wrong comparisons of, say, frequencies of individuals affected by different diseases. The parameters are not identifiable. The major problem is the impact of selective mortality, *i.e.*, the fact that the more frail individuals are more prone to die at a certain stage of a developing disease than are the less frail individuals. This means that it is not always possible to identify the right explanation among several possible explanations for an observed pattern of skeletal lesions. Examples are given and suggestions for solving at least some of the problems are presented.

Infectious middle ear disease

By Niels Lynnerup, Morten Qvist and Preben Homøe

Evaluation of general health is important in order to reconstruct the life conditions of earlier populations. This is usually done by analysing the skeletal remains of such populations. However, only few diseases leave their mark on the skeletons – indeed the most widespread and common diseases, such as pneumonia and gastrointestinal infections, which probably also accounted for the vast majority of deaths, do not leave any signs at all on the skeleton. Chronic conditions, on the other hand, such as tuberculosis and leprosy, do leave their mark, but the picture one gains by focusing on these diseases says more about the hardiness of a population (namely that individuals endured a lifelong disease) than about the general health.

Palaeopathologists have sought for such markers, *e.g.* osteoporosis, Harris' lines, dental enamel hypoplasia and porotic hyperostosis, but many of these methods either suffer from biased scoring methods, or the link to modern medical clinical observations is tenuous. We present a new method to evaluate general living conditions in earlier populations. Our method relates to the occurrence of chronic middle ear disease in childhood, and we think it has several advantages: correspondence between chronic infectious middle ear disease (IMED) and general living conditions is affirmed in modern medical epidemiological observations, the bone changes brought about by IMED occur in childhood, and the skeletal element used to evaluate the occurrence of IMED is the petrous part of the temporal bone in the skull, one of the sturdiest bones in the skeleton.

We applied this method to three medieval skeletal materials from Nordby, an early medieval rural parish churchyard (function period approximately AD 1050-1250), Tirup, also a country parish churchyard, but from the later medieval period (function period approximately AD 1150-1350), and finally a monastic churchyard, used as parish churchyard for the citizens of Aalborg, one of the larger cities of medieval Denmark (function period approximately AD 1240-1530).

The intact skulls from these churchyards were X-rayed from each side, and the area of the so-called pneumatic cells in the occipital bone was measured. From earlier studies we have proved the relationship between cell size as seen on X-ray photographs and occurrence of IMED earlier in life. Also, this relationship has been expressed mathematically, so that the left and right side cell area size may denote the risk of the individual having had or not having had IMED in childhood.

The results showed that there was a pronounced rise in the frequency of IMED from the early to later medieval period. This seems to reflect the well-known agrarian crisis between the early and later medieval period: probably mainly due to land overuse and climatic changes, the population levels fell, and, as observed at

Tirup, childhood mortality rose. Also, at this point in time, plague hit Denmark, further stressing population health. Our results also showed that the highest frequency was found in Aalborg, which may be explained by increased pathogen load in a more densely populated urban centre.

^{14}C Dating of human bones. Using the Greenland Norse as an example

By Jette Arneborg, Jan Heinemeier, Niels Lynnerup, Niels Rud and Árny E. Sveinbjörnsdóttir

The article gives an overview of the difficulties encountered in interpreting ^{14}C dating of human bone, which may lead to erroneous results. Human food intake often has a considerable marine component, which leads to an increase in the apparent ^{14}C age of human bones due to the so-called marine reservoir effect, *i.e.* the apparent ^{14}C age difference between contemporaneous marine and terrestrial organisms. The marine reservoir age typically amounts to about 400 ^{14}C years, which is therefore the expected ^{14}C age excess in humans with 100% marine food intake. Measured values of the carbon stable-isotope ratio ^{13}C/^{12}C in bone collagen, expressed in terms of its fractional deviation from a standard, δ^{13}C, may be used to assess the fraction of marine food in a mixed diet.

Typical sources of error, which, particularly in the past, have lead to misinterpretation of ^{14}C dates of bones of humans or animals with mixed marine/terrestrial diet, are 1) Under-estimation of the required ^{14}C reservoir correction based on measured δ^{13}C values 2) The marine food component originates partly from fjord or estuarine environments, for which reservoir ages of more than 900 years have been found in some parts of Denmark 3) Intake of freshwater fish from lakes and rivers, which, in areas of Denmark with calcareous underground, may have very high reservoir effects that unfortunately will not be revealed by δ^{13}C measurements.

We use our ^{14}C and δ^{13}C investigation of about 30 Greenland Norse bone and textile samples as an example of how human bone may be successfully ^{14}C dated under favourable conditions where the difficulties 2) and 3) do not apply. With the use of reservoir corrections based on a calculated marine food component varying from 20 to 80%, the corrected ^{14}C ages ranged from about AD 980 to 1430, *i.e.* most of the time span of the Norse colonisation of Greenland. We used comparative dating of textiles (terrestrial origin) and skeletons with a high marine content (80%), which had been wrapped in the textiles for burial, to calibrate the reservoir correction. Finally we point to the possibility of using the nitrogen isotope ^{15}N in bone collagen as an indicator of a dietary component of freshwater fish.