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THE DATE OF THE STONE-CIST CEMETERY AT JÕELÄHTME RECONSIDERED

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Fifteen radiocarbon dates of inhumed burials were obtained for the 36 stone-cist graves at Jõelähtme, the largest completely excavated stone-cist cemetery in Estonia, to confirm and complement the typo-chronological date based on the Nordic Bronze Age chronology. The bronze artefacts of Nordic origin, such as razors, tweezers, double buttons, and looped toggles, in which the cemetery is, in the local context, exceptionally rich, date from Montelian Periods IV and V, more specifically perhaps around the turn of the periods. This is in good accordance with the radiocarbon dates, which show that burial began around 1000 BC at the latest and ended around 900 BC at the earliest. It is likely that the lifespan of the cemetery was longer between 1100 (less likely, 1200) and 800 BC. Besides the human remains, a dog bone and a cat bone were radiocarbon dated to ca AD 260–540 and 990–1160, respectively. Particularly surprising was the late date for the dog, because the separate cist apparently built for dogs suggested a date contemporary with the Bronze Age burials.

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Introduction

Bronze Age stone-cist graves in Estonia are usually poor in finds and therefore difficult to date. A notable exception in this regard was discovered at Jõelähtme, northern Estonia, where 36 stone-cist graves were rescue excavated in 1982–1984 (Kraut 1985). Many of the relatively numerous artefact finds at Jõelähtme turned out to have well-known and datable counterparts in the Nordic Bronze Age find assemblages. The scale of excavation and the finds have granted the site several high-sounding titles: the first extensively excavated Late Bronze Age cemetery, the oldest and most imposing stone-cist graves, the oldest above-ground cemetery, the oldest stone structures, etc., in Estonia (e.g. Lõugas 1988, 18; Lõugas & Selirand

1989, 151; Pillak 1998, 120; Pajo 2006; Kraut 2007, 32; Eerma 2013; Eesti reisijuht 2016, 34; Pärtel s.a.). The cists and the ring walls, reconstructed 25 metres from their original location right by the E20 road and next to a small museum of the Rebala Heritage Reserve, have served visitors as an exemplary Bronze Age cemetery since the mid-1980s.

In his review of the excavation results, Ants Kraut (1985) assigned the bronze artefacts of Scandinavian origin to Periods IV and V of the Nordic Bronze Age, or the 9th–8th centuries BC following Evert Baudou's classic work on Nordic Late Bronze Age chronology (1960). For the overall date of the cemetery, Kraut proposed the 'end' or 'last centuries' of the Late Bronze Age, i.e. the 8th–7th centuries BC according to the local chronology prevalent at the time (see Jaanits et al. 1982, 129, 136). In the 1990s, based on the updated absolute chronology of the Nordic Bronze Age, Valter Lang (1996, 310) asserted that the cemetery at Jõelähtme was established around 1000 BC or even earlier. Later, however, a slightly younger date in mainly Period V (900–600 BC) was advocated (Lang & Kriiska 2001), or a more ambiguous reference to Periods IV and V was made when the date of the cemetery had to be addressed (Lang 2007a; 2007b). In popular sources, the date of the cemetery has been and often still is varying between the 9th and the 7th centuries BC (e.g. Jõelähtme kivikirstkalmistu 2003; Eesti reisijuht 2016, 34; Rebala muinsuskaitseala 2019). These estimations, or at least some of them, are probably stuck in the 1980s, uninformed of the fact that the absolute chronology used by Baudou is long out of date. If someone is to blame here, it is professional archaeology's inability to communicate its developments to wider audiences.

Although the typo-chronology of the Nordic artefacts offers good grounds for dating, it also poses potential problems. First, the majority of the deceased appear to have been interred without (datable, preserved) artefacts. Further, it is possible that the artefacts represent only a short period in the cemetery's lifespan. Hypothetically, it is conceivable that the burials and artefacts are temporally separate, as stone cists in Estonia are not closed grave complexes. Finally, the concept of a 'date of an artefact' is ambiguous, since artefacts have lifespans from production to, in this case, deposition. As far as it is possible that object biographies (resp. mortuary practices) varied by region, a straightforward application of the Nordic chronology to other regions may not be appropriate.

In full awareness that the available methods do not solve all the issues above, I arranged radiocarbon dating for a selection of skeletons to verify and complement the existing knowledge of the cemetery's date and the associated themes. The results of the radiocarbon analysis form the core of the paper. Relying on Baudou (1960), a widely used authority on relative chronology even today (see e.g. Kneisel 2013), and a few more recent works on absolute chronology (Olsen et al. 2011; Hornstrup et al. 2012), I will also review the types and dates of the relevant artefacts in more detail than has been done before. Since the published information on the site is undeservingly scarce, some space has to be devoted to the description of the cemetery and the burials as the context of the radiocarbon dates. The basic characteristics of single graves can be found in the Appendix.

The cemetery

Stone structures

The cemetery is situated in a karst landscape ca four kilometres from the coast (Fig. 1). Less than a hundred metres to the west, the partly subterranean Jõelähtme River re-emerges from the earth. The northern and western parts of the cemetery had perished before the site was discovered and excavated. The excavator estimates that the survived part of the cemetery may have been no more than a third or a quarter of what was once there (A. Kraut, pers. comm. 2020; see also Kraut 1985, 348). The upper parts of the extant stone mounds had also been destroyed or entirely wiped out by road construction and horticultural activities. The damage had been particularly severe in the westernmost part of the cemetery, where no more than the

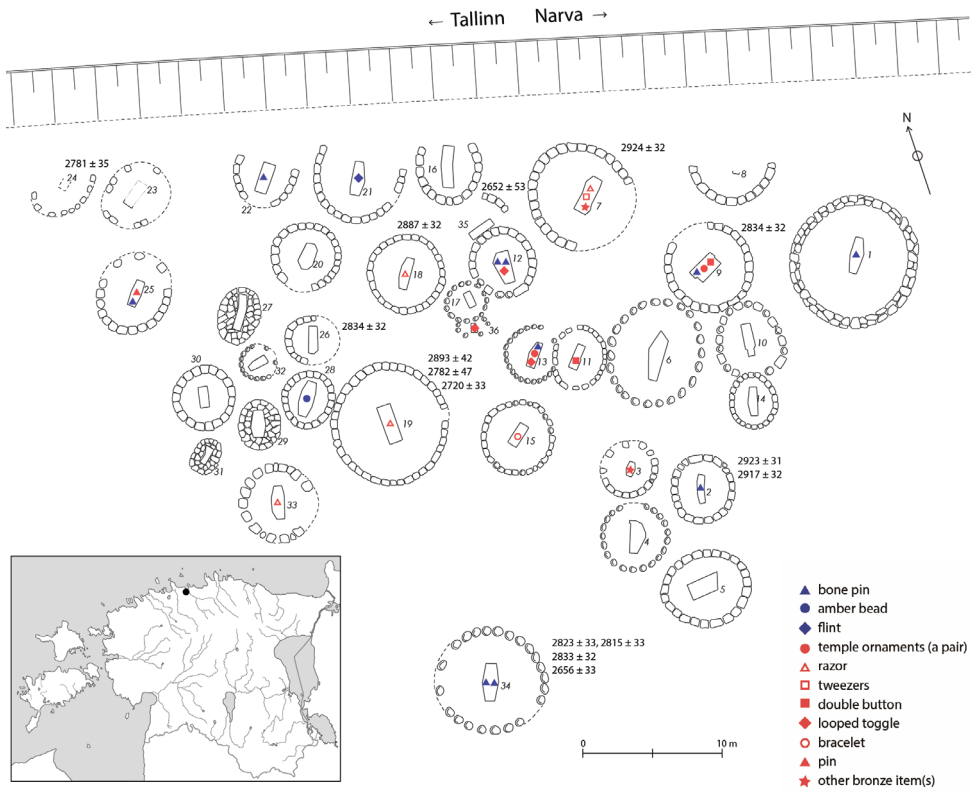

Fig. 1. Plan of the stone-cist cemetery at Jõelähtme (based on a plan provided by Ants Kraut). Note that the drawing is not fully accurate about construction particulars, including the joins of the graves (as proved by the photos taken during excavation). Graves 27, 28, 31, and probably 29 consisted entirely of limestone. The rest of the graves had a fill of granite stones and limestone between the cist and the ring wall. Graves 3, 4, 6, 13, 17, 32, 34, and 36 had a ring wall with a granite stone foundation. The plan shows only Bronze Age finds and radiocarbon dates (BP); the location of finds within a cist/grave is schematic (see Appendix for more detailed information).

bases of the graves were extant. Best preserved were the easternmost graves, 1–11 (Kraut & Varul 2012). The state of preservation is a factor any research into the cemetery must consider.

The biggest of the graves had a diameter of ca 9 m, whereas the smallest with their nearly 3 m diameter were hardly more than a cist provided with an extra wall. Most of the cists were fit for adults but some were probably meant for children only. The cist of grave 6 deviated from the regular rectangular form and was reported as boat-shaped. All cists had dry stack limestone walls above limestone bedrock. The ring walls had a similar structure, except for a few cases where the limestone wall reportedly featured a granite stone foundation. The space between a cist and its surrounding ring wall had been filled with limestone slabs above a base of granite stones, except in the cases of a few small graves in the western part of the cemetery, which showed no granite stones in their structure. The cists had probably had a cover of large limestone slabs, perhaps topped with a granite stone. The excavator estimated that the original depth of the cists reached at least 50–60 cm, in some cases perhaps even a metre. This provides a rough indication for the height of the mounds at the time of their use. By the time of excavation, however, the best-preserved sections of limestone walls stood no more than 30–40 cm tall (Kraut 1985; see also Fig. 1 and Appendix).

Bones

Burial appears to have been exclusively by inhumation. The skeletons were poorly preserved, and the amount of bones led the excavators to believe that each grave housed only one deceased (Kraut 1985, 349). However, osteological studies (Kalman s.a.; Varul 2016) showed that such graves were a clear minority, if present at all, and the majority of the graves contained heavily intermingled remains of at least 2–4 persons. Despite the fact that some bones were located in the areas between cists and ring walls, there is no firm evidence that the bodies or bones had intentionally been placed outside the cists.

Both the above-mentioned osteological studies show a generally similar proportional age profile of the cemetery population. Accordingly, roughly one-fifth of the interred was made up by infants died within ca first 18 months of their lives, and roughly one-third by children who had died at the age of 2–10 years. About 30 per cent of the interred were adults over 20 years old. The remaining section divided rather equally between the age groups of ca 10–15 and 15–20 years. The assemblage appears to be clearly dominated by male sex, which is most probably because male sex markers are easier to recognize among the heavily fragmented material (e.g. Gustavsson 2012, 12; White & Folkens 2000, 362 f.). The combination of the dead in the graves shows no clear patterning according to age or sex categories. There was only one grave (34) where none of the osteologists detected the presence of subadult remains. On the other hand, in several graves only children's bones were recovered.

The relative figures above reflect the difficulty in providing more precise, absolute figures. As already indicated, for most of the graves there are two and for

grave 34 even three osteological estimations available, and the estimations frequently disagree with each other (see Appendix). Jonathan Kalman's unpublished and undated report, created probably in the late 1990s, is a grave-to-grave list of distinguished individuals' age and sex estimations with only few additional remarks. He listed 60–63 individuals for 33 graves. Liivi Varul's (2016) master thesis project resulted in a detailed and thus more reliable analysis, but it includes only 23 graves, where she identified a minimum of 69 individuals. On the basis of her figures, one could calculate the minimum number of individuals for all extant graves to be around 100. A problem with Varul's analysis is that several individuals have been distinguished on the basis of only a few or even a single bone(s) or tooth/teeth. First, this renders the age estimate of the 'individual' unreliable (resp. non-comparable). Second, it challenges the concept of *minimum number of individuals* because, given all circumstances of preservation, excavation, curation, research, etc. which probably enabled movement of bones by chance, and also taking mortuary practices in consideration, it cannot be ruled out that other parts of the skeleton were recorded as a separate individual in another grave. On the other hand, it should be admitted that, in view of the heavy fragmentation of the bones, the osteologists were probably unable to detect every interred individual (see also the section on grave 34 below). As for the third review of the grave 34 bones (Malve & Laneman 2015), certain discrepancies in Kalman's and Varul's preliminary reports had to be clarified as a prerequisite for a stable isotope analysis (Oras et al. 2016).

It is appropriate to emphasize, particularly in view of the following discussion of artefact finds and radiocarbon dates, that the burials in cists were not closed finds. The cists must have been recurrently opened to insert, and perhaps to remove. It is likely that the insertions were usually whole bodies, but some notably incomplete skeletons (see Varul 2016) do not allow ruling out partial burial or secondary burial of bones. Definitive evidence on removing or relocating bones as part of funerary or mortuary practices is lacking (Varul 2016; cf. Jonuks 2009; Varul & Rannamäe 2014) but, again, such practices cannot be excluded from consideration. Additionally, any examination of mortuary practices must consider that the cists were accessible to also grave robbers and animal disturbance, as well as the fact that the upper parts of the graves were gone before excavation.

Artefacts

The Bronze Age artefact finds, ca 30 items, were present in at least 18 graves, predominantly in cists (Fig. 1; Appendix). About half of such finds are characteristic of the Nordic Bronze Age. With rare exceptions, the artefacts cannot be associated with a particular individual. Although most of the finds appear to be ornaments or elements of clothing or headdress, one cannot be sure whether the present-day labelling of an artefact is accurate, and whether the artefact reached a grave during a funeral or on some other (ritual) occasion. This is important to remember when juxtaposing artefact typo-chronology and radiocarbon dates. As the focus of this paper is on chronological implications, the functions and gender and age

associations of the artefacts will not be addressed. Suffice to say that in Scandinavia the objects in question can be associated with both sexes, and discussion on functions is complicated, partly because cremation was the prevailing mode of disposal (see and compare e.g. Kaul 1998; Thedéen 2003; Forsgren 2007; Harding 2008; Storn 2008; Johansson 2011; Gustavsson 2012; Hornstrup et al. 2012, Catalogue; Warmenbol 2015; Arnoldussen & Steegstra 2018; Hornstrup 2018).

For the sake of contextual integrity, most of the Bronze Age artefact types will be dealt with in the next sub-chapter, where the context of radiocarbon dates is detailed. This concerns the bone pins, temple ornaments, knives (razors), tweezers, and double buttons. The remaining artefact types will be reviewed in this sub-chapter. Here and below the types of the Nordic artefacts have been confirmed by Karen Margrethe Hornstrup, an expert on the Late Bronze Age in Denmark. Photos of the majority of the Bronze Age finds can be found in the Appendix; for better readability separate references to illustrations will be avoided in the main text.

Of the finds that are not mentioned in the previous paragraph, the most important in terms of chronology are looped toggles, also known as anchor-shaped buttons, found in graves 12, 13, and 36. Baudou (1960) classified such finds as type XXVIB1, from predominantly Period IV assemblages; a Period V date is also possible (Hornstrup et al. 2012, 24, 36). Jutta Kneisel's chronological study based on correspondence analysis (2013) locates the toggles of this type in Period IV/V. The bronze bracelet of grave 15 cannot be ascribed to a type, but there are a few similar items among Period IV and V assemblages in Denmark (K. M. Hornstrup, pers. comm. 2020). The 2.6 cm long bronze tube with a diameter of 0.4 cm, found along with a few other ambiguous bronze items in grave 3, also has counterparts in Period IV and V graves in Scandinavia, although the tubes are usually shorter (Bergerbrant 2005, 17 f.; K. M. Hornstrup, pers. comm. 2020). In Estonia, a similar tube is known from grave 71 at Muuksi (Laneman & Lang 2013a, 114). The bronze pin in grave 25 is perhaps also of Nordic origin, but the absence of its head makes dating with any reasonable precision impossible.

As for the non-bronze finds, there are two amber beads, one of them from grave 28 and the other of ambiguous provenance (perhaps from grave 13). A few analogous beads (Ots 2006, 33) have been found in Saaremaa: in a stone-cist grave at Loona, which had a protracted use in the Late Bronze and Pre-Roman Iron Ages (Jaanits et al. 1982, 149 f.), and in the Period V–VI fortified settlement at Asva (Sperling 2014). Amber beads are present in Scandinavian Late Bronze Age graves (Hornstrup 2017, 85), but they are usually smaller than the Jõelähtme specimens (K. M. Hornstrup, pers. comm. 2020). A flint item of grave 21 is not datable in itself, but its location in a cist allows assignment to the Bronze Age; the flint originates from Scandinavia or the areas east of Estonia (Kristiina Johanson, pers. comm. 2020). A few other stone-cist graves in Estonia are known to have contained flint items (see Lang 2007a, 160 for references). A pendant of a dog canine (species determination by Eve Rannamäe, pers. comm. 2020), found in the north-eastern periphery of grave 25, may date from the Bronze Age as well as any other period (e.g. Hornstrup 2017, 83; Tvauri 2012, 155). A fragment of a stone axe of probably

Külasema type (K. Johanson, pers. comm. 2020), made in the Late Neolithic and without a known find context within the cemetery area, may have ended up at the site in the Bronze Age or later (see Johanson 2006).

Excavation of the site also uncovered finds younger than the Bronze Age. The crossbow fibula, found between graves 20 and 22, is of a very common type and dates from the 3rd–5th centuries, most likely the 4th century AD (Moora 1938, 130 f.; Rohtla 2005, 123 ff.). Two spiral finger rings come from unspecified contexts of grave 20. The most likely date for the rings is in the 3rd–5th centuries AD, although a later date is also possible (Lang 1996, 127). A similar date in the Roman Iron Age or a slightly later date in the Middle Iron Age is likely for a fire-striking stone found in or near grave 8 (Tvauri 2012, 88). The find assemblage includes at least one flint item that was perhaps also used for striking fire (K. Johanson, pers. comm. 2020); unfortunately, its location within the site is unknown and so is its date.

The Viking Age, and perhaps other periods of the Iron Age, are represented by potsherds, originally approximately 155 in number (Kraut 1985, 349). The majority of the potsherds were found scattered in and around graves 19, 23, 24, and 34, although they were also present at a few graves in the eastern part of the site. Five vessels are discernible, although the true number of vessels remains unknown. A decorated vessel from grave 19 that resembles pots depicted in Lang 1996, fig. 25: 6–9, and another vessel around graves 23 and 24, decorated with a motif similar to that in Lang 1996, fig. 24: 7, date from the 8th to the early 11th centuries (Laneman & Lang 2013b). Grave 19 contained fragments of at least two other vessels, one of them probably a specimen of Viking Age fine ware; the other vessel, parts of which were scattered in grave 34, has a more ambiguous Iron Age date. The sherds of the coarse-grained vessel near graves 3–5 date from the Viking Age or the Final Iron Age (ibid.; cf. Kraut 1985, 349).

The finds from the historical period include two silver coins of the late 15th century (Kraut 1985, pl. VI: 10, 11), a copper coin, a fragment of a ceramic tripod and of a clay pipe stem, and various iron objects such as nails, knives, etc. The iron objects, around twenty in number, have been included in the unpublished find list, but most of them are absent from the stored find assemblage.

Radiocarbon dates

The bone samples for radiocarbon dating by accelerator mass spectrometry were collected from different parts of the cemetery, including graves with and without Bronze Age artefacts (Fig. 1). With a few exceptions, adult individuals were selected for sampling, because their solid bones offer better chances for collagen extraction, and there were no grounds to assume that the adult age group dated differently from the subadult age group. The majority of the samples were collected according to Kalman's report before Varul's analysis became available (which has created some unfortunate but inevitable uncertainties in attributing the results to particular skeletons; see below). A few samples were included at a later date to

clarify the most outstanding discrepancies of the osteological analyses or other emerging issues. Altogether 17 samples of 13–14 human individuals and two animals from nine graves were AMS-dated. Contexts of the sampled individuals, sample details, and results of the radiocarbon analysis are particularized below, including Table 1. All calibrated radiocarbon dates in this paper are quoted at 95.4% probability ranges.

***Two individuals from grave 2*:** 2923 ± 31 BP and 2917 ± 32 BP (both 1220–1010 BC)

Kalman (s.a.) reported the remains of two males in the cist, of ages 15–20 and over 45 at death. Varul (2016) distinguished, besides two males with similar age determinations (17–19 and 40+ years, respectively), a third adult with indeterminate sex and age, and a 5–10 year old child. It is not possible to ascertain whether the first-mentioned radiocarbon date applies to the young male or the adult of indeterminate age and sex, and whether the second radiocarbon date applies to the latter adult or the older male. The cist also contained a bone pin with a slightly flaring head (here and below, refer to the Appendix for photos of the finds). Bone pins are relatively common finds in stone-cist graves in Estonia, but their characteristics offer no secure grounds to specify their date within the Late Bronze Age (cf. Lang 1992). The pins are viewed as 'local' (Lang 1992; 1996; 2007a) or as items with 'eastern roots' (Lang 2018). The eastern origin is, however, a statement that remains to be proven and elaborated. At Jõelähtme, eight bone pins of various shapes and probable tips of two further bone pins were uncovered in altogether seven cairns.

***Male from grave 7*:** 2924 ± 32 BP (1220–1010 BC)

The man interred in the cist (Kraut 1985, pl. III: 1–2) had died at the age of 30–35 (Kalman s.a.) or over 40 years (Varul 2016). Strontium and oxygen isotope analysis (Oras et al. 2016) showed that he had been born locally, i.e. in what today is northern Estonia. Details of his DNA analysis are reported in Saag et al. 2019. Varul (2016) also found three metatarsals of a child in the grave's bone assemblage, located outside the cist in the destroyed southern periphery of the grave. Besides the remains of the man, the cist contained decorated tweezers, a decorated razor, and fragments of an unidentified bronze object. Such tweezers, very common in Scandinavia, are assigned to type XIID and dated to (particularly the second half of) Period IV and to the transition phase from Period IV to V by Baudou (1960, 41 f., 112). In Kneisel's analysis (2013), XIID belongs to Period IV/V. Radiocarbon dating of cremation burials with this type of tweezers in Denmark and in Gotland, Sweden, have resulted in dates 2886 ± 34 BP (1200–930 BC; Hornstrup et al. 2012), 2761 ± 30 BP (1000–820 BC; Wehlin 2013, fig. 7.6: A; Hansson 1927, pl. 17: 84), and 2525 ± 150 BP (1010–210 BC; Kneisel 2013). The razor is an early form of Baudou's type XIB4a, which in Scandinavia occurs in Period IV and IV–V transition assemblages, sometimes combined with XIID tweezers (Baudou 1960, 34 f.).

Table 1. AMS dates of the bones from the stone-cist graves at Jõelähtme. Calibration after OxCal v4.4.2 with IntCal20 calibration curve (Bronk Ramsey 2009; Reimer et al. 2020). y – years; m – months; M – male; F – female; r – right; l – left; Hela – Laboratory of Chronology, Finnish Museum of Natural History; UBA – 14Chrono Centre for Climate, the Environment and Chronology, Queen's University Belfast; SUERC – Radiocarbon Laboratory, Scottish Universities Environmental Research Centre

Grave	Individual	Sampled bone	Lab code	Date BP	Date cal (95.4%)	$\delta^{13}C$ (‰)	$\delta^{15}N$ (‰)	Finds
2	Juvenile/adult	r humerus	Hela-2364	2923 ± 31	1220–1010 BC	–21.9	n/a	Bone pin
2	Adult	r humerus	Hela-2363	2917 ± 32	1220–1010 BC	–21.2	9.4	
7	M 30+ y	l humerus	Hela-2365	2924 ± 32	1220–1010 BC	–21.3	9.7	Tweezers, razor
9	F(?) 40+ y	r ulna	Hela-2366	2834 ± 32	1110–900 BC	–21.3	9.7	Temple ornaments, double button, bone pin
18	M(?) adult	r femur	Hela-2367	2887 ± 32	1210–930 BC	–21.5	9.4	Razor
19	Juvenile/adult	metatarsal	UBA-25493	2893 ± 42	1220–930 BC	–21.3	9.7	Razor
19	Infant/child	cranium	UBA-25494	2782 ± 47	1050–810 BC	–20.6	12.1	
19	M 30+ y	r femur	Hela-2370	2720 ± 33	930–800 BC	–21.3	9.8	
19	Dog 15+ m	l humerus	UBA-25496	1641 ± 33	AD 260–540	–21.4	9.2	
19	Cat <8.5 m	r humerus	UBA-25495	987 ± 37	AD 990–1160	–21.0	10.4	
24	M adult	humerus	Hela-2368	2781 ± 35	1020–830 BC	–21.6	8.9	
26	Adult	l humerus	Hela-2369	2834 ± 32	1110–900 BC	–21.5	9.7	
34	Adult 25+ y	r radius	Hela-2360	2833 ± 32	1110–900 BC	–21.3	10.1	Bone pins
34	M 25+ y	r radius	SUERC-63667	2823 ± 33	1110–890 BC	–20.8	9.1	
34	M 25+ y	r femur	Hela-2361	2815 ± 33	1110–840 BC	–21.2	10.2	
34	Adult	tubular bone	Hela-2362	2656 ± 33	900–780 BC	–21.3	10.2	
35	Child 7–10 y	l femur	UBA-25492	2652 ± 53	930–590 BC	–20.9	10.3	

Kneisel (2013) does not distinguish the early variant of XIB4a; classical examples of this type belong to Period V according to both Kneisel and Baudou.

***Female(?) from grave 9*:** 2834 ± 32 BP (1110–900 BC)

The sampled female (or *probable* female since Varul is hesitant about the sex determination) had been at least in her forties (Varul 2016) or fifties (Kalman s.a.) when she died. Besides her remains, the cist housed two or three subadults. Also found in the cist were a bone pin, a bronze double button, and a pair of bronze temple ornaments. The button is probably of type XXVIA3b, which dates from Period IV or, less frequently, the transition from Period IV to V (Baudou 1960, 87, 89). A similar button was present in the cist of grave 11. The temple ornaments were reported *in situ* on a skull in the northern end of the cist (Kraut 1985, 349), and the traces of green patina observed on cranial fragment(s) during osteological analysis (Varul 2016, 88) suggest that the skull and the ornaments belonged to the female. Temple ornaments of this type have usually been associated with Sosnitsky Culture in approximately what today is north-eastern Ukraine, and accordingly, a date in the 11th–9th centuries BC has been attached (Lang 1992; 2007a, 156; 2018, 206; Ciglis 2011). Here, however, a correction is in order, because the ornaments in question, i.e. the 'pendants of Belogrudovskaya type', are characteristic of 'cultural groups' bordering the Sosnitsky Culture area in the south where they date from ca 1400–1000 BC (Sergej Lysenko, pers. comm. 2020; Lysenko 2002; Lysenko & Lysenko 2009; Lysenko 2015). At Muuksi, Estonia, human bones from a cist of grave 71 that contained a pair of analogous ornaments have been radiocarbon dated to 760–400/200 BC, but it is unknown whether the ornaments belonged to the sampled individual(s) (see Laneman & Lang 2013a, 96, 103, 114). One specimen was found at Napa where calibrated dates of two radiocarbon-dated skeletons range from 1030 to 790 BC (Saag et al. 2019); the dates and the artefact, however, come from different graves. A few other pairs of similar ornaments have been found in Estonia, including in grave 13 at Jõelähtme; however, these finds do not add anything helpful in terms of chronology.

***Male(?) from grave 18*:** 2887 ± 32 BP (1210–930 BC)

Kalman (s.a.) identified a 20–25 years old male in the cist. Varul (2016) argues that there were two probable males, an individual 20–25 years old and an adult whose age cannot be further specified; the sampled bone may belong to either of them. The cist also contained one or two subadults. A knife (razor) was present in the cist. According to K. M. Hornstrup (pers. comm. 2020), the razor cannot be assigned to a certain type, but a date in Period IV or V is probable. The unpublished find list also includes a stone bead in the cist, unfortunately not present in the store. It can be speculated to have been a pebble worked by only nature (as in Lang 1996, 156) which, however, does not exclude the possibility of its use by people.

***Three humans and two animals from grave 19*:** 2720 ± 33 BP (930–800 BC), 2893 ± 42 BP (1220–930 BC), 2782 ± 47 BP (1050–810 BC); 1641 ± 33 BP (AD 260–540), 987 ± 37 BP (AD 990–1160)

All human individuals uncovered and identified in grave 19 were radiocarbon dated: a male 30–40 (Kalman s.a.) or over 45 (Varul 2016) years old, a late adolescent or adult under 40 years old and of unknown sex (Varul 2016), and an infant under six months (Kalman s.a.) or around twelve months old. According to Varul (2016), the cranium of the infant was located outside the cist whereas a few ribs and a tubular bone were present inside the cist (unless there were two infants involved). The radiocarbon date of the infant comes from the bone cluster outside the cist. Present in the cist was also a razor which, with its wide handle, probably represents Baudou's type XIC1 and dates from Period IV or V of the Nordic Bronze Age (Baudou 1960, 36 f.). Kneisel (2013) includes this artefact type in Period IV/V. A knife of probably the same type (K. M. Hornstrup, pers. comm. 2020) was found in the neighbouring grave 33.

Two animals were radiocarbon dated for this grave: a cat bone found in the southern part of the grave, and a dog bone from a 'cist-like' enclosure attached to the south-western exterior side of the grave's ring wall (interior measurements ca 70 × 55 cm; not shown in Fig. 1). While the young cat was present with only one bone, the attached enclosure and, to a notably lesser extent, the southern part of the mound held the remains of at least three adult dogs, all with withers height around 55 cm (Kraut 1985, 349; Varul & Rannamäe 2014, 154 f.). The trio had left at least 93 bone fragments from basically all body parts, including a cervical vertebra with a cut mark (Varul & Rannamäe 2014, 154). Within another project a radiocarbon date (1224 ± 28 BP; AD 680–890) has also been obtained for a sheep bone with no definite find context within the grave (Rannamäe et al. 2016; AI PP 213). Besides the bones of probably two sheep, the zooarchaeological material includes the remains of at least two pigs, one or two cattle, a horse, two hares, a beaver, a seal, and several birds and rodents (Kraut 1985, 349; Varul & Rannamäe 2014).[1] The grave, mainly its western half, also contained fragments of at least three clay vessels probably of Viking Age dates (Laneman & Lang 2013b), a stem of a clay pipe from the 17th–19th centuries (Pallo & Russow 2008), and an iron nail with a date probably similar to that of the pipe.

***Male from grave 24*:** 2781 ± 35 BP (1020–830 BC)

Only the southern part of the grave and of the cist had been preserved over time. Both osteologists agreed that the few survived bones belonged to an adult male whose age cannot be specified. No Bronze Age artefacts have been reported for the grave.

[1] This is the only grave at Jõelähtme for which an archaeozoological review is available at the time of writing.

***Adult from grave 26*:** 2834 ± 32 BP (1110–900 BC)

Only Kalman's (s.a.) osteological data is available for this grave. Accordingly, the radiocarbon-dated individual of indeterminate sex had been 30–35 years old at death and accompanied by four subadults in the cist. No artefacts were found in this grave.

***Two or three individuals from grave 34*:** 2823 ± 33 BP (1110–890 BC), 2815 ± 33 BP (1110–840 BC), 2833 ± 32 BP (1110–900 BC), 2656 ± 33 BP (900–780 BC)

All three osteological reports that are available for grave 34 agree that the minimum number of the deceased was two, but the reports differ in age and sex estimations. At least two out of four radiocarbon dates come from a male whose age at death has been determined as 40–45 (Kalman s.a.), 30–50 (Malve & Laneman 2015), or 25–35 years (Varul 2016). Strontium and oxygen isotope analysis revealed that the man had been born locally (Oras et al. 2016); he has also been subjected to an aDNA analysis (Saag et al. 2019). At least one radiocarbon date applies to the second individual who may have been a female, though only Kalman (s.a.) dared a confident sex determination; age estimations for this individual are 25–30 (Kalman s.a.), 35–45 (Malve & Laneman 2015), and 40–45 years (Varul 2016). The fourth radiocarbon date was obtained for a bone cluster described by the excavator as the only burial in the entire cemetery that had originally been placed outside a cist (Kraut 1985, 349). The osteologists, however, argue that the bones collected from outside the cist probably belonged to the two individuals whose remains were present also in the cist. Accordingly, the radiocarbon date of the indeterminate tubular bone may apply to either of the two individuals. In view of the fact that the result differs considerably from the other three dates, it cannot be ruled out that there was, whether inside or outside the cist, a third and very poorly preserved individual, whose presence remained undetected by the applied osteological methods. The cist also contained a fragmented bone pin, and a pointed end of what was probably another bone pin was found during an osteological study (Malve & Laneman 2015). The photos taken during excavation show that the grave had suffered from the insertion of a telephone pole, which may account for the disturbed skeletons. Radiocarbon dating of a chicken bone from an unknown find context within the grave yielded a modern result (Ehrlich et al. forthcoming 2021).

***Child from grave 35*:** 2652 ± 53 BP (930–590 BC)

Grave 35 is interesting because it is not a complete or 'normal' stone-cist grave (see Fig. 1). Certain features in its structure show that grave 35 had been attached to the pre-existent grave 12 (and not that grave 12 had been built above or inside grave 35). The radiocarbon-dated sample came from a child who had died at the age of 7–10 years. This corresponds with Kalman's (s.a.) data who reported only

one child, 6–7 years old, in the cist. Varul (2016), however, identified five subadults, and the radiocarbon date may apply to three of them. No artefact finds have been reported.

Discussion

Bronze Age

The radiocarbon dates of the human bones, calibrated to calendar years, range from roughly 1200 BC to 800 BC (Fig. 2). The set shows that burial began around 1000 BC at the latest and ended around 900 BC at the earliest. It is evident that neither the maximum nor the minimum estimate necessarily signifies the true duration of the cemetery use, especially since only part of the cemetery had been

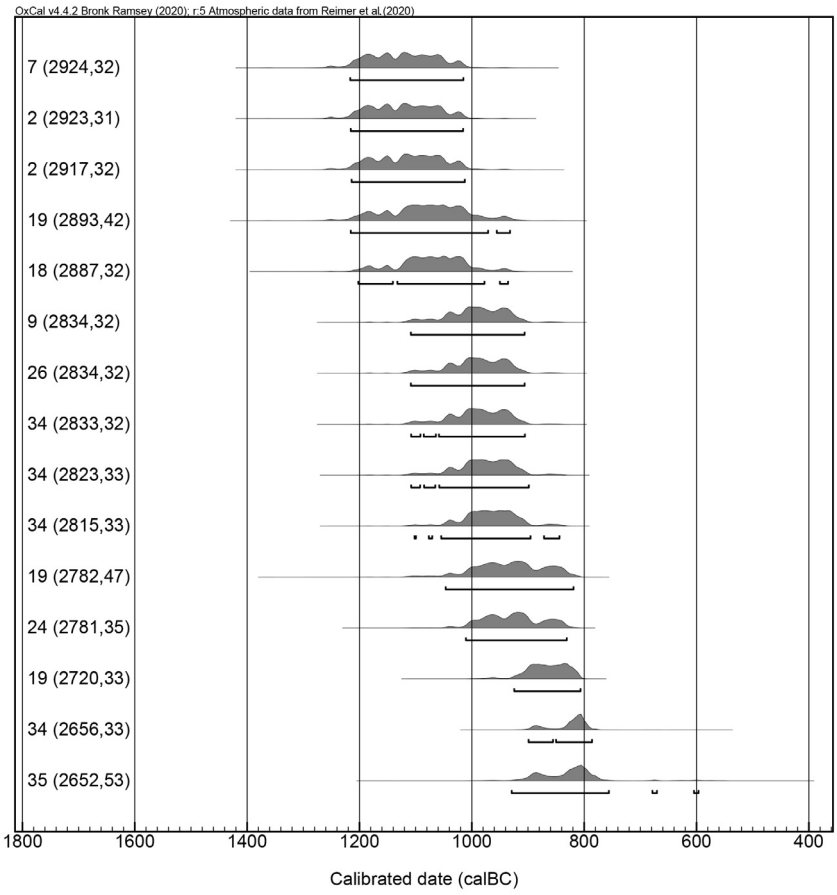

Fig. 2. AMS dates of the human bones from the stone-cist graves at Jõelähtme, corrected to calendar ages by OxCal v4.4.2 with IntCal20 calibration curve (Bronk Ramsey 2009; Reimer et al. 2020).

preserved over time. Achieving a finer-grained interpretation is nevertheless complicated, because the majority of the date ranges on individuals span about two centuries. Also, the data do not allow observing the growth of the grave field. In graves 2, 19, and 34 where several individuals were radiocarbon dated, the chronological succession of and intervals between burials cannot be conclusively established.

In an attempt to refine the radiocarbon chronology, the artefact chronology has to be addressed. It is useful to recall that in most cases the artefact finds cannot be attributed to particular individuals in the cists containing several skeletons. The female of grave 9 appears to be an exception though, and her temple ornaments, if the find type had any association with its southern counterparts, suggest that the earlier half of the calibrated radiocarbon date obtained for the skeleton, i.e. the 11th century, should perhaps be considered more likely than the latter half of the time range in question. The typo-chronological date of the double button in the same cist agrees with the radiocarbon date, although it does not narrow the latter any further (see Table 2), the more so that it is unknown whether the button belonged with the woman.

Another individual whose association with artefact finds is relatively likely is the male of grave 7. The razor and the tweezers in the cist possibly formed a set, given that the combination was common in Scandinavia and elsewhere in the Bronze Age (e.g. Baudou 1960, 40; Thedéen 2003). The relative date of the set is most likely in the late Period IV or the transitional phase between Periods IV and V. Translating this into absolute dates is challenging, however, and needs to be discussed also for the sake of other artefact types (see Table 2).

It is generally agreed that the beginning of Period IV is at 1100 BC, but the end of the period at 950, 920, or 900 BC is disputable (Montelius 1917; Olsen et al. 2011; Hornstrup et al. 2012; Wehlin 2013, 16). This variation makes the definition of the 'transition phase' difficult, and although the *Übergangszeit IV/V* is a notion frequently used by Baudou and repeated by others, it is usually left undefined with no clear boundaries. Olsen et al. (2011, 272) remark that further research is required to see if it is a separate archaeological period. An attempt has been made by Jutta Kneisel (2013; forthcoming 2021) who, on the basis of correspondence analysis, succeeded in showing that there is a group of finds that can be regarded as separate from the typical Period IV or Period V assemblages. The absolute date she proposes for the Period IV/V between 950/920 and 820 BC, however, appears to be poorly grounded and needs to be verified by more radiocarbon dates. A pertinent thing to note here is that she uses radiocarbon dates obtained for XIID type tweezers to establish an absolute date for the period, but in doing so she ignores a relevant date from Denmark, 2886 ± 34 BP, on the grounds that it is too early. The radiocarbon data from grave 7 at Jõelähtme suggests that such a date for XIID tweezers is not necessarily an anomaly. Kneisel's too late or too narrow definition of Period IV/V (and V) is probably the reason why the Jõelähtme data appear to be in relatively poor agreement with Kneisel's absolute chronology.

Returning to grave 7, the conclusion is that if the tweezers and the razor ended up in the grave together with the radiocarbon-dated man, a date in the 11th century

Table 2. Chronology of the artefacts that can be assigned to a type after Baudou 1960. Baudou's absolute chronology, now outdated, is replaced with the chronology of Olsen et al. 2011. Note that Kneisel does not discern the early form of XIB4a, therefore the Period V date for the Jõelähtme razor is not fully applicable

Artefact, grave, type	Baudou 1960 period	Abs. date BC Olsen et al. 2011	Kneisel 2013 period	Abs. date BC Kneisel 2013	^{14}C cal BC (95.4%)
Tweezers 7 XIID	(late) IV, IV/V	IV: 1100–950/920 V: 950/920–800	IV/V	IV/V: 950/920–820 V: 820–700	1220–1010
Razor 7 XIB4a early	IV, IV/V		(V)		1220–1010
Razor 19, 33 XIC1?	IV, V		IV/V		1220–930 (19) 1050–810 (19) 930–800 (19)
Double button 9, 11 XXVIA3b	IV, IV/V		–		1110–900 (9)
Toggle 12, 13, 36 XXVIB1	IV, V		IV/V		–

should be preferred over a date in the 12th century BC for this skeleton. The artefact types in question may be slightly older than hitherto assumed, but there is no reason to ascribe them to Period III.

The knife of grave 19 does not help in constraining the radiocarbon date ranges obtained for this grave, first and foremost because its 'owner' is unknown and its type is questionable. The remaining artefacts from the cists with radiocarbon-dated skeletons, i.e. the bone pins and a bronze knife, could not be used for refinement of the obtained radiocarbon estimates even granting the skeleton-artefact associations. The same is true for the artefact finds of the non-radiocarbon dated graves. It can be confirmed, however, that such finds are compatible with Periods IV and V or the (Late) Bronze Age.

Considering that (1) there is no particular reason to constrict any of the earliest radiocarbon dates to the 12th century BC, (2) of such cases, for at least grave 7 the (late) 11th century BC is considerably more likely, and (3) artefacts that are certainly older than Period IV or even the latter half of Period IV (see Baudou 1960, 112; Kneisel 2013, fig. 12) are absent, the beginnings of the cemetery should be dated to the 11th rather than the 12th century BC. The latter date cannot be entirely ruled out though, particularly as part of the cemetery had been destroyed, but also as the absence of artefacts is not necessarily equal with the absence of burials. At the other end of the cemetery's lifespan, there are no good grounds to exclude the 9th century BC or any decades thereabouts, even if the absence of 'pure' Period V finds tempts one to do so. Whether a simplified presentation of the cemetery's overall date should be 1200–800 or 1100–800 BC is however an issue leading to the question as to what is the proportion of pure statistics and a researcher's interpretation in the definition of a 'date' (e.g. Mook & Waterbolk 1985; Punning 2005). I prefer the view that radiocarbon data be interpreted along with other available threads of evidence. It should also be noted that the real lifespan of the cemetery may have been even less than the three hundred years.

The period of cemetery use is also possible to estimate if the number of buried individuals and the size of the cemetery users' group is known (see e.g. Lang & Ligi 1991 for a formula). At Jõelähtme, however, both figures are too indeterminate to yield results of reasonable definitiveness. The number of buried individuals and related problems were discussed above. As for the size of the living community, it is widely held that a group of stone-cist graves represents a small kin group such as a family, and that only selected members of the group were accorded a burial in a stone-cist grave (Lang & Ligi 1991; Lang 1996; 2007a). At Jõelähtme the idea of selective burial appears doubtful, insofar as groups of potential outsiders cannot be detected from the cemetery population's age and sex profile. A family or kin group cemetery is a plausible suggestion, although the possibility that more than one such group were involved cannot be excluded. Group size is a calculable figure too, but only if the period of cemetery use is known, which is not the case here.

Although the date between 1200/1100 and 800 BC is the same or earlier than previously suggested, it no longer grants the title of the oldest stone graves in Estonia. This is because radiocarbon dating of bones has helped finding other groups of stone-cist graves that are at least as old as or even older than the cemetery at

Jõelähtme (Laneman & Lang 2013a; Saag et al. 2019; see also Laneman 2012; Laneman et al. 2015). This means that Jõelähtme's previous status as the 'oldest' had been mainly based on the underestimation of the age of the stone-cist graves that were empty of (bronze) finds. I have outlined the reasons of this underestimation elsewhere (Laneman & Lang 2013a, 95, 102 f.). A slight exaggeration in advertising the superlative qualities of the site has also played a role, particularly in popular literature. Occasional stone-cist graves with a IV–V Period razor or tweezers have been known since the early 20th century (e.g. Šturms 1935; Mandel 1975; Lõugas 1981), but these findings were obviously less attractive and easy to look over because of their modest quantity. As far as the end of the stone-cist tradition is concerned, it is difficult to establish between 800 and 400 BC because of the Hallstatt plateau of the calibration curve (see also Laneman et al. 2015, 132). An example of (relatively) late stone-cist graves can be found at Rebala four kilometres to the north-west of Jõelähtme (Lang et al. 2001; Laneman forthcoming 2021).

In a wider perspective of the Baltic Sea region, the turn of Period IV to Period V has been recently described as the time of the emergence of the Baltic Sea hybrid culture (Wehlin 2013, 47, 77, 184, and references therein; see also Podėnas & Čivilytė 2019). The concept has been coined to describe the common cultural traits of and contacts between the Late Bronze Age populations around the Baltic Sea, in certain contrast to the earlier views of western expansion and colonialism in the eastern lands. Further, some researchers believe that it was also the time of 'comings from the east', i.e. the arrival of the Proto-Finnic migrants from originally the West Uralic region to the areas inhabited by a Proto-Germanic population (Lang 2018). The aDNA analysis, however, detected no Siberian ancestry in the fifteen stone-cist graves that were sampled (including Jõelähtme 7 and 34), although the presumed Finno-Ugric component was present in early *tarand* graves of the Pre-Roman Iron Age around 500 BC at the latest (Saag et al. 2019). The Western hunter-gatherer affinities, the most noticeable feature discovered in the stone-cist population, is not particularly telltale, and the Germanic origin is also a hypothesis yet to be proven.

It has been argued that the graves at Jõelähtme mirror both the western and eastern 'directions': the Scandinavian bronze items and perhaps the grave form manifest the western, and temple ornaments and bone pins manifest the eastern influence (Lang 2018, 166). It must be added, however, that the origin of only Scandinavian artefacts is more or less certain, and even then the meaning of 'origin' is multifaceted and ambiguous. The two aDNA-analysed men who, according to an isotope analysis, had been born in what today is northern Estonia, were accompanied by either a Nordic razor and tweezers or bone pin(s). All things considered, the data is inconclusive and enables multiple readings. The same, perhaps necessarily, applies to the whole discussion about the 'contacts' across the Baltic Sea and along the rivers of the East European Plain further south-east. The topic has a long history with more or less differing opinions or repeated truisms with questionable empirical and theoretical bases, and contribution thereto requires a profound approach beyond this article's scope and interest.

Iron Age and beyond

Another topic with a potential for far-reaching speculation is the post-Bronze Age life of the cemetery. A 3rd–6th-century date for a dog in the cist-like structure attached to grave 19 was entirely unanticipated. The few zooarchaeological observations made for stone-cist graves show that dogs, if present, are represented by a single tooth in the cist or by occasional bones in other parts of the grave (Spreckelsen 1926, 41; Friedenthal 1929; Kriiska et al. 1998, 37 f.; Vedru 1998, 64; Laneman et al. 2015, 120). An apparently larger amount of dog bones was located in the northernmost periphery of grave 70 at Muuksi (Vassar 1937; 1938, 332), although it is unknown whether or not the 'wolf-sized' dog was of a Bronze Age date. Strictly speaking, the same applies to the other referred cases. At Jõelähtme, however, a separate cist for dogs appeared to be present, and there were no structural indications of its relatively late origin. After all, dogs were common in Gotlandic Late Bronze Age ship settings (Gustavsson 2012; Wehlin 2013), and influence from this direction was rather clear at Jõelähtme. It was therefore reasonable to presume that the dogs were contemporary with the human burials (e.g. Šafranovski 2014 interprets along these lines).

In the 3rd–6th-century burial sites, the presence of dogs appears to be also manifested by only occasional bones, and it was not before the Viking Age when dogs became more prominent in western Estonian stone cemeteries (Jonuks 2006; Tvauri 2012, 286 f.). The visibility of dogs is no better in the settlement sites of the period. At Jõelähtme, if the radiocarbon date coincides with the building of the 'dog cist', it is notable that the ring walls of the graves, or at least grave 19, must have been discernible and perhaps in good order for more than a millennium after burial ceased in the Bronze Age. Long-term curation of old stone cemetery walls has been suggested elsewhere (Lang 2000, 104). More or less contemporary with the dog(s) appear to be a few artefact finds (see above), but they came from the northern part of the grave field and it remains unknown whether they had any connection to the dogs, or what their purpose was. Let it be also noted that the closest contemporary settlement site was probably situated ca 150 metres north of the cemetery (Lõugas 1998).

Regardless of the date, interpretation is challenging. There is too little evidence to ascertain how the dogs died and how they were interred, and whether the deposit was, roughly put, a burial or a sacrifice (see e.g. Morris 2011, 149 ff. and Toplak 2019, 216 for conceptual discussion). An adult dog whose more precise age is unknown could have died of e.g. old age, disease, accident, or by killing by a human or another animal; killing by human may have been ritual (in the widest sense of the word), practical/economic, conflict-induced, an act of mercy, or a combination thereof. Body parts from nose to tail were present, but the question whether the number of bones, too small for several individuals, was a result of partial burial or damage done to the upper parts of the cemetery remains unanswered. The enclosure was probably fit to house a whole sizeable dog, but if there were several individuals they must have been stacked on top of each other, or interred with intervals.

Although some are more probable than others, all the listed options are possible, given that the human-dog relationships have generally been highly complex entanglements of practical and non-practical nature (e.g. Jennbert 2003; Gräslund 2004; Snyder & Moore 2006; Morris 2011, 159 ff.; Cummings 2013; Mannermaa et al. 2014; Kõivupuu 2017; Nabhan 2017). It is all too easy, particularly with reference to the location in the karst area, to lead the discussion to the highly generalized and fairly trite observation that all over the world dogs have been viewed as psychopomps, border crossers, and guardians at the thresholds between the seen and unseen (e.g. De Grossi Mazzorin & Minniti 2006; Cummings 2013, 124; Nabhan 2017). Predictably, sooner or later someone will come up with a reference to the three dogs of Kalevipoeg, the title character of the national epic. I will refrain from further speculation, at least until additional evidence becomes available. Further study, including detailed taphonomic analysis and more information about the cut mark if possible, may be of some help, and additional radiocarbon determinations for the other dogs are highly advisable.

Interpretation of the 10th–12th-century single cat bone is even more difficult. It is impossible to ascertain whether its arrival to the southern part of grave 19 (where its find circumstances are obscure) was human-mediated. Admittedly, the radiocarbon date is partly overlapping with the date of the pottery from both grave 19 and other parts of the cemetery (see above), but it remains unknown if there was any connection between the cat and the potsherds. Both a contemporary stone cemetery and a settlement site evidence that the neighbourhood was populated at the time (Lang 1996, 403 f.).

Knowledge on prehistoric cats in Estonia is almost negligible. The allegedly earliest domestic cat find has been reported from the 4th–5th-century *tarand* grave at Tõnija, Saaremaa, as a 'luxury gift to the lady of the house' (Mägi 1996, 431; 1999, 10). There were however only a few teeth present (L. Maldre, pers. comm. 2020), and it is generally advisable to remain cautious about the age of the animal remains in above-ground stone settings if no radiocarbon date is available. The latter principle of caution has been applied to the single cat bone found at grave IIB at Tõugu, which was a late Pre-Roman Iron Age site and thus even older than the grave at Tõnija (Maldre 2000, 412). At the sites of later Iron Age periods, cat bones are also a rare encounter until at least the Middle Ages beginning from the 13th century. Liina Maldre, an experienced zooarchaeologist, recalled occasional cat bones from Jaanilinn at Varbola, an 11th–13th-century hill-fort, and from the Viking Age settlement site at Pada (pers. comm. 2020). A few cat bones were also present in the Viking Age settlement site at Tartu (Tvauri 2001, 79). No radiocarbon dating has been applied to these bones.

Cats must have nevertheless been present and known; at least they were so in neighbouring Scandinavia and Rus (Bitz-Thorsen & Gotfredsen 2018; Zinoviev 2018; Toplak 2019). It is generally held that domestic cats dispersed across Europe along with the expansion of the Roman Empire, and later with Viking expeditions (e.g. Driscoll et al. 2009; Faure & Kitchener 2009; Ottoni et al. 2017). Although present long before, cats became commonplace in northern Europe, particularly in towns, by the late Viking Age around the 11th century (Bitz-Thorsen & Gotfredsen

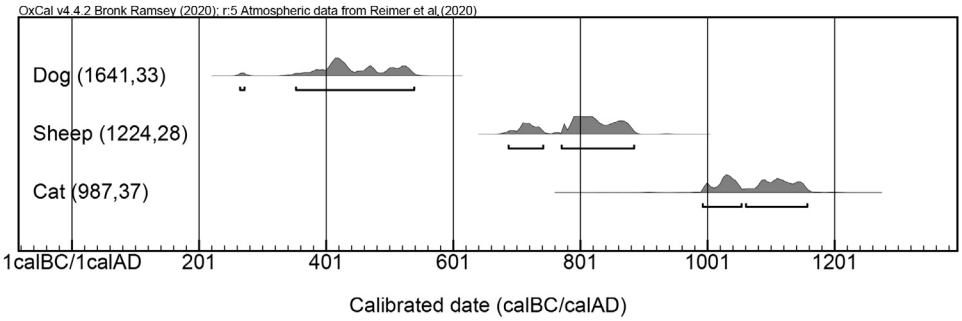

Fig. 3. AMS dates of the animal bones from stone-cist grave 19 at Jõelähtme, corrected to calendar ages by OxCal v4.4.2 with IntCal20 calibration curve (Bronk Ramsey 2009; Reimer et al. 2020). The date of the sheep is quoted from Rannamäe et al. 2016.

2018; Toplak 2019, 224). Cat pelt trade extended throughout medieval Europe, and the fur of preferably young individuals was expensive (Colling 1986; Prehal 2011; Poole 2015; Lloveras et al. 2017). Zinoviev (2018), however, is hesitant about the cat skinning in 10th–14th-century Novgorod and Tver. Cats were also valued as mousers, and sometimes as companions, if not pets proper (Poole 2015; Toplak 2019). In Vendel and Viking-period Scandinavia cats accompanied both men and women in graves (Prehal 2011; Toplak 2019). It is only unfortunate that the background story tells nothing about the short life of the Jõelähtme juvenile cat.

Temporally between the dog and the cat is an 8th–9th-century sheep from the same cairn, radiocarbon dated for another research project (Fig. 3; Rannamäe et al. 2016). Other animals, including cattle, pig, and horse, were present in the grave with occasional bones, a few of which bore marks of cutting or carnivore chewing (Varul & Rannamäe 2014). Most likely, these animals had not reached the site as whole carcasses. Notably, the radiocarbon date of the sheep overlaps with the date of the pottery, which suggests that it was food that once reached the site. Again, however, the data enables multiple interpretations for both the bones and the pottery, from an array of ritual practices to waste disposal, including the possibility that the two find categories were temporally separate. For more solid inferences, comparable archaeozoological data for other cairns of the cemetery and extensive radiocarbon dating of other animal remains is required. Currently a radiocarbon date is available for a sheep from grave 15 and a chicken from grave 34, and these dates indicate the 17th–20th centuries (Rannamäe et al. 2016; Ehrlich et al. forthcoming 2021). This is cautionary although not particularly unanticipated in view of people's habit of scattering rubbish around them (see also Laneman et al. 2015, 121).

Conclusions

Years ago, the complaint was that there was no charcoal to radiocarbon date the stone-cist cemetery at Jõelähtme, to confirm the date based on artefact chronology (Lang & Kriiska 2001). By now, the situation has improved. There are altogether

twenty radiocarbon dates from bone, mostly human and a few animal, and bones generally produce more reliable dates than charcoal, which in the case of stone settings rarely has a firmly established connection to burials.

The radiocarbon data suggests that in the preserved part of the cemetery interment began in the 11th century BC at the latest, and ceased most likely in the 9th century BC. This is in accordance with the presence of artefacts from (late) Period IV and/or (early) Period V of the Nordic Bronze Age. The ranges of calibrated radiocarbon dates and the dates of artefact types generally span centuries, which means that detailed inferences about e.g. gradual cemetery growth, intervals between interments in a cist and in different cists, etc. remain out of reach. Additional radiocarbon dates would possibly enable a more detailed chronology, but the amount of dates to achieve this must probably be rather large, unless the radiocarbon dating methodology itself makes considerable improvements. The Nordic Bronze Age chronology has also potential for improvement and increased accuracy, though the relation of an artefact to burials and to the cemetery must always be considered carefully in the case of non-closed find complexes such as the stone cists.

The currently available data suggests that burial did not continue after or long after 800 BC. Radiocarbon dating of occasional animal remains has nevertheless produced interesting though patchy and ambiguous insights into the later history of the site. This applies particularly to grave 19, where three animal bones, of a dog, a sheep, and a cat, have been radiocarbon dated to various Iron Age periods from the 3rd to almost the 13th century AD. Unfortunately, no comparable data is available for the animal bones in other graves, except for two cairns where radiocarbon analysis of a sheep and a chicken has produced a recent date. The Iron Age centuries have also left behind artefact finds, among them a few ornaments and some pottery. The evidence is nevertheless insufficient to decide firmly whether and when the findings speak of veneration, fear, disrespect, ignorance, or some other attitude towards the site.

The fact that none of the analysed animal bones is of a Bronze Age date serves, on the one hand, as another cautionary tale about interpreting animal remains in non-closed find complexes. On the other hand, it points to a vast (and probably madly expensive) avenue of research by systematically radiocarbon dating zooarchaeological remains. At Jõelähtme, however, it must be considered that the damaged context reduces the scope and reliability of inferences. This applies to the human remains as well.

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permission to read and cite her unpublished paper, and Kristi Tasuja and Ülle Tamla were most considerate when I needed access to the finds. Kristel Roog and Jaana Ratas helped with the illustrations and Mara Woods with language issues. The paper has remarkably benefited from discussions and comments provided by Valter Lang and, particularly, Karen Margrethe Hornstrup. The publication costs of this article were covered by the Estonian Academy of Sciences, the Institute of History and Archaeology at the University of Tartu, and the Institute of History, Archaeology and Art History of Tallinn University.

APPENDIX

The main characteristics of the stone-cist graves at Jõelähtme

d – grave's diameter, as measured alongside/across the cist. Measurements in centimetres and rounded.
° – cist's orientation.
Kalman/Varul – age and sex determinations in Kalman s.a. / Varul 2016. F – female; M – male; x – sex unknown. Age in years, unless stated otherwise.
fr – fragment(s). :x – registration number of a find in the find assemblage AI 5306 (Archaeological Research Collection at Tallinn University). The finds that are currently missing from the assemblage are shown in italics. 'Finds outside cist' means in most cases artefacts found within the ring wall and less frequently finds slightly outside the ring wall. Note that the pottery and iron objects found in the cists are not grave inclusions *strictu senso*. Photos: Kristel Roog and Jaana Ratas.
Source of the graves' measurements and location of finds: Ants Kraut, unpublished material.

1: d 965/820; cist 260 × 85 × 30–35, 26°
Kalman: M 30–35
Varul: x 9.5–14.5; x 12–18; M 40+
Finds in cist: a bone pin (:1)
Finds outside cist: *an ice nail (fr, :2), an iron object (fr, :3), 3 horseshoe nails (:4–6)*, potsherds (:7)

2: d 480/455; cist 215 × 85 × 20–25, 16°
Kalman: M 15–20; M 45+
Varul: x 5–10; M 17–19; M 40+; x adult
Finds in cist: a bone pin (:8)
^{14}C: 2923 ± 31 BP (juv./adult); 2917 ± 32 BP (adult)

3: d 420/420; cist 145 × 85 × 15–20, 28°
Kalman: x 0–1; x 1–2
Varul: x 0.25–1; x ~2; x 5–9
Finds in cist: a bronze tubule (fr, :9), a coiled bronze wire (:10)
Finds outside cist (?): a bronze object (fr, :11), potsherds (:12–13)

4: d 485/500; cist 235 × 105 × 20–30, 20°
Kalman: x 5–6; x adult
Varul: x 0–1; x 5 yrs ± 16 mos; x 14–16; x adult
Finds in cist: *an iron rivet (:14)*, potsherds (:15–16)

5: d 640/545; cist 265 × 145 × 15–25, 88°
Kalman: x 4–5; x 8–10; x adult
Varul: x ~1; x 3–5; x 6–10; x 40+
Finds outside cist: potsherds (:17–18)

6: d 770/680; cist 270 × 110 × 30–40, 31° (the cist has been described as boat-shaped by the excavator)
Kalman: x 15–18
Varul: x ~1; x 3–5; M? 16–17; x adult
Finds outside cist: potsherds (:19)

7: d 750/770; cist 250 × 115 × 20–25, 38°
Kalman: M 30–35
Varul: x infant/child; M 40+
Finds in cist: bronze tweezers (:20), a bronze razor (:21), *a bronze object (2 fr, :22)*
^{14}C: 2924 ± 32 BP (the male)
The adult male has been subjected to isotope (Oras et al. 2016) and aDNA analysis (Saag et al. 2019).

8: only southern part preserved; d ?/555; cist ? × 60–70 × 20–40, ?°
Kalman: x adult
Varul: x adult
Finds outside cist (?): *a fire-striking stone (:23)*

9: d 610/610; cist 165–180 × 120–140 × 30–35, 53°
Kalman: x 4–6; x 12–13; F 50+
Varul: x ~1; x 3–5; x 11–15; F? 40+
Finds in cist: 2 bronze temple ornaments (:24–25), a bronze double button (:26), a bone pin (:27)
^{14}C: 2834 ± 32 BP (the probable female)

10: d 495/485; cist 230 × 60–70 × 25–35, 10°
Kalman: x 0–0.5; x 20–30
Varul: (bones inaccessible)

11: d 490/410; cist 160 × 55 × 25–35, 39°
Kalman: x 0–0.5; x 2–3; x 2–3; x 3–4
Varul: (bones inaccessible)
Finds in cist: a bronze double button (:28)
Finds outside cist (?): *an iron object (fr, :29), a horseshoe (fr, :98)*

12: d 490/450; cist 235 × 95 × 20–35, 18°
Kalman: x 0–1; x 1–1.5; x 5–10; x 15–18
Varul: x ~1; x ~5; x 15–18
Finds in cist: a bronze looped toggle (:31), a bone pin (‘spade-headed’, :33–34)
Finds outside cist (?): a bone pin (with a hole, :32), *an iron nail (:35)*, a tripod vessel (fr, :36)

13: d 415/375; cist 210 × 70 × 15–20, 35°
Kalman: x 0.5–1; x 3–5; x 7–9
Varul: x ~1; x 2–4; x 5 yrs ± 16 mos
Finds in cist: a bronze temple ornament (:38), *a bone pin* (*:40; Kraut 1985, pl. VI: 7)*
Finds outside cist (?): a bronze looped toggle (:37), a bronze temple ornament (fr, :39)

14: d 410/345; cist 220 × 70 × 15–20, 12°
Kalman: x ~1; x 2–3; x 25–30; x 45+
Varul: x 0.5–1; x 2–4; x 25–35; M? 40+

15: d 590/550; cist 225 × 95 × 30–35, 46°
Kalman: x 4–5
Varul: x 0–0.5; x 2; x 5 yrs ± 16 mos
Finds in cist: a bronze bracelet (:41)
^{14}C: 185 ± 30 BP (a sheep bone, also subjected to aDNA analysis: Rannamäe et al. 2016; AI PP 212)

16: northern part destroyed; d ?/490; cist 285 × 55 × 15, 22°
Kalman: x 5–6
Varul: x 1–2; 4–8; x adult
Finds outside cist: an iron knife (:100)

17: d 310/290; cist 105 × 50 × 20–25, 0°
No bones preserved.

18: d 595/560; cist 235 × 50–60 × 15–20, 31°
Kalman: x 10–12; M 20–25
Varul: x 2–4; 9–14; M? 20–25; M? adult
Finds in cist: a bronze razor (:42), *a stone bead (:43)*
^{14}C: 2887 ± 32 BP (an adult)

19: d 910/870; cist 260 × 115 × 35–45, 7°
Kalman: x 0–0.5; M 30–40
Varul: x ~1; x juvenile / adult under 40; x M 45+
Finds in cist: a bronze razor (:44), potsherds (:51, 56)
Finds outside cist: an iron nail (:45), a clay pipe stem (fr, :46), potsherds (:47–50, 52–55, 57)
^{14}C: 2782 ± 47 BP (the child); 2893 ± 42 BP (the juv./adult); 2720 ± 33 BP (the male); 1641 ± 33 BP (a dog); 987 ± 37 BP (a cat); 1224 ± 28 BP (a sheep, also subjected to aDNA analysis: Rannamäe et al. 2016; AI PP 213)

20: d 470/480; cist 185 × 100–125 × 20–25, 51°
Kalman: x 10–11; x 20–30
Varul: x 11–16; x 25–35
Finds outside cist (?): 2 bronze finger rings (:58, 62)

21: northern part destroyed; d ?/640; cist 235 × 105 × 20–30, 21°
Kalman: M? 30–35
Varul: x infant/child; x 17–25; M 30–40
Finds in cist: a flint object (:60)
Finds outside cist: *an iron knife (:59)*

22: northern part destroyed; d ?/460; cist 200 × 80 × 15–20, 22°
Kalman: (bones inaccessible/missing)
Varul: x 11–14
Finds in cist: a bone pin (:67), *an iron rivet (:65)*
Finds outside cist: a silver coin (:63; Kraut 1985, pl. VI: 10), *an iron knife (:64),* an iron nail (:66)

23: severely damaged; d ca 350
No bones preserved.
Finds: potsherds (:68–69)

24: northern part destroyed; d ca 360–370; cist 80+ × 50 × 10, 24°
Kalman: M adult
Varul: M adult
Finds in cist: potsherds (:70–72)
Finds outside cist: potsherds (:73–75)
^{14}C: 2781 ± 35 BP (the male)

25: d 605/535; cist 185 × 80 × 20–25, 56°
Kalman: x 9–10
Finds in cist: a bronze pin (fr, :77), *an iron knife (fr, :78)*, a bone pin? (fr, :104)
Finds outside cist: a dog tooth pendant (:76)

26: d 425/365; cist 210 × 65 × 10–15, 23°
Kalman: x 0.5–1; x 6–8; x 10–12; x 10–12; x 30–35
^{14}C: 2834 ± 32 BP (the adult)
A sheep bone has been subjected to aDNA analysis (Rannamäe et al. 2016; AI PP 214).

27: d 425/300; cist 260 × 70 × 5–10, 17°
Kalman: x 0–0.5; x late adolescent / adult

28: d 425/395; cist 235 × 100 × 20–25, 35°
Kalman: x 1–2; x 8–9
Finds in cist: an amber bead (:80)

29: d 325/280; cist 180 × 95 × 10–20, 14°
Kalman: x 6–8

30: d 460/450; cist 155 × 55 × 20–25, 11°
Kalman: x 2–3

31: d 265/215; cist 150 × 50 × 10–15, 38°
Kalman: x 3–5

32: d 295/280; cist 145 × 55 × 15–20, 79°
Kalman: x 0.5–1
Finds outside cist: an iron nail (:82), a potsherd (:103)

33: d 565/565; cist 235 × 90 × 10–15, 25°
Kalman: x 0–0.5; x 8–9
Finds in cist: a bronze razor (:83)
Finds outside cist: *an iron knife (:84)*

34: d 775/770; cist 260 × 85 × 35–40, 14°
Kalman: F 25–30; M 40–45
Varul: M 25–35; x 40–45
Malve & Laneman 2015: M 30–50; x 35–45
Finds in cist: a bone pin (fr, :85)
Finds outside cist: potsherds (:86–92), a bone pin? (fr, no number)
^{14}C: 2833 ± 32 BP (the adult of unknown sex); 2823 ± 33 and 2815 ± 33 BP (the male); 2656 ± 33 BP (either of the two individuals or a third individual); 162.17 ± 0.4 pMC (a chicken; Ehrlich et al. forthcoming 2021)
The male has been subjected to isotope (Oras et al. 2016) and aDNA analysis (Saag et al. 2019).

35: d ca 260; cist 180 × 65 × 35, 69°
Kalman: x 6–7
Varul: x 0.25–1; x 3–5; x 5–9; x 5–9; x 6–10
^{14}C: 2652 ± 53 BP (a child at least 7 years old)

36: d ?/285; cist 100 × 40 × 10–15, 21°
Kalman: x infant
Varul: x 0–0.5; x 0–0.5; x 0.5–1
Finds in cist: a bronze looped toggle (:93)

Finds from between the graves: a bronze crossbow fibula (between graves 20 and 22, :61), an iron rivet (between graves 20 and 26, :79), a copper coin (between graves 31 and 33, :81), a potsherd (2 m north of grave 11, :30).
Finds of unknown or questionable location: a silver coin (:94; Kraut 1985, pl. VI: 11), a flint object (:95), *2 other flints (:96)*, a stone axe (fr, :99), potsherds (:97, 102), an amber bead (unnumbered, perhaps from grave 13).

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JÕELÄHTME KIVIKIRSTKALMETE DATEERINGUST

Resümee

Jõelähtme kivikirstkalmed paistavad Eesti seda tüüpi kalmete seas silma leiurikkusega, sealhulgas Skandinaavia päritolu pronksesemete suhtelise rohkusega. Viimati mainitud võimaldavad kalmistut ka võrdlemisi hästi dateerida. Teaduskirjanduses on Jõelähtme kalmete ajaline paigutus siiski kas üsna ebamäärane või isegi kergelt vastuoluline. Populaarteaduslikus kirjanduses võib aga tänini kohata vananenud, 1980. aastatel käibinud absoluutsel kronoloogial põhinevaid ajamääranguid.

Arvestades peale eelmainitu sellega, et pool Jõelähtme 36 kalmest oli ilma pronksiaegsete esemeleidudeta ja et esemed ei pruugi esindada kalmistu kasutusaega kogu selle pikkuses, lasti kalmevälja dateeringu täpsustamiseks analüüsida 17 luud radiosüsinikumeetodil. Analüüsitute seas olid 13–14 inimest ja kaks looma üheksast kalmest. Kolme kalme puhul (19, 24 ja 34) on dateeritud kõik osteoloogiliselt eristatud inimesed, ehkki 24. kalme puhul tuleb arvestada, et see oli suures osas lõhutud ja võis pronksiajal sisaldada enam kui ühe isiku säilmeid.

Kalendriaastatesse ümber arvutatud dateeringud näitavad, et kalmistu (säilinud osa) rajati ajavahemikus 1200–1000 eKr ja et matmine lõppes tõenäoliselt ajavahemikus 900–800 eKr. See on üldjoontes kooskõlas esemetüüpide kronoloogiaga. Suuremal osal Skandinaavia päritolu pronksesemete tüüpidel on üsna lai dateering läbi Põhjala pronksiaja IV ja V perioodi (s.o 1100–800/700 eKr), ehkki Jõelähtme puhul tundub, et kõige tõenäolisemalt kuuluvad need esemed IV ja V perioodi vahelisse nn üleminekuaega. Klassikalises kuueperioodilises jaotuses on vastavat absoluutdateeringut raske määratleda, sest tavaliselt seda üleminekuperioodi selgepiiriliselt ei defineerita ning pealegi pole IV ja V perioodi rajajoone osas 950. ja 900. aasta vahel selget hästi põhjendatud kokkulepet. Mõni uurija on küll üritanud seda kõnealust vahemikku eraldi perioodina piiritleda, ent vastav absoluutdateering on veel liiga ebakindlal alusel, et seda usaldusväärseks pidada. Nii või teisiti käib jutt eelkõige 10. ja võib-olla ka 9. sajandist eKr, mis sobib igati Jõelähtme radiosüsinikudateeringutega, kuid ei aita nende täpsustamisele kuigivõrd kaasa.

Küll aga võib oluline olla see, et kalmeväljalt ei ole saadud ühtki leidu, mis tuleks kindlasti dateerida III perioodi (st varasemaks kui 1100 eKr) või isegi IV perioodi esimesse poolde. Seejuures väärivad eraldi märkimist 7. kalme ornamendiga nuga ja pintsetid, mille puhul on võrdlemisi tõenäoline, et need jõudsid kalmesse komplektina ning koos mehega, kelle radiosüsinikudateering langeb kalibreerituna ajavahemikku 1220–1010 eKr. Kuna nimetatud esemed kuuluvad kõige tõenäolisemalt Põhjala pronksiaja IV perioodi lõppu või IV ja V perioodi piirimaile, võimaldavad need kõnealuse luustiku dateeringu (teatava ettevaatusega) kitsendada 11. sajandisse eKr. Et ka ülejäänud kõige vanemate dateeringute puhul ei ole mitte midagi sellist, mis sunniks eelistama nende varasemat, 12. sajandisse langevat otsa,

siis kõiki asjaolusid arvesse võttes tundub tõenäolisem, et kalmistu (või vähemalt selle säilinud osa) algusaeg jääb pigem 11. kui 12. sajandisse eKr. Dateeringu teises otsas ei ole midagi, mille alusel saaks praegu välistada 9. sajandi eKr või mingi osa sellest. Olgu ka lisatud, et üksikasjalikumaid järeldusi matmiskommete kohta (nt kalmete rajamise või matuste järjekorra kohta) ei võimalda radiosüsinikuandmed teha.

19. kalme lõunaküljele ehitatud kirstulaadsest rajatisest leitud täiskasvanud koera luu (mis kuulus ühele kolmest selles kalmes osteoloogiliselt eristatavast isendist) dateeriti aega 260–540 pKr ja sama kalme lõunaosast saadud üksik noore kassi luu ajavahemikku 990–1160 pKr. Mõlemast ajavahemikust on kalmeväljale jäänud ka väheseid esemeid, esimesest näiteks ambsõlg ja võib-olla kaks spiraalsõrmust, teisest peaasjalikult savinõukilde. Ühe teise uuringu käigus on 19. kalmest dateeritud ka lambaluu, mille kalibreeritud tulemus langeb 8.–9. sajandisse pKr. Koha rauaaegse tähenduse kohta on nende leidude põhjal väga keeruline midagi kindlat järeldada. Kalmeväljal oli ka muinasajast hilisemaid leide ja kaks teiste projektide käigus radiosüsinikumeetodil dateeritud loomaluud on osutunud kas uusaegseks või veelgi hilisemaks.