Danish Journal of Archaeology, 2014
Vol. 3, No. 2, 145–163, http://dx.doi.org/10.1080/21662282.2015.1084730

Routledge
Taylor & Francis Group

RESEARCH ARTICLE

A ritual site with sacrificial wells from the Viking Age at Trelleborg, Denmark

Anne Birgitte Gotfredsen[a]*, Charlotte Primeau[b], Karin Margarita Frei[c] and Lars Jørgensen[d]

[a]*Natural History Museum of Denmark, University of Copenhagen, Øster Voldgade 5-7, DK-1350 Copenhagen K, Denmark;* [b]*Laboratory of Biological Anthropology, Department of Forensic Medicine, University of Copenhagen, Frederiks V's Vej 11, 2100 Copenhagen Ø, Denmark;* [c]*Department of Conservation and Science, Environmental Archaeology and Material Science, The National Museum of Denmark, Ny Vestergade 11, DK-1471 Copenhagen K, Denmark;* [d]*Department of Research and Exhibitions, Ancient Cultures of Denmark and the Mediterranean, The National Museum of Denmark, Frederiksholms Kanal 12, DK-1220 Copenhagen K, Denmark*

(*Received 21 April 2015; accepted 12 August 2015*)

The promontory facing Storebælt with the well-known circular Viking Age military fortress of Trelleborg erected by Harold Bluetooth in AD 980/981 seems to have been an important ceremonial space prior to the erection of the fortress and contemporary with a nearby high status settlement dated to the seventh to the eleventh century. This study presents new cross-disciplinary investigations focusing on three sacrificial well-like structures (47, 50 and 121) from the pre-Christian Viking Age at Trelleborg. Two of the sacrificial wells (47 and 121) included the only skeletal remains of four children hitherto recovered from Danish Viking Age wells. The strontium isotope results of the four children point to local provenance. However, the results of each well seem to pair up in a systematic way pointing to that the children might come from two different key surrounding areas at Trelleborg. Furthermore, the three wells contained animal remains of primarily domestic livestock partly representing consumption waste from either profane or ritual meals deriving from, for example, *blót* activities. Well 47 produced a young he-goat and well 121 a hindlimb of an above-average-size young horse, a large part of a young cow and a large dog. Altogether intentional offerings deposited while still enfleshed and interpreted to have served as propitiatory sacrifices to honour or appease the gods and to ensure fertility. This research provides new information that enlightens the formation processes underlying accumulation of cultural deposits in features such as ritual wells, in the period prior to Christianity.

Keywords: human sacrifice; animal sacrifice; ritual well; strontium isotopes; pre-Christian Viking Age; paganism

Background

The circular Viking Age fortress of Trelleborg on the island of Zealand in Denmark is well known as a military fortress built by Harold Bluetooth in AD 980/981. The site is of utmost importance for the understanding of the beginning of the Danish state formation and has therefore been intensively investigated (Nørlund 1948, Price *et al*. 2011). Trelleborg is situated at a promontory bordered by the rivers Tude Å and Vårby Å in southeastern Zealand with a view towards the Great Belt (Figure 1). It was excavated in the years 1934–42 by Nørlund from the National Museum who a few years later published a comprehensive treatise on the results (Nørlund 1948). In the same publication, Degerbøl published the faunal material, hereby providing important and at that time new zoological information on our common domesticates and on husbandry and hunting practices at a Viking Age military garrison (Degerbøl 1948, p. 241ff). The fortress functioned as a military garrison for a short period and probably only a few decades. Strontium analyses indicate that the buried garrison population in the cemetery by the fortress consisted of individuals of both foreign and local origin (Price *et al*. 2011). Some of the axe types in the graves could indicate that the individuals came from the Slavonic areas in the southern Baltic area and thus providing further support for the results delivered by the strontium analyses.

However, it is important to note that when the fortress was built in 980/81 there already existed a larger settlement only 300 m east of the promontory where the fortress was erected (Figure 1). The settlement, which covered *c*. 4 ha, has produced more than 200 finds from the seventh to the eleventh century by metal detector surveys. Several are high-quality objects, and they indicate the presence of an elite residence. Among others, the find material consists of brooches and pendants of silver and bronze, strap mounts, dirhams, silver ingots, weights, etc. An unpublished survey carried out by the regional museum by magnetometer has also indicated activity areas and traces of other constructions. The large settlement both predates and succeeds the military garrison on the promontory. It is obvious to link this settlement with a number of unique ritual features and finds on the promontory from the period prior to the construction of the fortress. Nørlund also dealt with this unique material in his publication, and he identified the features as forming a sacrificial site from the

*Corresponding author. Email: abgotfredsen@snm.ku.dk

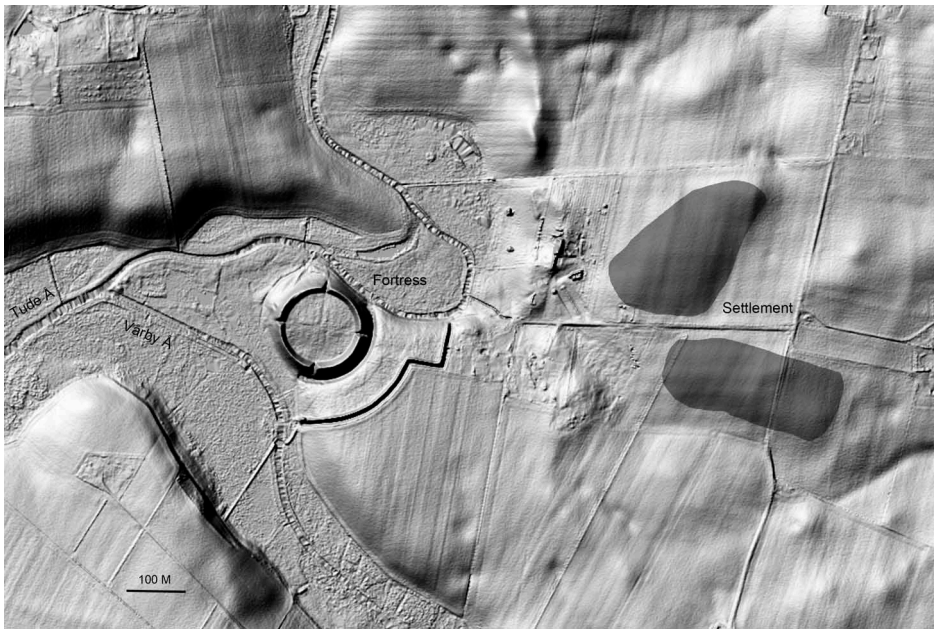

Figure 1. Lidar scan showing the location of the Trelleborg fortress on the promontory bordered by the rivers Vårby Å and Tude Å. To the east of the fortress is marked the extent of the settlement area (Trelleborggårde) producing rich metal detector finds from the seventh to the eleventh century. The settlement thus existed both before and after the fortress. Map: Danish Ministry of the Environment and Cultural Heritage Agency.

period before the fortress was erected (Nørlund 1948, p. 36ff). In our paper, we will elaborate further on the highly interesting ritual features and finds.

During the excavation of the fortress, Nørlund noticed several wells and pits partly due to their unusual contents, for example, human skeletal parts, and partly their construction and location (1948, p. 36ff) (Figures 2 and 3). In particular, two wells or well-like structures from the ninth to the tenth century, well 20/36 gr. 47 and well 12/37 gr. 121 (in the following designated wells 47 and 121), attracted attention by holding children's skeletons and some nearly complete animal corpses (Degerbøl 1948, p. 243ff, Nørlund 1948, p. 41f). Also, well 21/36 gr. 50 (= well 50) including skeletal parts of an adult person and a more ordinary assortment of animal remains was described in more detail by Degerbøl (1948, p. 243f). Nørlund suggested that prior to the erection of the fortress at least five out of six wells may have served as sacrificial wells, of which three (117, 121 and 123) were clearly associated with special horseshoe-shaped trench features (1948, p. 44). A similar trench feature has recently been excavated at the contemporary residential complex at Lake Tissø (Jørgensen, unpublished). Here, two entrance posts and a row of posts in the trench marked the construction. The trench construction was not associated with a well. However, the feature was probably associated with uncertain activities that took place inside the trench feature. Other circular ditch features have also been presented and discussed recently (Henriksen 2015, p. 201ff).

The two other wells 125 and 123 seem to have been cleaned and contained only few finds, more or less contemporary with the closing of the wells. However, there is also the possibility that well 125 was not filled with ritual depositions during the function. In the fill layers of well 117, fragments of soapstone vessels, a few iron fragments and an antler comb from the tenth century were found (Nørlund 1948, p. 40f). In well 123, an axe from the Viking period was found close to the bottom and an iron key in the upper fill layer (Nørlund 1948, p. 40). Well 117 is clearly older than the fortress as the supporting posts of the building were placed in the fill of the well. As we probably can associate well 123 with the adjoining horseshoe-shaped ditch, it indicates that this well also belonged to the period before the construction of the fortress.

Purpose of the study

As already suggested by Nørlund, the finds attest the importance of the area as a ceremonial space. The present investigations focus on the finds from the pre-Christian Viking Age by re-examination of especially wells 47, 50 and 121 in order to shed light on their formation process and to improve our knowledge of the offering rituals that took place at the promontory.

The human remains have been examined to provide an overview of the ages, health conditions and possible injuries. Moreover, the taphonomical approach aims to shed

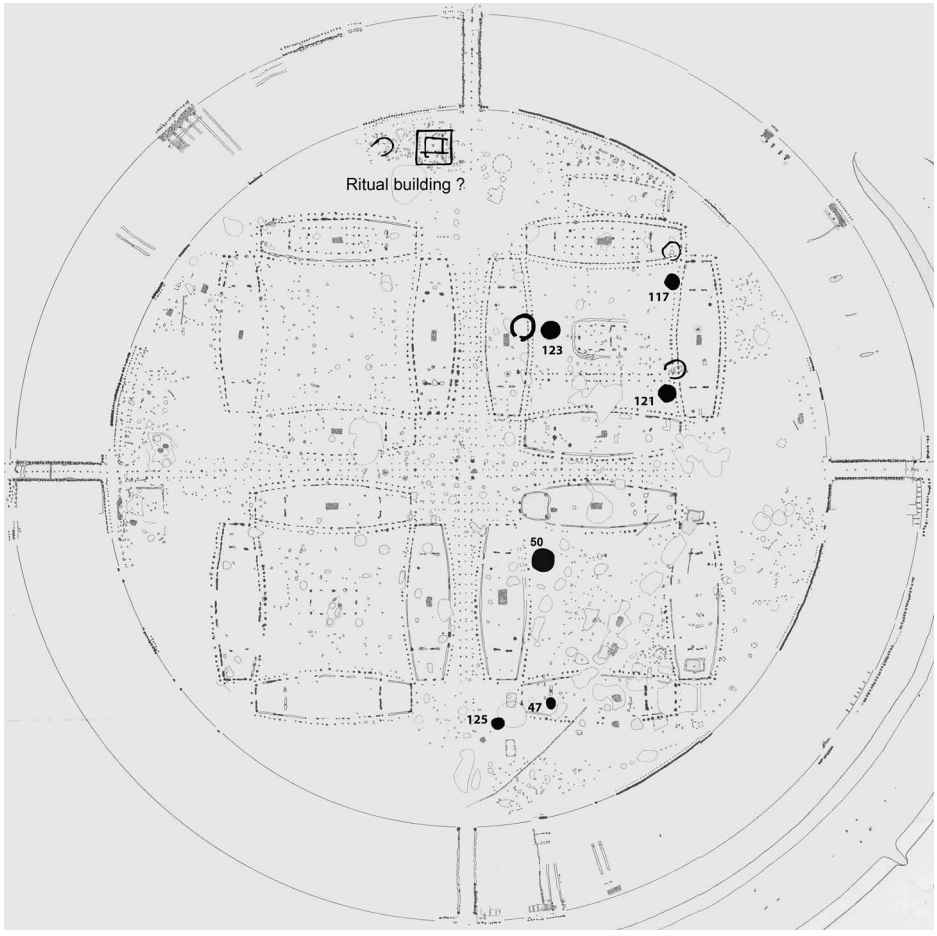

Figure 2. Nørlund's plan of the excavation. The six wells and the four horseshoe-shaped ditches are marked. A possible ritual area with a special building, a horseshoe-shaped trench and several pits and/or postholes is located immediately west of the north gate. Plan: Nørlund (1948) with additions.

light on whether it can be stated how the humans died and were treated post-mortem. Additional strontium isotope analyses of the four young individuals from two of the wells were conducted in order to reveal their provenance. Moreover, new ^{14}C analyses of the four children, a semi-complete goat and a part skeleton of a cow have been conducted in order to identify the time relation between the human and animal remains.

The study of animals in ritual use is often hampered by the difficulty in distinguishing between animal bones being the leftovers of ritual feasts and/or ordinary meals (cf. Lauwerier 2004). It is thus difficult to evaluate the archaeozoological evidence of ritual activity in settlement waste dumps, whereas special areas such as bogs, funerary sites (Magnell and Iregren 2010, Gotfredsen forthcoming) or special features such as wells or so-called shafts (e.g. Nilsson 2003, 2009, Grimm 2008, 2010, Serjeantson and Morris 2011) may offer better opportunities. Since beliefs and associated practices can shape the zooarchaeological assemblage, it is essential to pay attention to the spatial distribution and contexts of faunal remains (cf. Russell, 2012, p. 50). Moreover, in order to understand the processes of deposition and subsequent destruction and loss, it is of outmost importance to study the natural destruction and human-made modifications inflicted on the bones (Serjeantson 1991, Morris 2008, Magnell and Iregren 2010, Magnell 2012). Consequently, the archaeozoological part of the present study will focus on taphonomic analyses, peri- and post-mortem practices but also include contextual considerations.

Materials and methods

The three wells

Well 47 was located within house 4 in the southeastern building complex (Nørlund 1948, p. 41f). It was oval and measured 1.8 × 2.35 m at the surface and narrowed down to 0.90 × 1.20 m at the bottom. It was 2.13 m deep as measured from the surface of the subsoil. It was unclear

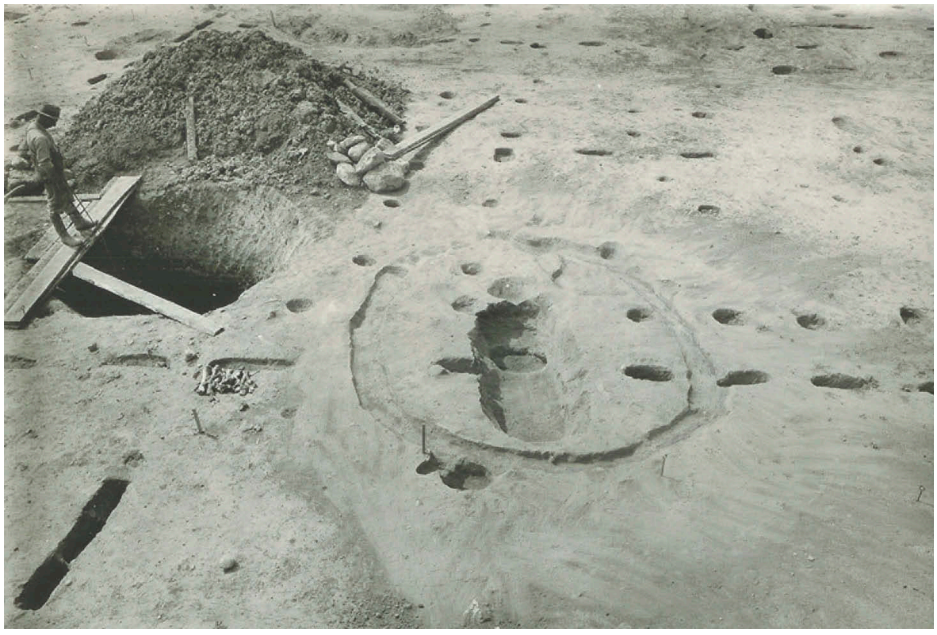

Figure 3. Trelleborg. The sacrificial well 121 and the associated circular foundation ditch during the excavation in 1937. The ditch shows weak traces of posts or planks. The well contained skeletons of two 4-year-old children and parts of three horses, two cows, four pigs, three sheep, a dog, a red deer and a peregrine falcon. Photo: Roar Skovmand, National Museum.

whether the shaft was in fact a well since no traces of stone setting or planks were detected (Nørlund 1948, p. 42). Among the artefacts in the fill was a tortoise brooch from the tenth century (Nørlund 1948, Pl. XXVII 1a–c), bronze bowl, arrow head, Slavonic pottery (Nørlund 1948, fig. 108b), two whetstones, spindle whorls, fragments of weaving weights, etc. The finds were, however, all located in the upper fill layers. The deepest lying object was the tortoise brooch in a depth of 1.59 m. The finds seem primarily to be related to the closing of the well. Nørlund (1948, p. 39ff) dates the well to the period before the fortress.

Well 50 was located in the southeastern building complex (Nørlund 1948, p. 39). At the surface, it had a diameter of 4.10 m and from a depth of 1.5 m it narrowed down to measuring 1.4 × 1.4 m. The well was approximately 3.6 m deep measured from the top of the subsoil. Traces of wooden planks were documented. At the bottom level was found fragments of a knife, iron fragments, a quern stone, three wooden bowls, bowl handle, fragment of a possible sledge runner, several wooden fragments and a wooden spoon (Nørlund 1948, Pl. XVIII 4–6). Nørlund (1948, p. 39) suggests that the well was in function during the fortress period.

Well 121 was located in the northeastern building complex (Nørlund 1948, p. 41). It was circular with a diameter of 3–3.75 m and reached a depth of *c*. 3 m below the surface of the subsoil. In the upper fill layers, fragments of pottery, semi-finished antler for combs, whetstone, a bone skate and iron fragments were found. The lower layers provided three belt buckles, a knife fragment and various iron objects. However, none of the finds seem to be associated with the primary function as a sacrificial well as they derive from the secondary fill material. Both well and the adjoining trench are cut by the building wall and thus from the period before the fortress.

The human bone analysis

The human bones were examined at the Laboratory of Biological Anthropology (LBA), Department of Forensic Medicine, University of Copenhagen. The human material from wells 50 and 121 is currently curated at the LBA, and the material from well 47 is on exhibition in the museum at Trelleborg. The bones were examined macroscopically as well as using CT images for teeth development and pathologies. Bone lengths were measured using an osteometric board. The age of the individuals was determined from dental development by the method according to Ubelaker (1989). Bone growth was examined according to Scheuer and Black (2000) and Primeau *et al*. (2012). Sex cannot be determined for children as young as the material present here, and for the adults too little material was available for sex assessment.

The faunal bone analysis

The animal bones[1] were examined and identified by use of the comparative collection of the Natural History Museum

of Denmark, University of Copenhagen. The bone material was recovered by shovels and not sieved. Further, no systematic registration of the *in situ* position of the animal bones was undertaken, although Nørlund made a few observations in the field. Consequently, bones which are considered to be articulated joints were actually rearticulated in the laboratory. The faunal material had suffered a substantial taphonomic loss since the time of recovery,[2] which was also seen for the human skeletons from the Trelleborg burial ground (Price *et al*. 2011, p. 481). The skeletal elements were identified to species, skeletal element, portion of the bone and side. The bones were sexed, aged and pathology was recorded. Age determination was based on mandibles with teeth *in situ* or isolated mandibular deciduous premolars (dp_4) or molars (M_3). Moreover, bone surface alterations such as gnawing, trampling and weathering were assessed. The weathering stage was scored according to Behrensmeyer (1978). Special focus was on man-made bone alterations, for example, burning and butchery marks. The definitions of cut mark types followed Binford (1981, p. 106ff, table 4.04). Measurements were acquired by a digital calibre, with a precision of 0.1 mm according to the definitions by von den Driesch (1976). The values for calculating height at the withers followed the guidelines recommended by von den Driesch and Boessneck (1974), although for horses May (1985) was followed.

The strontium isotope analysis

For the strontium isotope analyses of human remains, a tooth from each individual was sampled (either a deciduous molar or a permanent molar). The tooth enamel from each individual was mechanically pre-cleaned with a dental drill and subsequently repeatedly washed ultrasonically in ultrapure (MilliQ™ EMD Millipore Corporation, Darmstadt, Germany) water until the water remained visually clear. After drying, small pieces of enamel were removed by means of a small diamond blade saw and/or with chromium steel pliers. Extreme care has been taken not to sample dentin material along with the enamel. Amounts of 1–5 mg were weighted into 7 ml Teflon beakers (Savillex™ Savillex, Eden Prairie, Minnesota, USA). The samples were dissolved in a 1:1 mixture of 0.5 ml 6 N HCl (Seastar, Seastar Chemicals Inc., Sidney BC, Canada) and 0.5 ml 30% H_2O_2 (Seastar, Seastar Chemicals Inc., Sidney BC, Canada). The samples typically decomposed within 5–10 min, after which the solutions were dried down on a hotplate at 80°C. Enamel samples were taken up in a few drops of 3 N HNO_3 and then loaded on extraction columns with a 0.2 ml stem volume charged with intensively pre-cleaned mesh 50–100 SrSpec™ Sr-specific ion chromatographic extraction resin (Eichrome Europe Laboratories, Bruz, France) resin. The elution recipe essentially followed that by Horwitz *et al*. (1992), scaled to our needs. Sr was eluted/stripped by pure deionized water and then the eluate was dried on a hotplate. Strontium samples were dissolved in 2.5 µl of a Ta_2O_5–H_3PO_4–HF activator solution and directly loaded onto previously outgassed 99.98% single rhenium filaments. Samples were measured at 1250–1300°C in dynamic multi-collection mode on a VG Sector 54 IT mass spectrometer equipped with eight faraday detectors (Department of Geoscience and Natural Resources Management, University of Copenhagen). Also, 5 ng loads of the NBS 987 Sr standard gave $^{87}Sr/^{86}Sr = 0.710236 \pm 0.000010$ ($n = 10, 2\sigma$).

Results and discussion

In what follows, the investigations conducted on human and faunal bone material are presented. The human material is presented by each of the three wells. In contrast, the presentation of the animal bones is organized according to some overarching archaeozoological principles such as species distribution, taphonomy, selection of body part and species choice due to the large amount of bone material and the large species variation. Table 1 provides an overview of the representation of the human and animal remains with respect to isolated bones, joints and semi-complete skeletons in the three wells as well as other archaeological finds related to the wells. The results of the strontium isotope and radiocarbon dating are presented in Table 2 and Figure 4.

The human bone material

Well 47

In well 47, human skeletal remains of two children were found. Both skeletons were fairly complete and well preserved, though fragmented (Table 1 and Figure 5A). The remains of the two children are described as found near the bottom of the well, and it is reasonable to presume due to their completeness, as stated by Nørlund (1948, p. 42), that they were articulated when they were deposited in the well. It was also noted (Nørlund 1948, p. 42) that the bones had been exposed to fire.

This current examination found that the younger child was 4 years old (range 3–5 years), and the older child was 7 years old (range 5–9 years) based on dental development (Ubelaker 1989, p. 66), which is equivalent to previous examination (Sellevold *et al*. 1984, p. 131). We found no evidence of heat exposure of the bones as mentioned in Nørlund (1948, p. 42). Some of the bones do have a reddish brown colour which could be ascribed to heat exposure (Shipman *et al*. 1984). This is mainly evident on the tibia of the older child and some of the unfused hip bones of the younger child. However, this colouration is more likely to stem from the burial environment and the

Table 1. Census of the contents of the three Trelleborg wells showing type of deposit, context and associated finds.

	Well 47			
	Animal remains			
Human remains	Taxon	Type of deposit	Placement	Associated finds
Semi-complete skeletons of two children aged 4 and 7 years, with some fragmentation. Placed near the bottom at a depth of 2 m	Jackdaw	Single bone	All near the bottom at a depth of 2 m	A tortoise brooch, a bronze bowl, an arrow head, Slavonic pottery, two whetstones, spindle whorls and fragments of weaving weights found in the fill
	Dog	Single bones of individual 1 One heal joint and single bones of individual 2		
	Pig	Single bones of three individuals		
	Cattle	Single bones and foot joint[1] of one individual		
	Goat	Semi-complete skeleton of one individual		
	Horse	Single bones of one individual		
	Well 50			
	Animal remains			
	Species	Type of deposit	Placement	Associated finds
Fragments from the calvaria and proximal ends of a right ulna and radius from an adult individual	Swan	Single bones		Fragments of a knife, iron fragments, a quern stone, three wooden bowls, carved bowl handle, fragment of a possible sledge runner, wooden fragments and a wooden spoon placed at the bottom level
	Black-headed gull	Single bone		
	Dog	Single bones of one individual		
	Red deer	Single bones		
	Pig	Single bones of four individuals		
	Cattle	Single bones of three individuals		
	Sheep	Single bones of one individual		
	Horse	Single bones of one individual		
	Well 121			
	Animal remains			
	Species	Type of deposit	Placement	Associated finds
Semi-complete but fragmentary skulls and few postcranial parts of two children aged 4 years. Fragments from the calvaria from an adult individual	Peregrine falcon	Single bones of one individual		Fragments of pottery, semi-finished antler for combs, whetstone, bone skate and iron fragments found in upper layers of fill Three belt buckles, a knife fragment and iron objects found in lower layers of fill
	Dog	Semi-complete skeleton of one individual	On top of the children	
	Red deer	Single bone		
	Pig	Single bones of four individuals		
	Cattle	Single bones and skull, portion of vertebral column[1], right hind leg of two individuals	On top of the dog and children	
	Sheep	Single bones of three individuals		
	Horse	Single bones and portions of the neck[1], right hind leg and lower limbs[1] of three individuals		

Note: [1]Designates that based on the bone elements published by Degerbøl (1948) it was assumed that the bones had been associated; however, this could not be ascertained in the present analysis.

Table 2. Strontium isotope results from the four children.

Well no.	Tooth description	$^{87}Sr/^{86}Sr$	Error ± ppm
47 (young child)	Second deciduous molar	0.71088	21
47 (older child)	First deciduous molar	0.71023	20
121 (1)	First molar	0.71019	27
121 (2)	First molar	0.71084	13

Note: Errors reported are within-run ($2\sigma_m$) precisions of the individual runs.

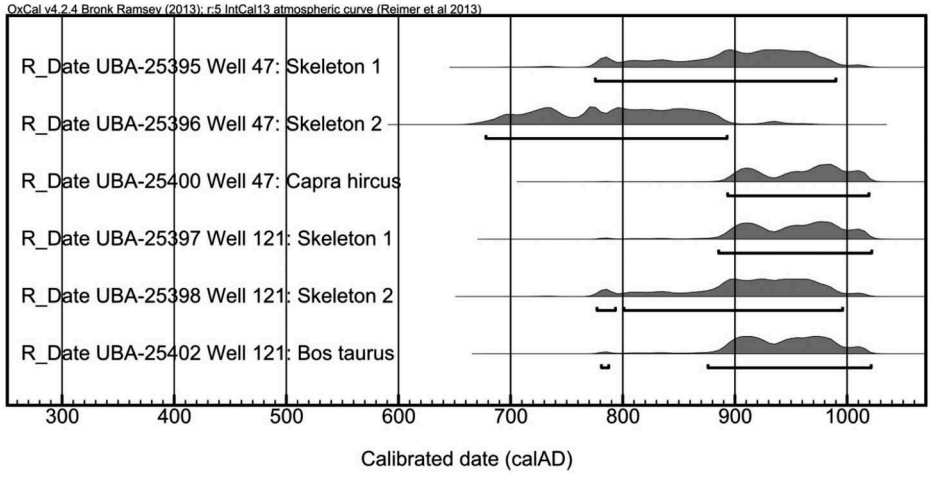

Figure 4. Radiocarbon datings from wells 47 and 121 calibrated with OxCal v4.2.3 (Bronk Ramsey 2013) and IntCal13 (Reimer et al. 2013). The three datings from well 47 indicate that the formations processes behind the depositions reach back to the eighth to the ninth century.

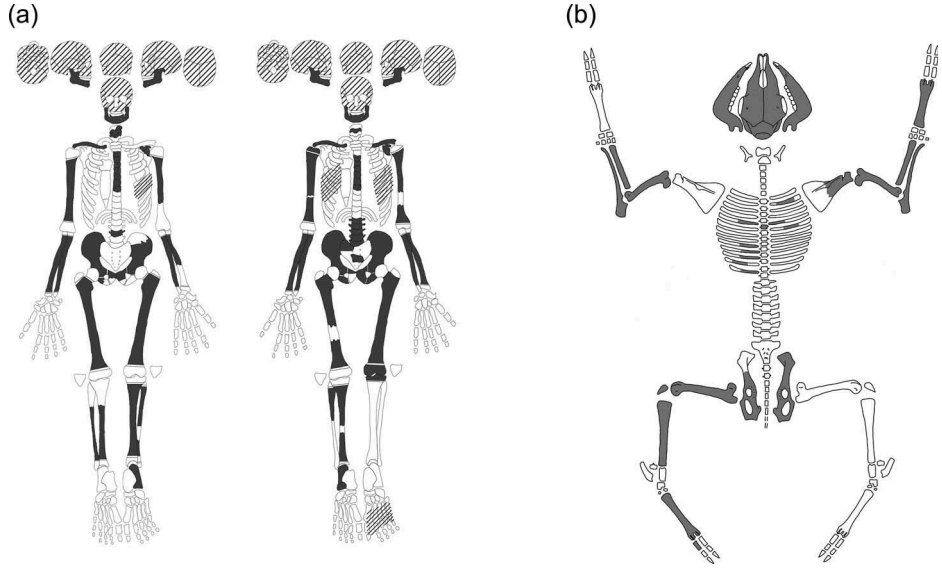

Figure 5. (A) Census of the skeletal elements present of the two children of well 47. To the left is the younger child (*c*. 4 years) and to the right the older child (*c*. 7 years). Skeletal elements that are hatched represent elements which are greatly fragmented and hence not precisely identified. (B) Census of the skeletal elements present of the young he-goat of well 47. In total, 24 bone elements were reassembled from 38 bone fragments. No butchery marks except for the possible blow to the frontal bones were observed. Basic skeletal drawing after Helmer (1987).

variation in colour between the bones is probably due to variations in the microenvironment of the well. The children were examined for growth disturbances expressed as enamel hypoplasia and Harris lines as well as cribra orbitalia which could be a sign of dietary deficiency or childhood disease (Harris 1931, Park and Richter 1953, Stuart-Macadam *et al*. 1985, Goodman and Rose 1990, Hillson 2000, Walker *et al*. 2009). The examination revealed a single Harris line on the younger child. There was no further evidence of the above-mentioned pathologies. However, diseases which are not expressed osteologically cannot be excluded. Both children had reached appropriate growth for their age. As such there are no indications of a chronically ill health.

There is no evidence of trauma, cut marks or dismemberment on any of the bones present. However, this does not mean that violence or dismember did not take place, only that there is no visible signs thereof. Several bones were broken, including the bones of the skull; however, all fractures resemble post-mortem breakage, that is, when the bones were dry. The cause of death cannot be determined.

The strontium isotope results (Table 2) of the two children fall within the Danish bioavailable range previously defined by Frei and Frei (2011, 2013), revealing that the children are most probably of local origin.

Well 50

In well 50, a few skeletal remains from an adult were found. The material only consists of nine fragments from the calvaria and an upper fragment of both lower arm bones from the right side (n = 11) (Table 1). According to Nørlund (1948, p. 244), the bones from the lower arm have been broken by force. Nørlund (1948, p. 39) further described that the bones were found in the fill of the well. According to Nørlund, the bones should therefore not be ascribed too much importance as the construction material may have been transported from elsewhere, for example, backfill in the form of sediments cleaned up from other wells or the bog area, hence containing random bone material. This is also mentioned as being the case elsewhere around the Trelleborg fortress, for example, well number 125 (Nørlund 1948, p. 41), and outside the south gate under the bridge at the inner moat (Nørlund 1948, p. 39).

Sex could not be determined from these fragments and age could not be more precise than ‘adult’. There were no signs of pathology. Further, it was found that the fractures on the ulna and radius resemble post-mortem breakage and as such have no evidence of violence.

Well 121

In well 121, human skeletal remains of two children were found. Both skeletons were well preserved though incomplete and fragmented. Skull fragments from both children were present and some few postcranial parts (Table 1 and Figure 6A). Nørlund (1948, p. 41) described that both children were complete when thrown in the well. There are no records of how the two children were found stratigraphically.

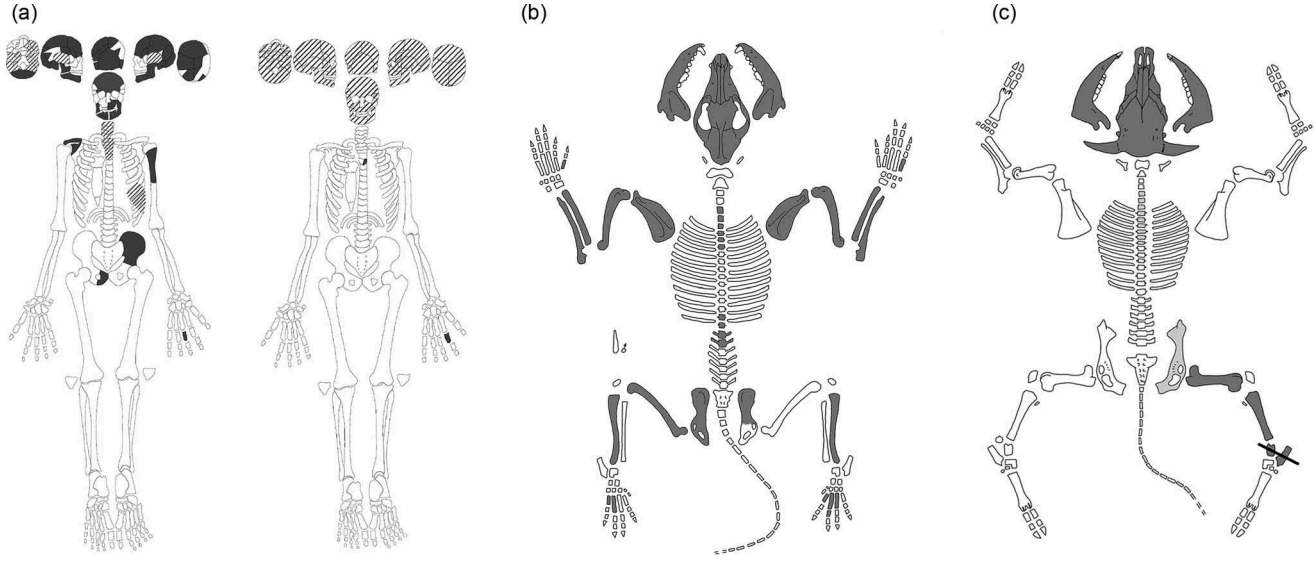

Figure 6. (A) Census of the skeletal elements present of the two children of well 121. To the left is skeleton 1 (*c*. 4 years) and to the right skeleton 2 (*c*. 4 years). Skeletal elements that are hatched represent elements which are greatly fragmented and hence not precisely identified. (B) Census of the skeletal elements of the adult dog of well 121. A total of 34 bone elements were retrieved. No bones exhibited butchery marks. Basic skeletal drawing after Helmer (1987). (C) Census of the skeletal elements of the young adult cow from well 121. The heal joint exhibited dismemberment marks (astragalus and calcaneus). Dark shaded elements were reanalysed in the present study, whereas light shaded elements were reported by Degerbøl (1948) and may have been articulated. Basic skeletal drawing after Helmer (1987).

This current examination found both children to be 4 years old (range 3–5 years), based on dental development (Ubelaker 1989, p. 66), which is equivalent to previous examination (Sellevold *et al*. 1984, p. 131). It is uncertain whether the postcranial elements are from both children as there are no indications of the postcranial bones representing more than one individual. The completeness of the children at the time of deposit cannot be confirmed from the remains preserved today. It is unknown whether the previous definition of completeness by Nørlund (1948, p. 41) differs from this assessment or whether a significant amount of bones have gone missing since the excavation. This was the case for many of the bones from the actual cemetery from the Trelleborg Stronghold (Price *et al*. 2011, p. 482). The children were examined for growth disturbances expressed as enamel hypoplasia and Harris lines as well as cribra orbitalia. The examination revealed no indications of the above. Diseases which are not expressed osteologically cannot be excluded. One of the children (skeleton 1) had in addition two teeth examined histologically in a previous study. The results reveal two periods of physiological stress within a week of birth as well as six periods the following year (Alexandersen *et al*. 1998, p. 15, 17). This is not uncommon on material of archaeological origin. There is no evidence of trauma, cut marks or dismemberment. Several bones were broken, including the bones of the skull; however, all fractures resemble post-mortem breakage, that is, when the bones were dry. There are no indications of chronically ill health. The cause of death cannot be determined.

The strontium isotope results (Table 2) of the two children fall within the Danish bioavailable range previously defined by Frei and Frei (2011, 2013), revealing that the children were most probably of local origin as concluded for well 47.

The adult bones found in well 121 consist only of two parietal fragments. Nørlund (1948) does not mention these two fragments in the publication. However, U. Møhl (unpublished sources) noted them at the Zoological Museum. It is uncertain why they were not included in the original publication. It is possible that the fragments were considered secondary deposits like those of well 50 and as such not given any further emphasis. The skeletal fragments are from an adult. Age cannot be asserted any further and neither can the sex of the individual. The edges of the fractures resemble post-mortem breakage, that is, when the bones were dry. There are no signs of pathology or trauma.

The faunal material

The three wells provided remains of seven mammalian and four avian species (Table 3). The Trelleborg site as a whole showed a preponderance of pig and cattle bones (Degerbøl 1948, p. 241). In recent excavations at Trelleborg Enge north and west of the stronghold, pigs predominated (Kveiborg and Ritchie 2013), which is in agreement with the species distribution of well 50, whereas the two other wells with children's skeletons showed a different pattern. Although whole skeletons of dog and goat inflated the number of identified specimens (NISP) counts, the minimum number of individuals (MNI) distributions still showed that dog, especially in well 47, and horse, in well 121, played

Table 3. The bird and mammal remains found in the three wells at Trelleborg as presented by taxon.

	Well 47		Well 50		Well 121		Total
Taxon	NISP	MNI	NISP	MNI	NISP	MNI	NISP
Swan (*Cygnus* sp.)			2	1			
Peregrine falcon (*Falco peregrinus*)					2	1	
Black-headed gull (*Chroicocephalus ridibundus*)			1	1			
Jackdaw (*Corvus monedula*)	1	1					
Dog (*Canis familiaris*)	11	2	3	1	34	1	
Red deer (*Cervus elaphus*)			10		1	1	
Pig (*Sus domesticus*)	12	3	16	4	22	4	
Cattle (*Bos taurus*)	8	1	21	3	13[1]	2	
Sheep (*Ovis aries*)			6	1	4	3	
Goat (*Capra hircus*)	38	1					
Horse (*Equus caballus*)	2	1	9	1	29[1]	3	
Total identified	72		68		105		245
Mammals unsp. (Mammalia sp.)	11				1		12
Grand total	83		68		106		257

Notes: NISP, number of identified specimens; MNI, minimum number of individuals.
Symmetry and ontogenetic age of the bones were considered in the MNI calculations. The faunal material published by Degerbøl (1948) with new material sorted from the human bones in 1981 and 2013 at LBA included.
[1]The number of discarded vertebrae and ribs was not informed.

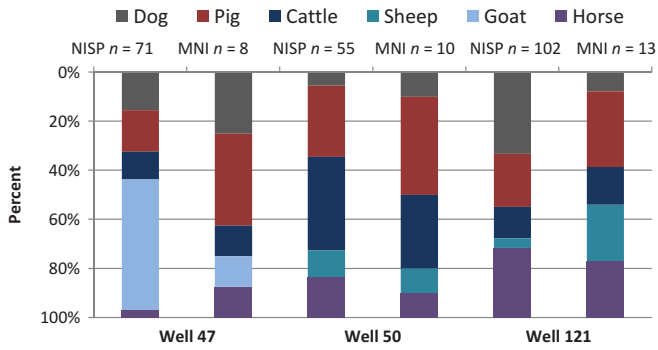

Figure 7. The relative frequencies of the domesticated mammals of the three wells at Trelleborg as shown by NISP and MNI. Data from Table 3.

relatively larger roles (Figure 7). Well structures of contemporary sites such as Tissø, Denmark, and Järrestad, Scania, Sweden, also showed higher relative frequencies of horse remains (but not dogs) as opposed to other structures at the respective sites (Nilsson 2003, table 1, p. 398, Gotfredsen *et al*. forthcoming). The age distribution of the animals in the three wells shows dog remains to be solely from adult animals, whilst the domestic livestock, especially pigs and ovicaprines and to some extent horse and cattle, were represented by young animals (Figure 8 and Supplementary Table 1).

Selection of specific body parts

Skulls and, in particular, mandibles predominate in many ritual contexts (Nilsson 2003, 2009, Magnell and Iregren 2010, p. 243). In traditional cultures, crania are connected to life-giving powers (Cooper 1993), and in Scandinavia the deposition of mandibles has been a well-known practice since the Mesolithic (cf. Noe-Nygaard and Richter 1990, Rudebeck 2010). Elk hunters of Mesolithic Europe deposited jaws and feet in a ritual pit at Popovo in Karelia (Bridault 1992) which points towards a strong symbolic value of these elements. The jaw bones may have served as a symbol of the sacrificed animals and in addition were easily transported from elsewhere to the place of deposition (Magnell and Iregren 2010, p. 243). At the entire Trelleborg site, the only intact skulls found were the goat cranium in well 47 and the dog and cow crania in well 121 (Degerbøl 1948, p. 245). Further, the wells produced two mandibles from pig, one from cattle, four damaged ones from sheep but none from horse except for two lower molars from a mandible. Skulls including mandibles may have had a symbolic significance but also represent primary butchery waste needing to be disposed of. Pigs and to some extent sheep were primarily represented by meaty parts of upper front and upper hind legs, especially in wells 50 and 121 (Table 4). Horse was represented by most body parts, whilst vertebrae and ribs were reported by U. Møhl (unpublished sources) originally to have been present. The dog and cow in well 121 were considered to have been whole skeletons by Nørlund (1948, p. 41): 'The cow lay on top of the dog and the children, and so much was preserved of the children as well as the two animals that it was safe to say that they were interred whole into the well' (author's translation). It seems very likely that the dog was deposited as a whole skeleton (Figure 6B). On the contrary, the cow is assumed originally to have been deposited as a part skeleton since large cattle bones were hardly overlooked during excavation (Figure 6C).

Pre-depositional events

Very little diagenetic degradation had occurred to the bones due to the waterlogged clayey calcium-rich sediments of the wells. The three samples showed low average weathering, although bones in well 50 exhibited a slightly higher frequency of weathering and other pre-depositional damage, for example, gnawing and trampling, than bones of the two other wells, which indicate that part of the content of this well had been subaerially exposed for some time prior to deposition (Table 5).

Butchery practices and fragmentation

Except for the butchered dog bones of well 47, pig and cattle bones overall exhibited the highest frequencies of butchery marks (Table 6; for more thorough descriptions, see Supplementary Table 2). In addition, pig bones were the most fragmented with proportions of whole bones varying between 25% and 36%, whilst cattle and horse bones varied between 46–90% and 50–80%, respectively. All sheep bones occurred as fragments. Horse bones did not exhibit cut marks, although one left metatarsal from well 50 was worked cranially presumably to make a bone skate. The semi-complete he-goat of well 47 was most likely killed by a blow to the frontal bones (Figure 5B and Figure 9). The postcranial goat bones had a relatively low proportion of

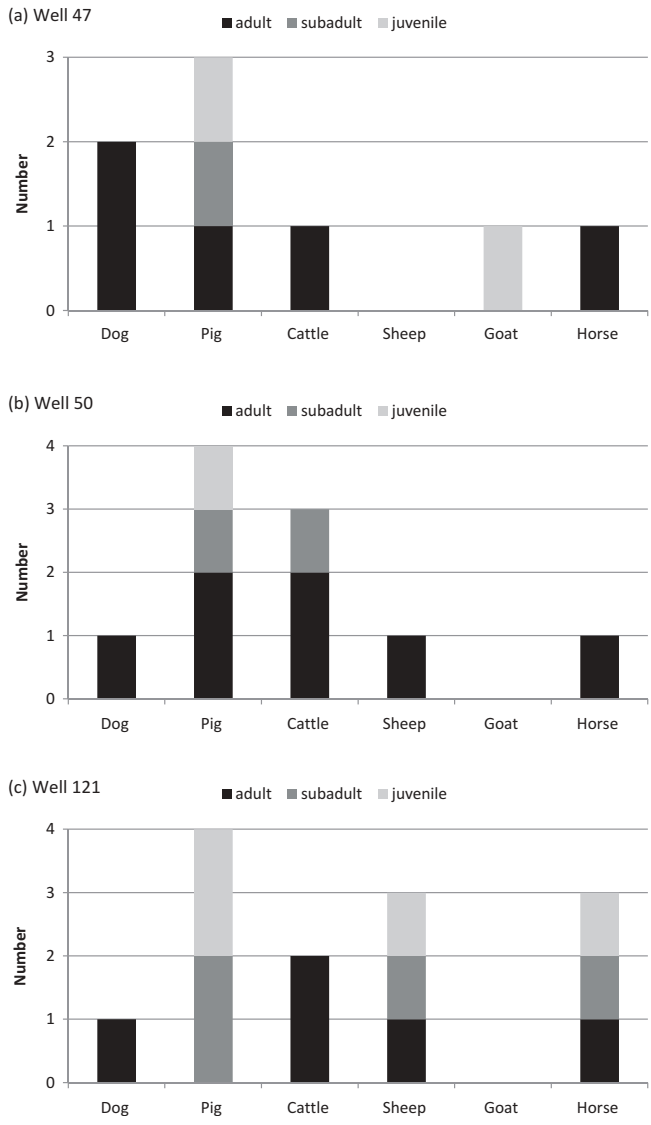

Figure 8. (A–C) Age distribution of the livestock animals of the three wells at Trelleborg as combined from dental eruptions and wear (Supplementary Table 1) and fusion data of the postcranial skeleton. Age categories follow Schmid (1972); adult: permanent teeth in function and epiphyseal lines fused; subadult: replacement of permanent dentition finished and epiphyses nearly ossified, late fusing epiphyses still open or with visible epiphyseal lines (size of the bones almost the size of adult bones); juvenile: replacement of deciduous teeth with permanent dentition and many epiphyses still unfused (size of the bones smaller than the adult bones).

whole elements, *c*. 50%, which was caused by mainly recent damage. The smooth, well-preserved bone surface and complete lack of butchery marks indicate that the meat (or some of it) may still have been attached to the bones at the time of deposition. The semi-complete dog skeleton of well 121 had intact bones without butchery traces (Figure 6B). In contrast, butchery marks were observed on more than half of the fragmented dog bones of well 47 (Table 6).

Place of deposition

Water and, in particular, wells played a central role as sacred places for people during the Iron Age (see Nilsson 2003, p. 288, 2009, p. 83). For instance, Snorre's *Edda* describes how wells were situated adjacent to the roots of Yggdrasil. One well was of particular importance and connected to the goddess or so-called Norn Urd (Carlie 2002, p. 674, Näsström 2002, p. 118). The so-called ritual shafts are structures that penetrate deep underground and form a line of communication between the living of the earth and the dead of the underworld (cf. Green 1992, p. 88). Such structures were often wells which had gone out of use, for instance, well 50 and possibly also well 121, whereas well 47 may not originally have been a well. It is, however, outside the scope of the present paper to discuss in depth the different kinds of wells or well-like structures (for ritualistic uses of wells,

Table 4. The animal remains of the major domesticates of three wells at Trelleborg as distributed by skeletal element.

	Well 47					Well 50					Well 121				
Skeletal element	Dog	Pig	Cattle	Goat	Horse	Dog	Pig	Cattle	Sheep	Horse	Dog	Pig	Cattle	Sheep	Horse
Calvarium	1			3			2				1		1		
Mandibula		2		2		1		1	1		2	1	2	3	
Caninus												2			
Premolar/molar				1						2					
Axis	1					1									
V. cervicalis											3				6
V. thoracica		1		1							5				
V. lumbalis	2										2				
Vertebra unsp.													Many[1]		
Costa		1		15											Many[1]
Scapula				1							2	2			
Humerus		1	1	2			6		1		2	2	1		1
Radius		2		2			4	3	3		2		1	1	
Ulna		1	1	2							2	5			
Metacarpus				1				2		1	2				2
Sacrum		1													
Pelvis				2		1					2		3		3
Femur	1			1							1		1		2
Patella				1											
Tibia	3		1	2			2		1		2	6	1		3
Fibula		1													
Metatarsus		2		1						3	5	2			2
Astragalus	1							6					2		1
Calcaneus	2				1		2	1		1			1		3
Tarsus															2
Metapodial II/IV															1
Phalanx 1			3	1	1			8			1				1
Phalanx 2			2							1					1
Phalanx 3										1					1
Phalanx unsp.												2			
Total	11	12	8	38	2	3	16	21	6	9	34	22	13	4	29

Notes: The faunal material published by Degerbøl (1948) with new material sorted from the human bones in 1981 and 2013 at LBA included.
[1]The number of discarded vertebrae and ribs was not informed.

Table 5. Census of bones with surface alterations shown by number and frequency.

	Gnawing						Trampling						Slight weathering			
	Well 47		Well 50		Well 121		Well 47		Well 50		Well 121		Well 47		Well 50	
Taxon	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%
Swan									1	100.0						
Red deer															1	100.0
Pig	1	14.3	1	12.5			2	28.6	2	25.0	1	14.9	2	28.6	4	50.0
Cattle			1	25.0	1	12.5			2	50.0					1	25.0
Total	1	1.4	2	9.1	1	1.8	3	5.2	5	22.7	1	1.8	2	2.9	6	27.3

Notes: Slight weathering designates weathering stage 1 *sensu* Behrensmeyer (1978). Frequencies were calculated from NISP counts of the re-examined sample: well 47: jackdaw ($n = 1$); dog ($n = 11$); pig ($n = 7$); cattle ($n = 1$); goat ($n = 38$); horse ($n = 0$). Well 50: swan ($n = 1$); black-headed gull ($n = 1$); dog ($n = 3$); pig ($n = 8$); red deer ($n = 1$); cattle ($n = 4$); sheep ($n = 2$); horse ($n = 2$). Well 121: peregrine falcon ($n = 2$); dog ($n = 34$); pig ($n = 7$); cattle ($n = 10$); sheep ($n = 4$); horse ($n = 3$).

see also Haasteren and Groot 2013). The widespread practice of using bogs and wetlands for ritual sacrifices and ceremonies in the early Iron Age changed through time to be settlement bound in the late Iron Age and Viking Age (e.g. Fabech 1991, p. 97, 1994, Nilsson 2003, p. 288, 2009, p. 95ff). Still, ritual depositions

Table 6. Census of bones with surface alterations inflicted by humans as shown by number and their frequency.

	Burning[1]						Cut/chop						Impact scars					
	Well 47[2]		Well 50		Well 121		Well 47		Well 50		Well 121		Well 47		Well 50		Well 121	
Taxon	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%
Black-headed gull									1	100								
Dog							6	54.5										
Red deer									1	10.0								
Pig			2	12.3			1	14.3	2	25.0	3	42.9	1	14.3				
Cattle			1	4.8	1	9.0			1	25.0	3	37.5			2	50.0	1	14.3
Total		0	3	4.5	1	1.0	7	12.1	5	22.7	6	10.7	1	1.7	2	9.1	1	1.8

Notes: Burning is slight burning and charring.
[1]Frequency of burning was based on NISP counts from Table 3. Frequencies of cut/chop and impact scars were calculated from NISP counts of re-examined sample see explanation for Table 5.
[2]Degerbøl (1948, p. 343) reported the majority of bones to have been subjected to mild burning; however, none of the re-examined bones could be confirmed to have been subjected to fire, hence none was recorded for well 47.

Figure 9. Skull of the *c.* 1-year-old male goat from well 47. Large parts of the forehead were missing which indicate that it was felled with a blow to the forehead before it was thrown into the well. Currently, the skull is at a permanent exhibit at the museum at Trelleborg. Photo: Anne Birgitte Gotfredsen.

continued to take place in wetland areas during the Viking Age (cf. Monikander 2010, Zachrisson 2014). At Trelleborg, the cultic rituals and disposal of waste from these acts had been carried out nearby inhabited areas, thus being in accordance with the general temporal trend. The presence of semi-complete skeletons indicates that the actual killing of the animals probably took place close to the wells, possibly within the horseshoe-shaped features (Nørlund 1948, p. 44).

The species choice

The major domesticates predominate whilst a few avian bones and red deer calvaria and antler fragments were the only remnants of wild species in the three wells (Table 3). This is in line with most Iron Age and Viking Age ritual contexts which show a preponderance of the typical livestock species (Nilsson 2009, p. 86, Magnell 2012, p. 296). In rare cases, wild species were also used (see, e.g. Magnell and Iregren 2010). Wild species and fantasy

creatures were significant for identity and cultural transformations and played an important role in the *Eddas* whilst domesticates were mentioned to a lesser degree. Still, domesticated species were of particular importance in rituals at houses and farms, in wetland and at death rituals (Jennbert 2006, p. 138). Which domestic species was preferred depended on the purpose, ritual context and regional variation.

Avian species. Degerbøl (1948, p. 244f) advocated for a symbolic significance of the jackdaw wing bone in well 47 and a swan wing (ulna and carpometacarpus) in well 50. Animal body parts used in burial rituals referred to those elements that were important in the animal's relations with humans (Schanche 2000, p. 295, Fowler 2004, p. 136f); in the present case the ability to fly. The jackdaw humerus was well preserved and may have been deliberately deposited with its feathers still attached. Unfortunately, only a broken distal swan carpometacarpus exhibiting trampling traces and abrasion was retained. Thus an interpretation of a deliberate deposition of a swan wing could not be confirmed. An intact well-preserved black-headed gull ulna exhibiting possible traces of feather removal was retrieved from well 50. Furthermore, a wing and a leg bone from a male peregrine falcon in well 121 indicate that falconry was practised by members of the elite using the Trelleborg area prior to and/or during the occupation of the fortress (Gotfredsen 2014).

Dog. Whole dog skeletons and skulls occurred in bogs and wells throughout the Iron Age in present-day Denmark and Scania (Nilsson 2003, 2009, p. 89). Large pointer-sized dog skeletons found in bogs, for example, Röekillorna, Scania and Valmosen near Rislev, Zealand, were found articulated and devoid of butchery marks and therefore considered as having been deposited as whole corpses (Nilsson 2009, p. 89). Sacrificed dogs included in Danish boat-graves and weaponry bog finds, summarized by Hatting (1978, p.73, 1985, p. 11), were also reported to be large, possible war dogs, *c*. 61–63 cm at the withers. The dog in well 121 was a rather tall and slender individual, *c*. 63 cm at the withers and presumably a male (evidenced from its prominent crista sagittalis). It was healthy without pathological signs on the bones and with only moderately worn teeth, that is, at its prime. In Celtic religion, the dog was an esteemed creature with an important role in mythology and also connected to water and spring cult (Gräslund 2004, p. 171). The dog symbolized not only death but also healing and fertility (Green 1992). Furthermore, it is regarded as a general Indo-German phenomenon that dogs acted both as conductors and guards at the entrance of the underworld (Gräslund 2004, p. 171, De Grossi Mazzorin and Minniti 2006, p. 62), and in the Old Norse religion this guarding dog was named Garm (Jennbert 2006, p.138). The deposition of an entire large dog devoid of butchery traces in well 121 seems to be in accordance with the sacrificial use of dogs during the Iron Age.

In stark contrast to the whole dog in well 121 are the butchered dog joints from well 47. It cannot be stated whether the meat was actually eaten, but some meat was stripped off the bones. Consumption of dogs is a widespread practice, and even within the same society dogs may both receive ritualistic burials and serve as food (Morey 2010, p. 90). In ancient Rome, written sources described how at certain times dogs were butchered and eaten at ritual meals (cf. Wilkens 2006, p.133).

Pig. In the Old Norse mythology, the pig was associated with fertility mostly in connection with Freyr but also the female goddess Freya. The meat-producing powers of pigs was exemplified by the myth of the male pig Särimmer being slaughtered and its meat cooked each evening to feed the warriors of Valhalla (Faulkes 1995, p. 32). Moreover, pork together with horse meat was the preferred meat for consumption at the *blót* meals (Faulkes 1995). The three Trelleborg wells contained disarticulated bones of pig, primarily meat-rich portions, and all but one were from juvenile and subadult individuals close to the optimal age of slaughter. The pigs in the wells conformed to the age of pigs from the site as a whole (Degerbøl 1948, p. 249) and represent consumption waste, although a nearly intact jaw bone from a boar (well 47) may have been selected for a deliberate deposition.

Cattle. Old Norse mythology mentioned cattle in the creation myth where they gave milk to the first gods Ymer and Bure (Faulkes 1995). Thus cattle were associated with life-giving powers. Cattle, valued for their meat, milk and hide, as well as being useful draft animals, were highly estimated domesticates indicating both wealth and status. In the Trelleborg wells, cattle remains comprised firstly of assumed consumption waste; secondly, a mandible (well 50) and a part skeleton of a young adult cow including the skull (well 121). The articulated upper meaty hind leg, dismembered at the heal joint (Figure 6C), probably was deposited while still enfleshed. The cow may thus have served as a propitiatory sacrifice to the gods.

Ovicaprines. Sheep did not play a prominent role in the Old Norse mythology whilst the goat was an important mythological animal. For instance, the two male goats Tanngnjóstr and Tanngrísnir pulled Thor's chariot as described in the Gylfaginning of the *Prose Edda* by Snurri Sturluson (Faulkes 1995, p. 22). The juvenile he-goat in well 47 was, as evidenced from epiphyseal fusion data, *c*. 1 year old and thus most likely killed in spring/early summer probably by a blow to the forehead (Figure 9). The stratigraphically close position to the

two children supports the notion that the juvenile goat was a sacrificial animal. Sheep were depending on the region widespread domesticates and much more abundant than goats at Scandinavian Iron Age sites (Gotfredsen 2004, Nilsson 2009, Magnell and Iregren 2010). Sheep comprised only 4% and 11% of the domesticated mammals in wells 50 and 121, respectively. They represent meal leftovers, that is, fragments of meaty upper limb bones and mandibles which may be regarded as butchery waste. Sheep were of minor importance in culture deposits at the Trelleborg site (cf. Degerbøl 1948, Kveiborg and Ritchie 2013, diagram 15) but occurred in higher frequencies, for example, *c*. 17% at Trelleborg Enge than was evidenced from the three wells. At Tissø (Gotfredsen *et al*. forthcoming) and Järrestad, sheep were represented by lower frequencies in wells than in, for example, pit houses, perhaps because sheep had a more ordinary usage (Nilsson 2003, p. 300).

Horse. The horse played a prominent role in the pre-Christian belief system as described in the *Eddas* and evidenced in the archaeological record (Carlie 2002, Nilsson 2003, 2009, Jennbert 2006, p. 138). It was the holy animal of Odin and Freyr and closely connected to fertility. The significance of horses as an intermediary between different world realms in the belief systems of Germanic tribes was already described by Tacitus (cf. Bliujienė and Butkus 2007, p. 100). During the Viking Age, the horse was seen as a symbolic creature of transformation and passage to other worlds (Loumand 2006). Horses dragged the sun over the sky and played an important role as sacrificial animal in the *blót* meals (see Nilsson 2003, p. 301, 2009, p. 85, 89f, Magnell and Iregren 2010, p. 241, 445). According to Ström (1985, p. 177), it was the practice to select and sacrifice the best and healthiest male animals suitable for breeding, whether it were boars, stallions or bulls at the Freyr's cult or winter *blót*.

Horse bones occurred in high relative frequencies in wells and wetlands sacrificial sites but played an insignificant role at other sites (see Nilsson 2003, 2009, Magnell and Iregren 2010, Magnell 2012). In the Trelleborg wells (seen altogether), all body parts of horse occurred, that is, meatless extremities as well as meat-bearing parts. Degerbøl (1948, p. 246) considered the charred horse bones of, for example, well 47, as an indication of horse flesh being eaten. Although food leftovers from horse may have been present in well 121, such a practice cannot be ascertained in the present analysis. The horse hindlimb in well 121 derived from an unusually tall individual, *c*. 149 cm at the withers as compared to a mean of 140 cm at the site as a whole (Degerbøl 1948, p. 244, table 2). The deposition of an above-average-sized young horse (stallion?) may be interpreted as a fertility sacrifice for Freyr or Odin. In addition, well 121 provided a metatarsal from a colt killed during spring/early summer.

Conclusions

The three wells dated to the eighth/ninth to tenth centuries unearthed a variety of archaeofauna and human remains. Two wells (47 and 121) contained children's skeletons, which seem to be deliberate depositions of semi-complete skeletons or limbs. These represent to date the only Danish Viking Age wells with human remains of children. Due to post-depositional events such as heavy breakage of the children's bones and post-excavation loss of bones, it could not be stated how the children died. Additionally, the wells contained a variety of animal remains of which some represented consumption waste of livestock species being the remains of profane and/or ritual meals such as *blót* activities.

A sacrificed young he-goat in well 47 killed during spring may be seen as a propitiatory sacrifice to honour or appease Thor and to ensure fertility. The deposition of a hindlimb of a young large-sized presumed stallion and large parts of a cow placed together with the children may also be interpreted as propitiatory sacrifices, whilst the large-sized high prestige male dog may have served a dual function as a sacrifice to the gods and a conductor for the children. The sacrificed animals showed evidence of having been deposited while still enfleshed and hence, as regards the animals normally used for consumption, constituted a resource loss to the society.

The strontium isotope results of the four children found in the two wells (47 and 121) point to local provenance. However, there seems to be a pattern, as the strontium isotope results of each well pair up. Hence, the youngest child from well 47 and child from well 121 (2) have strontium isotope ratios of ~0.7108. In contrast, the oldest child from well 47 and child from well 121 (1) have strontium isotope ratios a little less radiogenic in the order of $^{87}Sr/^{86}Sr \sim 0.7102$. Even though all values point to local origin, they do not seem to point to exactly the same area. It is, therefore, plausible that the children came from two different surrounding areas at Trelleborg. One could thus speculate if there is a ritual meaning that involves the sacrifice of children from certain nearby areas, which was repeated in these two wells.

Ritual wells have turned up in connection with archaeological excavations in Scandinavia. One fine example is from the royal residential complex at Lake Tissø, only *c*. 30 km north of Trelleborg (Jørgensen *et al*. 2014, p. 196, Gotfredsen *et al*. forthcoming). The use of wells as ritual sites has also been documented in earlier periods. At Lindängelund, close to the town of Malmö in southern Sweden, a number of wet areas and wells from different periods have been excavated (Carlie 2013). In a number of wells from the period 150 BC–AD 300 deposits containing remains of humans, animals, and wooden artefacts have been documented. In connection to the ritual site at

Trelleborg, it is important to note that it is closely associated with a settlement of higher status. The structure and organization of this settlement is still unknown; however, the stray metal finds indicate that we are dealing with a complex of some status. The ritual features on the promontory are not the only ones in the area. In connection with dredging of the river Tude Å, a ninth-century sword was found upstream of Trelleborg (Nørlund 1948, fig. 4). The distance to the find location for the sword is uncertain but is just outside the map in Figure 1. Undated human skeletons have been found in the bog area just east of the fortress (cf. also Nørlund 1948, p. 159). The finds so far indicate that systematic surveys and investigations would reveal further ritual sites and perhaps shape a ritual landscape similar to the one that have emerged in connection to the elite complex at Lake Tissø, where so far five contemporary ritual sites have been documented in the landscape encircling the royal residence (Jørgensen 2014, p. 137ff).

The cross-scientific analyses presented in this article demonstrate that further steps and new knowledge can be gained within an interdisciplinary collaboration between natural sciences and archaeology, particularly in order to clarify the formation processes underlying the accumulation of cultural deposits in features such as ritual wells. Apparently, they were used both for gift and communion offerings. Based on the archaeological traces of the pre-Christian religion on the Scandinavian sites, we can at least see that, in the ninth to tenth century, we had a religion which in part seems very vigorous and whose rituals seem to be firmly embedded in the mental world of the people. This is important for our understanding of the transition from the 'pagan' to the Christian religion.

Trelleborg constitutes an important site with regard to these power political aspects as we witness the closing of an important regional pre-Christian ritual site in connection with the construction of the fortress. A new political and military power clearly entered the regional scene and, with or without the consent of the local elite, closed down the old ritual site. We know that this event took place around AD 980. A few years ago, we would perhaps have thought that it coincided with the introduction of Christianity. However, if we look at the plan of Trelleborg we note an area just inside the northern gate where a probable stave built house is associated with one of the horseshoe features and several pits and/or postholes (cf. Figure 2). The house and adjoining features seem to respect the gate entrance and the plank-built street into the fortress. This indicates that the house and the features are contemporary with the fortress. In his publication, Nørlund (1948, p. 92f) suggested that the house could be a 'temple'; however, he rejected this interpretation as based on too weak arguments. Instead, he called it a 'gate house' with an uncertain function, perhaps not least because as it is situated at the gate facing the large wet area to the north. Today new archaeological excavations indicate that Nørlund's first interpretation could very well be correct. At the large residence at Fugledegård at Lake Tissø, the presumed pre-Christian ritual area south of the hall also in the tenth century contained a stave built house measuring 7 × 7 m (Jørgensen 2014, Fig. 7). The two buildings are not exactly similar in their construction details, but the building and the associated features at Trelleborg could very well constitute a similar ritual complex that served the Trelleborg garrison where the majority of the inhabitants with all probability not yet had converted to Christianity.

Acknowledgements

Kristian M. Gregersen, Natural History Museum of Denmark, kindly sampled the animal bones for radiocarbon dating. Further, the authors wish to thank two anonymous reviewers for their much appreciated comments on this paper.

Funding

The authors are grateful for the financial grant received from *A.P. Møller og Hustru Chastine Mc-Kinney Møllers Fond til almene Formaal* to the research project 'Pre-Christian Cult Places'.

Supplemental data

Supplemental data for this article can be accessed here.

Notes

1. During the present study, only 48% (n = 98) of the original bone sample (n = 203) published by Degerbøl (1948) could be found at the Zoological Museum–University of Copenhagen ZMUC or at exhibit at the museum at Trelleborg, Slagelse. In 1981, a small sample of animal bones (n = 53) was sorted from the human remains at LBA and sent to ZMUC. Those bones were not seen by Degerbøl. One additional peregrine falcon was reidentified from the duck bones (Gotfredsen 2014). Therefore, a total of 152 bones could be examined or re-examined in the present study. Degerbøl (1948, p. 243–45) based his publication on the bone identifications undertaken by U. Møhl, who was rather specific as regards species identification, assessment of bone element and sometimes portion of the bone, and moreover information on fusion stage and charring. Consequently, the present analysis encompass analyses regarding frequencies, age and skeletal part distributions and occurrence of charring, applied on the entire bone assemblage (n = 257). Weathering, trampling and butchery trace assessment was not undertaken by Degerbøl, and therefore, these evaluations were applied to the assemblage actually re-examined in the present study (n = 152).
2. Nørlund (1948, p. 41) stated that a skeleton of a dog and a cow was found on top of the children in well 121. However, only vertebrae, a skull and some limb bones of the cow were apparently brought back to the laboratory since Degerbøl (1948, p. 244) reported on only 13 cattle bones plus many vertebrae. Except for a dog's axis, well 47, one from well 50, and articulated vertebrae (n = 10) of the semi-complete

dog from well 121, recovered ribs and vertebrae were not retained. Some ribs and vertebrae occurring amongst the animal bones separated from the children's skeletons at the LBA in 1981 lend support to the notion that those skeletal elements in some numbers had originally been present in the wells. U. Møhl noted in his identification lists that all bones of bird species and special mammal species such as dog and small-sized mammals were kept, whereas smaller fragments of large-sized mammals were disregarded (U. Møhl, unpublished sources). The stored animal bone assemblage of major domesticates presently kept at the Natural History Museum of Denmark gives the impression that only identifiable portions of the major long bones with articular ends and other easily identifiable portions of the main skeletal elements as well as jaws with teeth *in situ* were retained.

References

Alexandersen, V., *et al*., 1998. Aspects of teeth from archaeologic sites in Sweden and Denmark. *Acta Odontologica Scandinavica*, 56, 14–19. doi:10.1080/000163598423009

Behrensmeyer, A.K., 1978. Taphonomic and ecologic information from bone weathering. *Paleobiology*, 4 (2), 150–162.

Binford, L.R., 1981. *Bones. Ancient men and modern myths*. London: Academic Press.

Bliujienė, A. and Butkus, D., 2007. Armed men and their riding horses as a reflection of the warrior hierarchy in Western Lithuania during the Roman Iron Age. *In*: A. Bliujienė, ed.. *Weapons, weaponry and man: in memoriam Vytautas Kazakevičius*. *Archaeologica Baltica*. Klaipeda: The Instutute of Baltic Region History and Archaeology. Vol. 8, 95–116.

Bridault, A., 1992. The status of elk during the Mesolithic. *In*: A. Grant, ed. *Animals and their products in trade and exchange. Anthropozoologica*. Paris: Éditions du Centre National de la Recherche Scientifique, 151–160.

Bronk Ramsey, C. 2013. OxCal 4.2. Available from: http://c14. arch.ox.ac.uk/oxcal [Accessed 3 December 2014]

Carlie, A., 2002. Gård och kultplats. Om bruket av offerhandlingar på en yngre jarnåldersgård i Hjärup, sydvästra Skåne. *In*: A. Carlie, ed. *Skånska regioner. Tusen år av kultur och samhälle i förändring*. Stockholm: Riksantikvarieämbetets förlag, Riksantikvarieämbetet. Arkeologiska undersökningar Skrifter No. 40, 653–679.

Carlie, A., 2013. Archaeology and ritual: a case study on traces of ritualization in archaeological remains from Lindängelund, southern Sweden. *Folklore*, 55, 49–68. Available from: http://www.folklore.ee/folklore/vol55/carlie.pdf.

Cooper, J.C., 1993. *An illustrated encyclopaedia of traditional symbols*. Leibzig: Thames & Hudson.

De Grossi Mazzorin, J. and Minniti, C., 2006. Dog sacrifice in the ancient world: a ritual passage?. *In*: L.M. Snyder and E. A. More, eds. *Dogs and people in social, working, economic or symbolic interaction*. *Proceedings of the 9th conference of the international council of archaeozoology*, August 2002, Durham, Oxford: Oxbow Books, 62–66.

Degerbøl, M., 1948. Dyreknogler fra Trelleborg. In: P. Nørlund, ed. *Trelleborg*. Copenhagen: Nordisk Forlag, Nordiske Fortidsminder. IV (1). Det Kongelige Nordiske Oldskriftselskab, 241–265.

Ewbank, J.M., *et al*., 1964. Sheep in the Iron Age: a method of study. *Proceedings of the Prehistoric Society*, 30, 423–26. doi:10.1017/S0079497X0001519X

Fabech, C., 1991. Booty sacrifices in Southern Scandinavia: a reassessment. *In*: P. Garwood, *et al*., eds. *Sacred and profane. Proceedings of a conference on archaeology, ritual and religion*. Oxford: Oxbow Books, 89–99.

Fabech, C., 1994. Reading society from the cultural landscape. South Scandinavia between sacred and political power. *In*: P.O. Nielsen, K. Randsborg, and H. Thrane, eds. *The archaeology of Gudme and Lundeborg*. *Papers presented at a conference at Svendborg*, October 1991. Copenhagen: Akademisk Forlag, *Arkæoeologiske studier*, Vol. 10, 169–183.

Faulkes, A., 1995. *Snorri Sturluson Edda*. (Trans.). London: Evryman.

Fowler, C., 2004. *The archaeology of personhood*. London: Routledge.

Frei, K.M. and Frei, R., 2011. The geographic distribution of strontium isotopes in Danish surface waters – a base for provenance studies in archaeology, hydrology and agriculture. *Applied Geochemistry*, 26, 326–340. doi:10.1016/j.apgeochem.2010.12.006

Frei, R. and Frei, K.M., 2013. The Geographic distribution of Sr isotopes from surface waters and soil extracts over the island of Bornholm (Denmark) – a base for provenance studies in archaeology and agriculture, *Applied. Geochemsitry*, 38, 147–160. doi:10.1016/j.apgeochem.2013.09.007

Goodman, A.H. and Rose, J.C., 1990. Assessment of systemic physiological perturbations from dental enamel hypoplasias and associated histological structures. *American Journal of Physical Anthropology*, 33, 59–110. doi:10.1002/(ISSN)1096-8644

Gotfredsen, A.B., 2004. Jernalderpladsen Østervang – hvad dyreknoglerne fortæller. *Årbog for Køge Museum*, 2003, 23–36.

Gotfredsen, A.B., 2014. Birds in subsistence and culture at Viking Age sites in Denmark. *In*: L. Bejenaru and D. Serjeantson, eds. *International Journal of Osteoarchaeology*. Special Issue Paper. Chichester: John Wiley & Sons, Ltd. *24*, 365–377. doi:10.1002/oa.2367

Gotfredsen, A.B., forthcoming. *Animal sacrifices and deposits in inhumation graves of the Roman Iron Age in Zealand and Funen, Eastern Denmark*. With a contribution on the anthropological material. *In*: L. Boye and U. Lund Hansen, eds. Kroppedal.

Gotfredsen, A.B., Henriksen, P.S., and Jørgensen, L., forthcoming. Kalmergården. *In*: L. Jørgensen, ed. *The Viking manor at Lake Tissø*. Copenhagen: PNM – Publications from the National Museum.

Grant, A., 1982. The use of tooth wear as a guide to the age of domestic ungulates. *Ageing and Sexing Animal Bones from Archaeological Sites. BAR British Series*, 109, 91–108.

Gräslund, A.-S., 2004. Dogs in graves – a question of symbolism? *In*: B.S. Frizell, ed. *PECUS. Man and animal in antiquity. Proceedings of the conference at the Swedish Institute in Rome*, 9–12 September 2002, Rome: Swedish Institute, 167–176. http://www.isvroma.it/public/pecus/graslund.pdf

Green, M.J., 1992. *Animals in Celtic life and myth*. London: Routledge.

Grimm, J.M., 2008. A dog's life: animal bone from a Romano-British ritual shaft at Springhead, Kent (UK). *In*: N. Benecke, ed. *Beitrage zur Archaeologie und Prähistorischen Anthropologie*. Langenweissbach: Gesellschaft für Archäozoologie und Prähistorischen Anthropologie. Vol. 6. 54–75.

Grimm, J.M., 2010. A bird for all occasions: the use of birds at the Romano-British sanctuary of Springhead, Kent (UK). *In*:

W. Prummel, J.T. Zeiler, and D.C. Brinkhuizen eds. *Birds in archaeology. Proceedings of the 6th meeting of the ICAZ bird working group in Groningen*, 23 August–27 August 2008). Groningen: Barkhuis Gronigen University Library, 187–195.

Harris, H.A., 1931. Lines of arrested growth in the long bones in childhood: the correlation of histological and radiographic appearances in clinical and experimental conditions. *The British Journal of Radiology*, 4, 561–588. doi:10.1259/0007-1285-4-47-561

Hatting, T., 1978. Zoologisk beskrivelse af dyreknoglerne fra sb. 16. *In: Himlingøje-Gravpladsens Høje. Særtryk Af Antikvariske Studier*, 2, 69–74.

Hatting, T., 1985. Forhistoriske hunde i Danmark. Nye fund fra jernalderen. *Dyr I Natur Og Museum*, 1, 8–13.

Helmer, D., 1987. Fiches descriptives pour les relevés d'ensembles osseux animaux. *In*: J. Desse and N. Desse-Berset, eds. *Fiches d'ostéologie animale pour l'archéologie*. Série B: mammifère, n° 1. Centre de recherches archéologiques du CNRS/APDCA.

Henriksen, M.B., 2015. Kystens kultpladser – vikingernes rituelle aktiviteter ved havet. *Odense Bys Museer*, 2015, 201–216.

Hillson, S., 2000. Dental pathology. In: M.A. Katzenberg and S. R. Saunders, eds. *Biological anthropology of the human skeleton*. New York: Wiley-Liss, 249–286.

Horowitz, E.P., Chiarizia, R., and Dietz, M.L., 1992. A novel strontium-selective extraction chromatographic resin. *Solvent Extraction and Ion Exchange*, 10, 313–336. doi:10.1080/07366299208918107

Jennbert, K., 2006. The heroized dead. People, animals, and materiality in Scandinavian death rituals, AD 200–1000. *In*: A. Andrén, K. Jennbert, and C. Raudvere, eds. *Old Norse religion in long-term perspectives*. Lund: Nordic Academic Press, 135–140.

Jørgensen, L., 2014. Norse religion and ritual sites in Scandinavia in the 6th–11th century. *In*: H.C. Gulløv, ed. *Northern worlds – landscapes, interactions and dynamics*, *Proceedings of the northern worlds conference*, Copenhagen, 28–30 November 2012. PNM Publications from the National Museum. Studies in Archaeology & History Vol. 22. Copenhagen: National Museum, 129–150.

Jørgensen, L., *et al*., 2014. Førkristne kultpladser – ritualer og tro i yngre jernalder og vikingetid. *In*: *Nationalmuseets Arbejdsmark 2014*. Copenhagen: National Museum, 186–199.

Koudelka, F., 1885. Das Verhältnis der Ossa longa zur Skelethöhe bei den Säugetieren. *Verhandlungen des Naturforchenden Vereines in Brünn*, 24, 127–153.

Kveiborg, J. and Ritchie, K., 2013. 13.4. Zooarkæologisk gennemgang af knoglemateriale fra Trelleborg, Fyrkat og Aggersborg. *In*: A.S. Dobat, ed. *Kongens Borge. Rapport over undersøgelserne 2007–2010*. Højbjerg: Jysk Arkæologisk Selskab, 206–297.

Lauwerier, R.C.G.M. (2004). The economic and non-economic animal: roman depositions and offerings. *In*: S. Jones O'Day, W. Van Neer, and A. Ervynck, eds. *Behaviour behind bones: the zooarchaeology of ritual, religion, status and identity. Proceedings of the 9th conference of the international council of archaeozoology*, Durham, August 2002. Oxford: Oxbow Books, 66–72.

Legge, A.J., 1992. Excavations at Grimes Graves Norfolk 1972–1076. Fascicule 4. *In*: *Animals, environment and the Bronze Age economy*. London: British Museum Press.

Loumand, U., 2006. The horse and its role in Icelandic burial practices, mythology and society. *In*: A. Andrén, K. Jennbert, and C. Raudvere, eds. *Old Norse religion in long-term perspectives*. Lund: Nordic Academic Press, 130–134.

Magnell, O., 2012. Sacred cows or old beasts? A taphonomic approach to studying ritual killing with an example from Iron Age Uppåkra, Sweden. *In*: A. Pluskowski, ed. *The ritual killing and burial of animals: European perspectives*. Oxford: Oxbow Books, 195–207.

Magnell, O. and Iregren, E., 2010. Veitstu Hvé Blóta Skal? The Old Norse Blót in the light of osteological remains from Frösö Church, Jämtland, Sweden. The Swedish Archaeological Society. *Current Swedish Archaeology*, 18, 223–250.

May, E., 1985. Widerristhöhe und Langenknochenmasse bei Pferden – ein immer noch aktuelles problem. *Zeitschrift Für Säugetierkunde*, 50, 368–382.

Monikander, A., 2010. Våld och vatten. Våtmarkskult vid Skedemosse under jänåldern. In: A. Andrén, ed. Stockholm Studies in Archaeology 52. Stockholm: Stockholms Universitet.

Morey, D.F., 2010. *Dogs: domestication and the development of a social bond*. Cambridge: Cambridge University Press.

Morris, J. (2008). Re-*examining associated bone groups from Southern England and Yorkshire, c. 4000 BC to AD 1550*. Thesis (PhD). Bournemouth University.

Näsström, B.-M., 2002. *Blot. Tro och offer i det förkristna Norden*. Stockholm: Norstedts.

Nilsson, L., 2003. Blóta, Sóa, Senda. Analys av djurben. I*n*: B. Söderberg, ed. *Järrestad. Huvudgård i centralbygd. Riksantikvarieämbetet Arkeologiska undersökningar. Skrifter*. Stockholm: Riksantikvarieämbetet. Vol. 51. 287–309.

Nilsson, L., 2009. Häst och hund i fruktbarhetskult och blot. *In*: A. Carlie, ed. *Järnalderens rituelle platser*. Halmstad: Kulturmiljö Halland, 81–99.

Noe-Nygaard, N. and Richter, J., 1990. Seventeen wild boar mandibles from Sludegårds Sømose: offald or sacrifice?. *In*: D.E. Robinson, ed. *Experimentation and reconstruction in environmental archaeology*. Oxford: Oxbow Books, Symposia of the Association for Environmental Archaeology, 9, 175–187.

Nørlund, P., 1948 ed. *Trelleborg*. In: Nordiske Fortidsminder. IV (1). Det Kongelige Nordiske Oldskriftselskab. Copenhagen: Nordisk Forlag.

Park, E.A. and Richter, C.P., 1953. Transverse lines in bones: the mechanism of their development. *Bulletin of the John Hopkins Hospital*, 93, 234–248.

Payne, S., 1973. Kill-off Patterns in sheep and goats: the mandibles from Aşvan Kale. *Anatolian Studies. Journal of the British Institute of Archaeology in Ankara*, 23, 281–303.

Price, D.T., *et al*., 2011. Who was in Harold Bluetooth's army? Strontium isotope investigation of the cemetery at the Viking Age fortress at Trelleborg, Denmark. *Antiquity*, 85, 476–489. doi:10.1017/S0003598X00067880

Primeau, C., *et al*., 2012. A method for estimating age of Danish medieval sub-adults based on long bone length. *Anthropologischer Anzeiger*, 69 (3), 317–333. doi:10.1127/0003-5548/2012/0168

Reimer, P.J., et al., 2013. IntCal13 and Marine13 Radiocarbon Age calibration curves 0-50,000 years cal BP. Radiocarbon, 55, 1869–1887. doi:10.2458/azu_js_rc.55.16947

Reitz, E.J. and Wing, E.S., 1999. Zooarchaeology. In: *Cambridge Manuals in Archaeology*. Cambridge: Cambridge University Press.

Rudebeck, E., 2010. I trästodernas skugga. Monumentala möten I neolithiceringens tid. *In*: B. Nilsson and E. Rudebeck, eds. *Arkeologiska och forhistoriske världar. Fält, erfarenheter och stenåldersplatser i sydvästra Skåne*. Malmö: Malmö Museer, 83–251.

Russell, N., 2012. *Social zooarchaeology: humans and animals in prehistory.* New York: Cambridge University Press.

Schanche, A., 2000. *Graver i ur og berg. Samisk gravskikk og religion fra forhistorisk til nyere tid*. Karasjok: Davvi Girji OS.

Scheuer, L. and Black, S., 2000. *Developmental Juvenile Osteology.* San Diego: Academic Press.

Schmid, E., 1972. *Atlas of Animal Bones*. Amsterdam: Elsevier.

Sellevold, B.J., Hansen, U.L., and Jørgensen, J.B., 1984. *Iron Age man in Denmark*. Copenhagen: Det Kongelige Nordiske Oldskriftsselskab.

Serjeantson, D., 1991. The bird bones. *In*: B. Cunliffe and C. Pole, eds.. *Danebury: an Iron Age hillfort in Hampshire. Volume 5. The excavations 1979–1988: the Finds*. London: Council for British Archaeology, Res. Rep. 73, 497–81.

Serjeantson, D. and Morris, J., 2011. Ravens and crows in Iron Age and Roman Britain. *Oxford Journal of Archaeology*, 30 (1), 85–107. doi:10.1111/j.1468-0092.2010.00360.x

Shipman, P., Foster, G., and Schoeninger, M., 1984. Burnt bones and teeth: an experimental study of color, morphology, crystal structure and shrinkage. *Journal of Archaeological Science*, 11, 307–325. doi:10.1016/0305-4403(84)90013-X

Ström, E., 1985. *Nordisk hedendom. Tro och sed i förktisten tid*. Akademiförlaget. Stockholm: Scandinavian University Books.

Stuart-Macadam, P., *et al*., 1985. Porotic hyperostosis: representative of childhood conditions. *American Journal of Physical Anthropology*, 66, 391–398. doi:10.1002/ajpa.1330660407

Ubelaker, D., 1989. *Human skeletal remains: exavation, analysis, interpretation*. Washington, DC: Taraxacum Press.

van Haasteren, A. and Groot, M., 2013. The biography of wells: a functional and ritual life history. *Journal of Archaeology in the Low Countries*, 4 (2), 25–51. Available from: http://jalc.nl/cgi/t/text/get-pdf318a.pdf?c=jalc;idno=0402a02

von den Driesch, A., 1976. *A guide to the measurement of animal bones from archaeological sites*. Peabody Museum Bulletin I. Cambridge, MA: Harvard University.

von den Driesch, A. and Boessneck, J., 1974. Kritische Anmerkungen zur Widerristhöhenberechnung aus Längenmassen vor- und frühgeschichtlicher Tierknochen. *Sonderdruck Aus Säugetierkundliche Mittteilungen*, 22 (4), 325–348.

Vretemark, M., 1997. Från ben till boskap. Kosthåll och djurhållning met utganngspunkt i medeltida benmaterial från Skara. *Skrifter Från Länsmuseet Skara* (Skara), 25, 192.

Walker, P., *et al*., 2009. The causes of porotic hyperostosis and cribra orbitalia: a reappraisal of the iron-deficiency-anemia hypothesis. *American Journal of Physical Anthropology*, 139, 109–125. doi:10.1002/ajpa.v139:2

Wilkens, B., 2006. The sacrifice of dogs in ancient Italy. *In*: L.M. Snyder and E.A. More eds. *Dogs and people in social, working, economic or symbolic interaction*. *Proceedings of the 9th conference of the international council of archaeozoology*, Durham, August 2002. Oxford: Oxbow Books, 123–137.

Zachrisson, T., 2014. Händelser vid vatten. Om näcken vid Lutbron och de förkristna dödsoffren i sjön bokaren. *Uppland: Saga Oc Sed. Kungliga Gustav Adolfs Akademiens Årsbok*, 2014, 69–91.