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THE IMPACT OF THE CLIMATE CATASTROPHE OF 536–537 AD IN ESTONIA AND NEIGHBOURING AREAS

In 536–541 AD a short-term and sudden cooling took place in the northern hemisphere. Archaeological and palynological data reveal that this event caused crop failure and demographic catastrophe in what is today Estonia. It took until at least the end of the 9th century to return to the previous population level. As a result of this crisis, previous power relations, trade networks, and handicraft traditions were disrupted, settlement structures transformed, and the entire world view of people changed. The climate catastrophe may have influenced the development of agriculture in Estonia. One can assume that the predominance of rye cultivation in Estonia in the second half of the first millennium is a result of the climate anomaly of 536–537.

In Finland, where hunting and fishing were the main livelihoods and thus land cultivation was of marginal importance, the climate catastrophe does not show in the archaeological record as a decrease of archaeological finds as it does in Estonia or eastern Sweden. One can, though, observe disruptions of the previous trade networks due to the events of 536–541 and the formation of new ones. These changes had an important role in forming both the unique material culture of the Finnish Merovingian Period and in expanding land cultivation in the area of southern Finland during the next few hundred years.

The impact of the catastrophe of 536 was so substantial that it could be considered an important threshold in the Estonian archaeological chronology. It is then that the greatest cultural upheaval since the major changes between the Early and Late Bronze Age are visible. It would be appropriate to set the border date between the Migration Period and Pre-Viking Age approximately in the year 550. Another advantage of this date is that it allows the Estonian Iron Age periodization to be synchronized with those used in the Scandinavian countries and Finland.

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Introduction

In 536–541 AD a short-term and sudden cooling took place in the northern hemisphere which has caught the attention of researchers only quite recently. In 1983, Richard Stothers and Michael Rampino published a list of volcanic eruptions prior to 630 AD known from historical sources (Stothers & Rampino 1983). Their list included a veil of dust or dry fog that darkened the sky for almost a year in 536–537 AD and caused crop failure.

Dendrochronologist Mike Baillie found physical evidence of the event studying the tree rings of Irish oak (Baillie 1994). During the last decades, numerous publications (e.g. Randsborg 1997; Axboe 1999; 2001a; 2001b; Baillie 1999; Keys 1999; Gunn 2000; Høilund Nielsen 2006; Gräslund 2008; Gräslund & Price 2012; Arrhenius 2013) have discussed the historical significance and impact of the 536–537 event as well as its archaeological manifestations and written sources. The emergence of this new research topic is due to recent advancements in climate reconstructions based on natural science. Having access to much higher-resolution climate records makes it possible to discuss the demographic, economic, and cultural impacts of climate change more precisely (Widgren 2012, 126).

The event in question appears clearly in the growth rings of trees in the northern hemisphere, namely in the common oak (*Quercus robur*) and families of pine (*Pinus*). Tree rings show abnormally little growth in 536 and the following years. A similar pattern has been found in tree rings from 540 in the southern hemisphere, for example in southern Chile and Argentina (Baillie 1999; 2007; Gunn 2000; Jones 2000; Young 2000 and citations therein). Tree rings of the northern hemisphere show that growth was hampered in two periods. After recovery a new, even sharper drop emerged in 540–541 (D'Arrigo et al. 2001, 240). According to tree rings, extraordinarily cold weather continued in the northern hemisphere until the year 545 (Gräslund & Price 2012, 430 and citations therein).

Traces of the event can be found in ice cores from Greenland and Antarctica. The earliest studies referred to the high sulphuric acid content of ice deposits in Greenland from around 540 which indicate the volcanic origin of the event (see Stothers & Rampino 1983; Stothers 1999). Later researchers have also found evidence of substantial sulphate deposits in ice layers from Greenland and Antarctica, supporting the notion of volcanic dust (e.g. Traufetter et al. 2004; Larsen et al. 2008; Ferris et al. 2011).

Most scientists who have studied the causes of the event of 536 have concluded that it was caused by an immense volcanic eruption in the tropical zone of Earth (see Stothers & Rampino 1983; Stothers 1999; Larsen et al. 2008). Several volcanoes and places have been proposed (see Stothers 1984; Keys 1999; Wohletz 2000). The most convincing evidence so far refers to the Tierra Blanca Joven eruption of the Ilopango caldera in central El Salvador (Dull et al. 2001; 2010; Oppenheimer 2011, 254 ff.). Others believe that a comet or a meteorite explosion caused the event (Baillie 1999; 2007; Rigby et al. 2004). Magnetite and silicate spherules found from the ice layers of 536–537 in Greenland support this alternative explanation (Abbott et al. 2008). Similar sphelures have been found in northern Australia from a supposed metorite crater in the Gulf of Carpentaria (Abbott et al. 2008; Subt et al. 2010). Thus, natural scientists have not agreed on what caused the climate anomaly of 536–537. Nevertheless, according to tree growth rings it was the worst shock to the ecosystem within the last 2000 years (Baillie 2007, 106).

Antti Arjava (2006) has studied written evidence from Mediterranean sources of the extraordinary event of 536–537. In several of these sources it appears that a darkening of the sun was observable in the Mediterranean region during more than a year. Bishop Michael the Syrian writes in his 12th century chronicle, quoting the 6th century ecclesiastical historian John of Ephesos:

> Each day it shone for about four hours, and still this light was only a feeble shadow. /…/ The fruits did not ripen, and the wine tasted like sour grapes (Arjava 2006, 78 f.).

Roman official Magnus Aurelius Cassiodorus wrote in the year 536 or 537 that an eclipse had been going on for almost an entire year that caused crops to fail. Cassidorus asserts:

> So we have had a winter without storms, spring without mildness, summer without heat (Arjava 2006, 80).

Several sources indicate that the darkening of the sun could have caused famine. A collection of biographies of popes, *Liber pontificalis*, mentions a devastating famine in the "whole world" in the year 537. According to the bishop of Milan mothers had eaten their children because of the famine (Arjava 2006, 80). Reports of crop failures and famines reached beyond the Mediterranean area. Written sources from northern China mention cold, dryness, crop failure, and famine between the years 535 and 538 (Keys 1999, 149–160, 281 ff.; Houston 2000).

The middle of the first millennium as an interlude in the archaeological record

The crisis of the middle of the first millennium is clearly visible in the Estonian archaeological material. Reseachers up until the 1920s commonly assumed that the local population, believed to consist of eastern Germanic Goths, migrated to the south at the end of the Roman Iron Age (50–450 AD). The land was thought to have remained unoccupied until the 9th century when the ancestors of Estonians and Livonians arrived from the east (Grewingk 1871, 49; Hausmann 1896, XIII; for more details see Tvauri 2003). Archaeological finds at the beginning of the 1920s filled the chronological gap and gave evidence for the continuous inhabitation from the Roman Iron Age to the Late Iron Age (Tallgren 1925). Still, even from the 1920s to the 1930s it was widely believed that large parts of Estonia had emptied due to the migration of people into Finland (Tallgren 1925, 32; 1931, 146; Vassar 1938).

From the 1930s onward, researchers no longer discussed the possible disruption of habitation in Estonia. For the moment, sufficient amount of finds and radiocarbon dates prove continuous inhabitation. Nevertheless, researchers have still assumed that something significant must have happened in the middle of the first millennium due to a dramatic shift in the settlement patterns at that time (see Ligi 1995, 227). Opinions differed about what exactly could have happened. The shift in settlement patterns characteristic of the Migration Period has been most frequently explained by changes in agricultural technology (Shmidekhel´m 1955, 206 ff.; Jaanits et al. 1982, 300; Lang 1995, 165; 1996, 496).

Different theories concerning the so-called Migration Period crisis have also been proposed in Scandinavia. The notion that the crisis was brought about by the pandemic of 541–542, the Plague of Justinian, has been presented repeatedly (Gräslund 1973; Seger 1982; Herschend 1988, 64). In Gotland and Öland, the decrease in habitation has been explained to be a result of intensive agricultural land-use which led to soil exhaustion and the proceeding emigration (Widgren 1983; Carlsson 1988; Herschend 1988; Näsman 1988). The abandonment of settlement sites and decreases in the number of burial sites have been interpreted as a result of changes in agricultural methods, systems of land use, and the resulting shift of settlements into locations nearby (Sporrong 1971, 197; Carlsson 1979; Näsman 1991, 168; Hedeager 1992, 224; Myhre 2000, 36). Some researchers believe that the 6th century crisis was caused by war (Liedgren 1989, 77) or disruption of former exchange networks (Kivikoski 1961, 186; Huurre 1979, 168). Others believe that the crisis was brought about by the concurrence of several unfavourable conditions such as ecological crises, changes in trading networks, war, and plague (Meinander 1977, 42 f.; Ambrosiani 1984; Magnus & Myhre 1986, 403 ff.). There are also those who doubt if there is any reason to talk about a crisis at all. The decrease in indicators of human impact, revealed in palynological data, is believed to have been caused by changes in settlement patterns (Pedersen & Widgren 2004, 309).

As mentioned above, the atmospheric anomaly of 536–537 caught the attention of researchers only in 1983 and archaeologists became familiar with the subject only in the late 1990s. Climate-related explanations of the crisis, however, were not unknown also in prior discussions (for example Herschend 1988, 64). Clearly, archaeological research published before the mid-1980s cannot explain the 6th century crisis as a result of the event of 536.

While assessing the former discussion, one has to consider that it is difficult to see one specific event in archaeological and palynological data. Typology-based dates of finds from the Migration Period and following centuries are imprecise in both Scandinavia and continental Europe, despite the fact that in the latter case it is possible to relate the dates to coin finds and written sources (see Pihlman 1990, 53 ff.). Even more imprecise are the dates in the Baltic countries that are based directly or indirectly on Scandinavian and central European chronologies.

The use of natural science-based dating methods has added a tremendous amount of data about the past. Still, it has been difficult to identify a single event with the help of radiocarbon dates. For the moment, dendrochronological dating methods have made it possible to receive extremely accurate dates. To adapt such precise information into a previously formed picture of the past could be challenging. Dendrochronologist Mike Baillie has written:

> These are the related effects whereby the specification of a dendrochronological horizon tends to suck in loosely-dated archaeological, environmental and even ancient-historical information – the dated "event" being used to explain a wide spread of previous observations. The converse situation, again exposed by the intrusion of dendrochronology, is where truly synchronous events in the past may have gone unrecognised because the dating – mostly radiocarbon based – has *smeared* the "event" into a "period". There is a distinct possibility that short-term, catastrophic, events have gone unrecognised in prehistory simply because, hithero, evidence for them has been spread through time by radiocarbon (Baillie 1991, 12).

The weather event of 536–537 AD is a factual incident that cannot be ignored while studying the history of the middle part of the first millennium. Natural science-based methods for research and dating have developed to a level where archaeologists are able to explore short-term single events and not only long-term developments.

The impact of famine in Estonian recorded history

Researchers of the Estonian Iron Age have so far not focused their attention on crop failures and famines. Numismatist Ivar Leimus has been the only Estonian Iron Age researcher who has examined this question. He inferred from the chronological distribution of coin hoards that a famine that killed entire families and left numerous treasures buried beneath the earth may have struck Estonia and neighbouring countries in the middle of the 10th century (Leimus 2004). The lack of interest in this topic can be explained by the fact that there were no natural-science based methods available for more precise datings of events and for revealing the human impact on the natural environment until recently.

It is possible to study the famines Estonia suffered during historical times by means of written sources. Although there is no direct and exact data about demographic changes in Estonian territory before the 19th century, indirect evidence provides a picture of the catastrophic extent and the impact of famines. It has been estimated that there were 150 000–180 000 inhabitants in Estonia at the beginning of the 13th century (Tarvel 1966). This number was surely reduced when the Danish and German crusaders conquered what is now Estonia in the years 1208–1227. A severe famine struck Old Livonia in 1315. The pandemics known as the Black Death reached Estonia in 1351. Those events clearly caused a population loss, but there is no data about the extent of the loss (Selart et al. 2012, 168 f.). The conditions of the 15th century and the first half of the 16th century were favourable for population growth. As estimated, around the year 1550 there were 250 000–300 000 inhabitants in Estonia (Tarvel 1992, 144). Thereafter, the Livonian War (1558–1583) and the Polish-Swedish war (1601–1625) caused severe population loss which was aggravated by the cooling of the climate in the second half of the 16th century when the Little Ice Age started. In 1601–1603 a harsh famine struck Estonia. By 1640 the total population was approximately 120 000–140 000 (Palli 1996, 14). In the period of 1640–1695 a rapid growth of population took place. By the year 1695, the population had risen to 325 000–400 000 (Liiv 1935, 38; Palli 1993, 34; 1996, 14). One of the severest crop failures and famines throughout Estonian history caused by unfavourable climate conditions struck the land in 1695–1697. It has been deduced that it killed 70 000–75 000 people. Most of them did not starve to death but died of the contagious diseases easily caught by malnourished people (Liiv 1938). In the year 1700 the Great Northern War began. Battles and looting immediately overcame the entire Estonian territory. In 1708 there was a crop failure in northern Estonia; in 1709 crop failure spread over the entire area of Estonia. Famine made way to epidemics and in 1710–1711 the worst plague in Estonian history broke out. By the year 1712 the number of Estonian inhabitants was 150 000–170 000 (Palli 1997, 27), i.e. approximately the same as at the beginning of the 13th century, half a millennium before.

Thus, the aforementioned data suggest that a single incident of famine, and the accompanying starvation and epidemic, may have destroyed the results of population growth of several centuries. Estonian society until the 19th century was fully dependent upon agricultural production. Crops from the fields determined whether people lived or died, and crops were determined mainly by the weather. Famine in the Iron Age was even more devastating than at the time of recorded history. First, the agricultural technology of the Migration Period (450–550 AD) and Pre-Viking Age (550–800 AD) was clearly more primitive than at the Early Modern Age and thus the crops were smaller. Second, it was impossible to import grain from distant regions as it was impracticable even in case of famines of historical periods in the region. As late as in 1866–1868 there was a famine in the Grand Duchy of Finland that killed 8 per cent of population, a total of 150 000 people (Turpeinen 1986). All that in a situation where the state functioned with a working infrastructure such as roads, sailing and steamships. In the Iron Age recovery from the crop failure and re-cultivating the fallow fields must have been hampered by the inability to import seed grain.

Traces of the event of 536 in palynological data from Estonia and the neighbouring countries

A decrease in human impact on the natural environment is revealed in all Estonian pollen diagrams of the first millennium AD that have been studied with sufficient resolution and where indicators of human impact are considered.

The sediments of Lake Maardu not far from Tallinn and the bog peat at Saha-Loo revealed a clear decrease in human impact in the second half of the Migration Period after a strong expansion in the Late Roman Iron Age (Veski & Lang 1995; Veski 1996; 1998, 42). In the pollen diagrams of Verevainu swamp, next to the hill fort and the settlement site of Keava/Linnaaluste in southern Harjumaa, the indicators of sedentary farming settlement reached their peak in the Late Roman Iron Age and the Migration Period and dropped rapidly in the Pre-Viking Age (Heinsalu et al. 2003; Heinsalu & Veski 2010, fig. 4). In the vicinity of Lake Tõugjärv at Rõuge in south-eastern Estonia, the proportion of arable land increased considerably at the end of the Roman Iron Age and at the beginning of the Migration Period in comparison with the previous periods; however, in about the 6th century it dropped abruptly and then again recovered rapidly (Poska et al. 2008, 538, fig. 4). The pollen diagram of Lake Hino in the south-eastern corner of Estonia shows a decreased human impact on the environment in the 7th–9th centuries (Laul & Kihno 1999). The pollen diagram of Parika bog in northern Viljandimaa reveals that the general trend between the Pre-Roman Iron Age and the first part of the Viking Age was a slow increase in human impact; however, on two occasions, around the 5th and the 9th century, the human impact decreased considerably (Niinemets et al. 2002). The diagram of Surusoo bog in Saaremaa shows a temporary decrease in human impact in the mid-first millennium (see Veski 1996, fig. 2).

In Swedish palynological studies, a population loss appears clearly in the 6th century. A rapid contraction of the settlement is observable in the vicinity of Lake Mälaren (Sporrong 1971, 197) and in the province of Östergötland (Widgren 1983). In the province of Hälsingland, pollen diagrams show decreases in human impact around the year 500 (Engelmark & Wallin 1985). In several areas of Norrland, the agricultural landscape reforested around the same time (Engelmark & Wallin 1985). Data from Öland clearly show decreases in human impact in the 6th century (Königsson 1968, fig. 103; Herschend 1988, 64). In Denmark, palynological data reveal decreases in arable land and foresting in the middle of the first millennium (Hamerow 2002, 109 ff.).

As for Latvia and Lithuania, the archaeological literature does not mention any possible decrease in population around the second half of the 6th century. Nevertheless, both the archaeological sites and the artefact finds show that the area settled by the Baltic peoples witnessed major changes in settlement and culture in the second half of the 6th century and through the 7th century (see Tautavičius 1996; Asaris et al. 2008, 48; Bliujienė et al. 2012, 128).

In addition, palynological studies in Lithuania have revealed a notable decrease in human activity around the 6th century (Simniškytė et al. 2003, 283; Stančikaitė et al. 2004, 27). As the decrease of indicators of human impact in pollen diagrams of Lithuania is not as sharp as in the agricultural areas of Scandinavia, it has been interpreted as a result of the general cooling of climate after the period of Roman Climate Optimum (Stančikaitė et al. 2004, 29).

In the southern shore of the Baltic Sea, in northern Poland, the pollen diagrams of Stążki bog show a complete lack of human impact for a short period in the middle of the 6th century, whereas the sediments of the preceding 3000 years reveal constant human impact (Gałka et al. 2013, fig. 3). Palynological studies conducted in north-eastern Poland also show a temporary decrease in human impact in the 6th century (Kupryanowicz 2007, 62).

The dates of pollen diagrams are inevitably inaccurate. First, radiocarbon dating provides date ranges of about one century in duration; second, only some strata are dated by this method. However, peat growth or sediment processes need not have occurred at a constant rate. The pollen diagram of one specific sample is insufficient to draw any major conclusions about regional processes. But the situation whereby pollen diagrams of Estonia as well as in neighbouring areas to the west, south-west, and south show systematic and sudden decreases in human impact sometime between the 5th and 7th century, often the sole or largest decrease in the whole diagram, can only be explained by a single disastrous event – probably the climate anomaly of 536–537, which was followed by a famine and an accompanying high mortality rate.

Archaeological evidence of demographic catastrophe in southern Scandinavia in the 6th century

The crisis in the 6th century is observable in several neighbouring regions, for instance in the archaeological record in Sweden. The total number of occupied sites across the Uppland province fell by 75 per cent during the 6th century (Göthberg 2007, 440), whereas the number of new sites founded in new places after that time was substantially smaller. Identical patterns appear at burial grounds. In Västmanland province, adjacent to Uppland, the majority of the grave-fields that had been in continuous use since the Pre-Roman Age (and some began even earlier), were abandoned around the middle of the first millennium (Löwenborg 2010, V; 2012, 12 f.). Over 1300 Iron Age house foundations have been recorded on Öland, all apparently abandoned in the 6th century, while on Gotland at least 1900 similar deserted structures have been documented (Gräslund & Price 2012 and citations therein).

In southern Norway the entire settlement structure and social organisation collapsed in the 6th century – many farms were abandoned, rich burials became rare, the production of pottery came to an end, iron production decreased considerably, and the previous trade relations were disrupted (Solberg 1998, 247). In several areas of southern Norway the number of burial finds known to date from after the middle of the 6th century is 90–95 per cent fewer than in the period before (Solberg 2000, 180–182, 197 f.).

In Denmark, palynological data show a decrease in the proportion of arable land and an increase in afforestation in the middle of the first millennium accompanied by an abrupt decrease in the number of settlement and burial sites while the number of hoards increased (Hamerow 2002, 109 ff.). Judging on the basis of material culture, it seems that the previous foreign contacts of Denmark were totally interrupted in the late 6th century and in the 7th century, to be re-established only in the 8th century (Høilund Nielsen 2006, 48).

Evaluation based on the distribution of sites shows that the Scandinavian population may have decreased by 50 per cent in the 6th century (Gräslund & Price 2012, 433). It was the greatest change in settlement patterns in Sweden for 6000 years; in many cases, the settlements abandoned at this time had been in continuous use for more than 1000 years (Gräslund & Price 2012, 431 f.). It has even been proposed that the catastrophe of the 6th century was critical for the development of the strikingly different political economies of the later Iron Age, manifested in new types of monumentalized cemeteries and settlements in new locations (Gräslund & Price 2012, 434).

Lack of finds in Pre-Viking Age Estonia

Examining the archaeological record against the background of the event of 536–537 AD highlights at first a rather abrupt decrease in the number of sites and stray finds all over Estonia after the Roman Iron Age.

Forts that disappear in Estonian archaeological records at the end of Pre-Roman Iron Age reappear in the Migration Period. The only signs of these forts are radiocarbon dates and/or occasional artefact finds under the ramparts of approximately ten later forts (Tvauri 2012, fig. 2), and there are no data concerning the construction and appearance of these forts. Material dated to the Pre-Viking Age has been obtained from 13 Estonian forts and from the Koorküla Valgjärv lake settlement (see Tvauri 2012, figs 3, 7). The majority of this material consists of individual radiocarbon dates; finds dated to the Pre-Viking Age are extremely rare. From the Iru fort only a strap end, a cross-shaped buckle pin, and a buckle dated to the 5th–7th century have been found (Lang 1996, 99, 101 f.). From other Estonian forts there are no artefacts from the 6th or 7th centuries; all artefact finds have been dated to the 8th–10th centuries.

Since only a few settlement sites are known from the Roman Iron Age, the Migration Period, and Pre-Viking Age, and an even smaller number has been excavated (see Lang 2007, 49 ff.; Tvauri 2012, 63 ff.), it is impossible to draw any conclusions about the settlement dynamics based on this particular type of site.

It is evident that the number of graves decreased – while about 150 graves are known from the Late Roman Iron Age (AD 200–450), less than 60 represent the Migration Period. However, this tendency coincides with the end of building *tarand* graves, which need not have been related to a decrease in the population but changes in burial practises (Lang 1996, 270). At the same time, during the Migration Period, forts and settlement sites, almost unknown previously, make their appearance in the archaeological record, although at first only in modest numbers. In some regions, for example in the vicinity of Vihasoo and Palmse on the northern coast of Estonia, mostly field remains are known from the period following the Roman Iron Age (Lang 2000, 221). On the other hand, in Saaremaa for instance, where only two grave sites are known to represent the Roman Iron Age (see Lang 2007, fig. 116), the number of graves increased in the Migration Period. The situation is similar in Läänemaa, where graves of the Late Roman Iron Age are absent but graves of the Migration Period are relatively numerous. The assumption about a decrease in the population during the transition from the Roman Iron Age to the Migration Period is not supported by palynology either. In fact, the pollen diagrams of north-western Estonia show a strong human impact during the Migration Period (Veski & Lang 1996; Koot 2004), and in Saaremaa, too, the human impact was stronger during the Migration Period than during the previous period (Veski 1996).

The number of the discovered burials of the Pre-Viking Age is roughly equal to that of the Migration Period, represented by 65 sites (Tvauri 2012, fig. 188). In most cases, however, these burials comprise no more than occasional artefacts of this period in some earlier or later burial sites. An increase in the number of burial sites can be observed only in the eastern part of south-eastern Estonia; while none are known from the Migration Period, cremation barrows started to be built sometime in the second half of the 6th century. About a dozen hill forts reveal traces of human presence in the Pre-Viking Age; however, in most cases, these are only radiocarbon dates and/or occasional artefact finds, which by comparison with the abundance of finds of the Viking Age are very few in number. Until now four settlement sites are known to date from the Pre-Viking Age, while three settlement sites of the Migration Period have been discovered.

The previously presented figures demonstrate that the number of Migration Period sites and the number of Pre-Viking Age sites are more or less equal. However, in accordance with the chronology used in this study, the length of the Migration Period was 100 years (AD 450–550), and the Pre-Viking Age lasted for 250 years (AD 550–800). This means that the Pre-Viking Age is in fact represented by relatively fewer sites than the Migration Period. It is especially difficult to find any sites or even objects that could be dated to the second half of the 6th century and the first half of the 7th century, as the majority of sites and portable finds of the Pre-Viking Age date only to the late 7th century or the 8th century. Thus, one could conclude that a decrease in the human impact as manifested in the pollen diagrams roughly coincides with a decrease in the number of sites at the end of the Migration Period and the beginning of the Pre-Viking Age. This is probably a result of a noticeable decrease in the population size in about the mid-6th century.

It appears to have taken until at least the end of the 9th century – the entire Pre-Viking Age and the first half of the Viking Age – to return to the previous population level. It must be considered that the dust veil of 536–537 coincided with the cooling of the climate after the Roman Warm Period which had lasted in Europe from around 100 BC to 200 AD and which had been favourable to agriculture. The cooler era lasted approximately until the year 800 (Büntgen et al. 2011) and magnified the impact of the catastrophe of 536 to the human settlement.

Impact of the 536 climate catastrophe in Finland and northern Fennoscandia

Interestingly enough, it seems that to the immediate north and east of the population crisis zone of the 6th century the settlement remained stable or even expanded; in some places the local people became sedentary farmers at that time. For instance, in northern Norway the economic, social, and political situation seems to have been stable throughout the 6th century. In southern Norway, where the coastal settlement witnessed a collapse in the second half of the 6th century, hunting, fishing, usage of mountain pastures, and even iron production continued in the mountains and in forested regions (Myhre 2000, 35).

In northern Ångermanland in the coastal area of the Gulf of Bothnia in northern Sweden, the 6th century witnessed the emergence of agricultural permanent settlement (Pedersen & Widgren 2004, 310 f.; Wallin 2004). Palynological studies conducted in northern Uppland showed that land cultivation might have decreased in the mid-6th century, but not all pollen diagrams attest to this (Randheden 2007, 117). Quite the contrary, in the region of Vendel the human impact on nature increased during the Vendel Period, that is, AD 550–800 (Karlsson 1999). In the

Åland Islands, permanent settlement emerged only in about 600, which was followed by settlement expansion until the beginning of the 11th century (Roeck Hansen 1991, 54, 156 f., 166).

Most Finnish archaeological and palynological data do not provide any evidence of a population crisis in the 6th century. Quite the contrary – at that time in south-western Finland, permanent traces of slash-and-burn agriculture appear in pollen diagrams even in those regions where previously only occasional traces of land cultivation had been found (see Tolonen 1983; Vuorela 1985). In inner Finland, too, in several locations in Tavastia (Häme) and Savonia (Savo) the first indicators of continuous slash-and-burn practise appear in the 6th–7th centuries (Tolonen 1978; Simola et al. 1985). However, one has to consider that in southern Finland land cultivation became the principal means of subsistence only at the end of the Roman Iron Age, and even then in combination with cattle rearing and foraging, because the climatic conditions and the agricultural technology of the Iron Age did not enable people to support themselves by field cultivation alone (Solantie 2005). Based on the condition of the teeth of the buried at Luistari cemetery, which was in use during the Pre-Viking and Viking Ages, it has been deduced that there were very little carbohydrates in the diet of the deceased, which indicates low proportion of cereal (Salo 2005, 83, 112). Thus, crop failures affected the Finnish population less than it affected the population of its southern neighbours, for whom land cultivation was almost the only means of food production.

In northern Fennoscandia, where land cultivation was not practised, there is no trace of change in around the 6th century. In the Roman Iron Age, this region was integrated with the southern farming areas into a single trade system visible through archaeological finds, but both ceramics and metal objects disappeared here as early as at the end of the Roman period, though judging by the radiocarbon dates the settlement did not fully vanish (Carpelan 2003, 60 f.). One might assume that the crop failures affected the foragers of this region less than the farmers in the south. In north-western Russia, too, it is impossible to identify the population crisis in the mid-first millennium, because finds of even the first half of the first millennium are rare.

Thus, one can observe a sudden population loss in the 6th century in a zone in northern Europe that encompassed at least Estonia, Latvia, Lithuania, Gotland, Öland, southern Sweden as far as Lake Mälaren, southern Norway, Denmark, as well as Schleswig-Holstein and northern Frisia in Germany. In the middle of the first millennium these were the northernmost areas where land cultivation had become the predominant means of subsistence – depending on the region, the people either supported themselves by intensive slash-and-burn or fallow agriculture, or cultivated fertilized permanent fields. In these areas population loss was manifested in the abandonment of settlements, afforestation of fields, decreased numbers of burial grounds or burials, increased number of hoards, and, finally, in significant changes in material culture. The latter is reflected also in the fact that in the archaeological chronology of Sweden, Norway, and Finland, the year 550 marks the end of the Migration Period.

The end of the world and sacrifices to the gods

It is nearly impossible for us to imagine how it influenced people living in northern Europe 1500 years ago when there was suddenly only a feeble shadow of the sun at daytime and the moon and the stars disappeared from the night sky.

In pre-Christian Norse mythological poetry one finds a description that may refer to how the event of 536–537 must have appeared to Norse people – the prophecy of the final battle at the end of the worlds (*Ragnarök*). Swedish archaeologist Bo Gräslund has written about this in detail (2008).

In the Prose Edda one of the events preceding the end of the world is the great winter (*Fimbulvetr*):

> First of all that winter will come to be called Fimbulwinter. Then snow will drift from all directions. There will then be great frosts and keen winds. The sun will do no good. There will be three of these winters together and no summer between (Faulkes 1987, 52 f.).

"The Prophecy of the Seeress" (*Völuspá*) in the Poetic Edda describes the same event as follows:

> The sun turns black /…/ the bright stars vanish from the sky (Larrington 1996, 11).

In Norse mythology, the final battle in which both people and gods were destroyed was followed by a resurrection of the world. In the mid-6th century life continued after the catastrophe and the surviving people created new culture with new settlement patterns significantly differing from the old ones. It has been noted that the descriptions of the great winter in the Norse tradition give account of specific weather conditions, including their appearance, duration, and precise effect. There is nothing comparable in the end-of-the-world stories in other mythologies whereas parallels can be found from the textual sources from Late Antiquity describing the event of 536 AD. The assumption that the great winter is a reflection of the extreme weather events of 536–537 AD is supported by the fact that all the material culture described in the *Völuspá* corresponds to that of the 6th century and thus the main body of the poem could have been composed in the Pre-Viking Age (Gräslund & Price 2012, 437).

It has been assumed that numerous votive deposits of 6th century Scandinavia, especially sacrificial gold, might be related to the event of 536–537 and the ensuing distress. Although gold objects were sacrificed already at the beginning of the Migration Period, there are especially numerous gold offerings known from the end of the Migration Period. Morten Axboe (1999; 2001a; 2001b; 2004) asserts that the event of 536 and its aftermath unleashed an extraordinary amount of religious activity in Scandinavia, as a result of which most of the gold that had been imported from the disintegrating Roman Empire to Scandinavia ended up as offerings on the bottom of bodies of water and bogs. It brought about the end of the 'golden age' in Scandinavia, i.e. by the period corresponding to the Pre-Viking Age (550–800), gold became an extremely rare commodity.

There is no written record of the Estonian pre-Christian beliefs but phenomena described by Axboe can be observed here in a smaller scale. It is noteworthy that out of 19 hoards of the 5th–8th centuries (see Oras 2010), 13 could have been deposited in 536 or during the subsequent decade (Tvauri 2012, 297).

Bo Gräslund has pointed out that in Gotland the erection of the picture stones with solar symbols ceased in the middle of the 6th century. Different images of the sun, popular in Scandinavia since the Bronze Age, disappeared completely and were replaced by symbols related to mythological stories of gods and heroes (Gräslund & Price 2012, 437 f.). In Estonia and Finland the sun disappears from the iconography of the artefact finds dating from the 6th century (see Salo 2012a, 164 ff.). Disc fibulae, penannular brooches, decorative pins, neck rings, and pendants with solar symbols, following the Roman example, reached the eastern shore of the Baltic Sea in the 3rd century through the south-eastern area of the Baltic Sea. Images of the sun also frequently adorn Estonian and Finnish jewellery of the Migration Period, for example disc-headed pins and wheel-headed pins, and crossbow fibulae with a star- or shovel-shaped foot (see Jonuks 2009, 228 ff.). Those images vanish in the Pre-Viking Age and Viking Age in Scandinavia, as well as in Estonia and Finland; instead the design and decoration of jewellery cast (Eastern) Christian symbols (see Purhonen 1998, figs 22–24, 26, 28; Callmer 2008; Salo 2012a, fig. 39; 2012b, figs 62, 64, 68, 83, 85).

It seems as if people had lost faith in the sun during the years when it was darkened. In Scandinavia a new set of religious ideas came forth, the centre of which constituted stories of gods and heroes and the end of the world. The whole perception of *ragnarök* was probably inspired by the real life experiences of 536 AD and the following years. At around the same time Christian ideas started to reach northern Europe through the Byzantine Empire. The end of the world along with the Judgement Day is also a central idea in Christianity.

Changes in burial customs and concepts of afterlife in the 6th century

In Estonia (with the exception of western Estonia) in the Roman Iron Age the principal and most numerous grave type was the typical *tarand* grave – quadrangular stone closures attached to each other in an east–west row, which are mostly filled with stones; the cremated remains of the dead and the grave goods are located between and beneath the stones (see Lang 2007, 191 ff.). Most typical *tarand* graves contain only Roman Iron Age artefacts, thus the common understanding is that they were abandoned in the mid-5th century. Of the approximately 150 graves dated to the Late Roman Iron Age, only about 30 also involve finds dated to the Migration Period (Tvauri 2012, 254). An alternative understanding is that burial in the existing *tarand* graves continued for a longer period without any grave goods, but the establishment of new graves and *tarands* ended around the year 450 (Ligi 1995, 227). Thus, one cannot exclude the possibility that burial into the *tarand* graves continued throughout the Migration Period.

Beginning with the Migration Period, two new grave types appear in the Estonian archaeological record: cairn graves and stone grave-fields. Cairn graves are distinct and rather small stone piles which clearly rise higher from the surrounding ground; the boundaries of stone grave-fields are not as distinct, they are diffuse, sometimes patchy, and generally cover larger areas. Their burials are similar: remains of cremated bodies along with grave goods are scattered beneath and between the stones in both cairn graves and stone grave-fields.

The 6th century also witnessed changes in grave types in Finland. Cairn graves, Kärsämäki-type graves of Scandinavian origin with underground cremation burials, and Estonian-style *tarand* graves were replaced by stone gravefields similar to those in Estonia. Stone gravefields are distributed in south-western Finland, in the Tavastia region, and to a lesser extent in southern Ostrobothnia. As a completely new phenomenon, inhumations with inclusions appeared in the second half of the 6th century in south-western Finland in Eura and in Köyliö. In other regions of Finland cremation burials prevailed. The practise of inhumation itself was not unknown in Finland before, but burying the dead in clothes and with ornaments and weapons was novel (Salo 2012b, 215). It is assumed to be a Christian burial custom that Finnish warriors brought along from central Europe (Salo 2012a, 98). The fact that the influence reached Finland straight from central Europe is remarkable; no counterparts in the 6th–7th century Estonia or eastern Sweden have been discovered.

Tõnno Jonuks, who has studied Estonian prehistoric religion, emphasizes that during the Middle Iron Age significant changes in the religion appeared. The Migration Period witnessed the beginning of a transition to a more personified concept of soul, and, thus, the world view that had been focused on ancestors was gradually replaced with a new world view, which reached its apex in the Final Iron Age (Jonuks 2009, 242, 261 ff.). According to Jonuks, this change in the religious world view is manifested in the Estonian archaeological record by the emergence of new grave types, the end of rituals conducted with bones of the dead, the spread of inhumation burials, an increased frequency in placing cremated bones as clusters instead of scattering, and the emergence of grave hoards. He also argues that the emergence in the Migration Period of grave goods that cannot be regarded as cloth fittings or personal jewellery or grooming tools, i.e. mainly weapons and tools, are manifestations of the individual and more personified concept of soul and the altered concepts of the afterlife. Jonuks claims that the new concept of the afterlife, which started to spread in the 5th–6th centuries, focused on the souls of the nobility and their proper social position in the next world. The idea of the afterlife world may have been influenced by the conception of paradise in Christianity and the conception of Valhalla in the Germanic pre-Christian religion. One might believe that their view of the afterlife entailed revelry, fighting, and hunting, and for this reason, objects for those ends were needed there (Jonuks 2009, 262, 313). Unto Salo has also stated, drawing on the change in burial customs in Finland during the Merovingian Period (AD 550–800), that the world view of people changed entirely (Salo 2012b, 214).

Watershed moment between the Early and Late Iron Ages

Klavs Randsborg has noted that 536 and the following years are close to the important borderline in the archaeological chronology of northern Europe between the Migration Period and the following period that in many countries is called the Vendel Era (Randsborg 1997, 198). The end of the Migration Period is usually dated to the year 550 and in Scandinavian archaeological chronology this date divides the Iron Age into the Early and Late Iron Age. As archaeological chronologies are based on the changes in material culture, one can say without entering into further detail that in northern Europe a significant shift in material culture took place in the 6th century.

I already described above how the symbolism of the jewellery changed. Another important development was the shift in the style of Scandinavian animal ornamentation from Salin's Style I to Salin's Style II around the middle of the 6th century. This new style was undoubtedly a matter of new creation rather than gradual evolution (Høilund Nielsen 1998, 9).

When observing the change in material culture of Estonia in the 6th century one notices at a glance that artefacts of the Migration Period on the one hand, and Pre-Viking Age and Viking Age artefacts on the other, form two clearly different groups. There is a gap between those two groups, as hardly any finds date to the second half of the 6th century. I have managed to identify only two artefacts from that period: two bronze tongue-shaped cast belt ends – one from the Käbiküla burial site in southern Harjumaa (Tvauri 2012, fig. 138: 4) and the other from the Nurmsi *tarand* grave in Järvamaa (Vassar 1943, fig. 23: 4). Counterparts of those belt ends from Öland are dated to the second half of the 6th century (Nerman 1929, 36; 1969, Nos 232–261).

When the Estonian archaeological find material is visible again in the 7th century, a shift has occurred in jewellery fashion. For example, bow fibulae, which were very popular up to then (especially crossbow fibulae with simple cast catch-plates and crossbow fibulae with star-shaped and spade-shaped feet), went almost entirely out of use. The brooch type that replaced it during Pre-Viking Age was the penannular brooch. Small dress pins were replaced by large ones. The changes in the symbolism of jewellery, where solar symbols were replaced by Eastern Christian iconography, is described above. The shift in the jewellery fashion was the greatest after the 2nd–3rd century when Roman style jewellery was first introduced. The next abrupt change in jewellery fashion in Estonia did not take place until the 13th century.

Changes in exchange networks of inhabitants of the Finnish coastal area

As mentioned above, there is no decrease of the number of burials in the 6th century southern Finland, nevertheless a sudden and profound change in material culture took place also there (Lehtosalo-Hilander 1984, 285). The Finnish Merovingian period (550–800) has been characterized, drawing upon archaeological findings, by an outbreak and blossoming of local culture during which former artefacts of Scandinavian and Baltic example are replaced by highly unique weapons and jewellery with no counterparts in neighbouring areas (cf. Salmo 1938; Salo 2012a, 96).

During the Merovingian period, for the first time after the Stone Age, types of artefacts described as *Finnish type* or just *Finnish* enter the archaeological scene (e.g. Huurre 1979, 198; Lehtosalo-Hilander 1984, 286). Finnish type jewellery consists of small equal-armed brooches (Kivikoski 1973, Nos 399–402), snake brooches (Kivikoski 1973, Nos 403–405), crayfish fibulae (Kivikoski 1973, No. 396 ff.), penannular brooches with a flat triangular ring and rolled terminals (Kivikoski 1973, No. 434), concavo-convex bracelets with flaring terminals (Kivikoski 1973, No. 453), and ring-headed dress pins with a cross-shaped extensions below the head (Kivikoski 1973, No. 446). Finnish type weaponry includes seaxes with a broad blade, a straight back, and a curved edge (Salmo 1938, 139 ff.; Kivikoski 1973, Nos 526, 527); angons with a barbed blade, an extended neck, and a stepwise tang (Kivikoski 1973, Nos 549, 550); tanged long-bladed spearheads (Kivikoski 1973, No. 854; Lehtosalo-Hilander 1982, 30 f.); dagger-shaped spearheads (Kivikoski 1973, No. 555); and the so-called Finnish shield bosses (Kivikoski 1973, No. 530). Such weapons were not used in Scandinavia or Estonia; their exact counterparts are known from central European Germanic areas (see Salmo 1938, 211 f., 218 ff.; Cleve 1943, 132; Huurre 1979, 199 f.; Lehtosalo-Hilander 1982, 39; 1984, 314). Dagger-shaped spearheads, which were widely used in Finland, have no counterparts anywhere (see Salmo 1938, 231 ff.).

Numerous finds of Nevolino-type belts and belt mounts in the graves of the Merovingian period are evidence of connections with territories far east of Finland (Kivikoski 1973, Nos 583–597). Such belts were worn by women from the Kama (branch of Volga) River basin in the 7th–9th centuries (Gening 1979; Goldina & Vodolago 1990, 80 f., tab. XXIX, LXVIII). A complete Nevolino belt has been found in the warrior's grave of the second half of the 7th century in Eura Pappilanmäki in south-western Finland (Salmo 1941, fig. 16). Weapons from the same grave indicate that it belonged to a man, thus it has been assumed that Nevolino-type belts did not reach Finland directly but through mediators (Meinander 1973, 150). In addition, penannular brooches with a flat triangular ring and flat round brooches reached Finland from the Kama River basin during the Merovingian period (Meinander 1973). Finno-Ugrian people living in the Kama River basin brought wilderness goods from north-eastern Europe to the south, forming a distinctive Permic culture area in the course of their economic activity. It is very likely that Finnish furs were brought to the Orient by Permic fur traders.

At the beginning of the Merovingian period, new jewellery types entered into use in Finland such as round Permian brooches (Kivikoski 1973, Nos 425–430), chain-holders (Kivikoski 1973, Nos 469, 472), and pendants (Kivikoski 1973, Nos 480, 482, 485) with examples in the Eastern Roman Empire. They represent Eastern Christian symbols (e.g. cross, Christogram, two pigeons, anchor). These influences reached Finland through the territory of modern Ukraine (see Salo 2012a; 2012b).

Irrespective of whether the central European weapons, jewellery with eastern Roman examples, and ornaments from the Kama River basin reached Merovingian era Finland by the agency of trade or mercenaries, they reflect greater foreign contact than in the previous period. In order to understand what caused this change one has to consider the economy of Finnish inhabitants at the time. The main means of livelihood were hunting, fishing, and trading wilderness goods in southern markets. Land cultivation, namely slash and burn cultivation, was of marginal importance. Settlements were concentrated around the river mouths in the coastal area where it was easy to travel to inland wilderness areas by rivers and also access the sea. Some settlements in the Roman Iron Age in Finnish coastal areas were found with a material culture that significantly resembled that of Scandinavia or Estonia. Based on this fact it has been assumed that Finnish coastal areas traded extensively with inhabitants of eastern Sweden and of Estonian coastal areas. It is also commonly believed that some proportion of the inhabitants of river mouth settlements in Finland were migrants from Scandinavian or Estonian areas (Huurre 1979, 159; Salo 1984, 223, 246). Naturally, one cannot talk of trade in its contemporary meaning; goods were not delivered to the market but exchanged within kin networks. This explains how burial customs from Sweden (Kärsämäki-type burial grounds) and from Estonia (*tarand* graves) could have spread to the Finnish coastal area. It is possible that trade inhered in taking the wilderness goods acquired from inland to the coastal areas of eastern Sweden and Estonia where Finnish middlemen received grain, weapons, and jewellery in return. Vironians took Finnish goods to the territories of Baltic peoples, for example to the south-eastern shore of the Baltic Sea.

The famine of 536–537 might have broken this trade network, because the Svear and Vironians had either died of starvation or they simply had no grain or beer to offer in exchange for furs. It is impossible to specify how the Finnish fur traders managed to trade their goods, but it seems that after misfortune had struck their middlemen, they had to find new markets. Whether the inhabitants of Finnish coastal areas travelled with their goods to the southern shore of the Baltic Sea or Germanic traders arrived themselves is irrelevant. What is relevant is the fact that the ancestors of Finns developed first-hand contacts with the territories of modern northern Germany, and new but probably indirect trade bonds with territories of modern Ukraine and Permic area.

When former trade networks of Finnish inhabitants with their closest overseas neighbours were interrupted, the importation of grain ceased. Even if some grain was thereafter imported from further south, the amount was probably insufficient because the long distance would have made import impractical. This could explain why land cultivation spread in Finland particularly during the Merovingian period.

Contacts between Finland and north Estonian coastal area did not end completely, but for the time being, "Finns" had become "independent", i.e. they did not need Vironians for middlemen. Archaeological finds indicate that the active party in the area of the Gulf of Finland by the Pre-Viking Age or the Merovingian Period were namely the ancestors of Finns, not Estonians. For example, finds of Nevolino-type belts are distributed only in Finnish coastal settlements throughout the entire Baltic Sea region except for a few belt mounts discovered in north Estonian Pre-Viking Age burial grounds (see Tvauri 2012, 171, fig. 142); thus, it is plausible that they originate from Finland. In the 7th century jewellery of Finnish type and most likely Finnish origin appears in the cemeteries of northern and western Estonia, namely concavo-convex bracelets with flaring terminals, ring-headed dress pins with cross-shaped extensions below the head, penannular brooches with flat triangular ring and rolled terminals, and crayfish fibulae (see Tvauri 2012, figs 93: 3, 97: 1, 100: 3, 128: 1). Finds of bronze pins with a chain of pendants also indicate ties between Estonian coastal areas and Finland. The main distribution area of those pins, and pendants worn with the pins, was south-western Finland. The most impressive exemplar of this pin type has been found in Püssi, Virumaa as a stray find (see Tvauri 2012, fig. 101). Pendants attached to the pin can be considered a reflection of the earliest Eastern Christian influence, reaching Finland and Estonia in the 7th century. Among them are shapes of the cross, the Greek letter Ω, anchors, and the Christogram (see Salo 2012b, figs 77, 82). In addition to jewellery of Finnish origin, a couple of Finnish angons (Tvauri 2012, 192, fig. 161) and one seaxe (Tvauri 2012, 187, fig. 155: 3) are known from the Pre-Viking age in Harjumaa. The fact that "Finnish" artefacts are numerous in Estonia in the 7th century and no "Estonian" artefacts dating to the same period are known from Finland indicate that it was the Finnish ancestors who had foreign contacts and did the trading.

The significance of the climate anomaly of 536–537 for rye cultivation

Rye (*Secale cereale*) was common in all of Europe by the beginning of the Christian era, but it grew as a weed in barley and wheat fields. As grain cultivation moved north, the importance of rye as the most frost-resistant cultivated grass increased until the point where it began to be cultivated as a separate crop (Barker 1985, 46; Behre 1992; Lempiäinen 2005, 110).

The results of palynological research show that almost throughout Estonia, rye came to be cultivated as a separate crop in about the 6th century AD (Poska et al. 2004, 47), and in north-western Estonia perhaps even earlier – in the Roman Iron Age (Veski & Lang 1996; Heinsalu & Veski 2010, 87, fig. 4). In the pollen spectrum of Lake Ala-Pika in the northern part of the Otepää Uplands, rye appeared more or less permanently in about AD 600 (Laul & Kihno 1999, 12). In the Haanja Uplands, the extensive retreating of forests and the spread of rye cultivation similarly began in about the middle of the first millennium: in the surroundings of Lake Külajärv at Plaani in about AD 500, and around Lake Verijärv in AD 700 (Niinemets 2008, 66). In Scania too, for instance, in the 8th century, the proportion of rye began to increase rapidly at the expense of barley (Pedersen & Widgren 2004, 383).

It is possible that the spread of rye cultivation was accelerated by the climatic catastrophe of AD 536–537, as the latter may have caused both barley and wheat crops in fields to fail, while rye, as a less demanding cereal, at least produced seed grain. It may have been as a result of this that pure rye seed was first obtained over an extensive area. This hypothesis, however, needs further analysis in cooperation with natural scientists.

Conclusions

Archaeological and palynological data reveal that the event of 536–537 caused crop failure in what is today Estonia. This brought about famine severe enough to cause a demographic catastrophe. It took the entire Pre-Viking Age and the first half of the Viking Age until at least the end of the 9th century to return to the previous population level.

The decrease in human impact as a result of lower population levels is evident in several pollen diagrams. In contrast to the numerous Roman Iron Age sites and artefact finds, and relatively numerous sites and finds from the Migration Period, the Pre-Viking Age is almost findless, especially in its first half. At the same time, a number of votive hoards are deposited in around the 6th century, which could be explained as sacrifices brought about by extremely unfavourable weather conditions.

The crisis of the 6th century was not just another famine with a more catastrophic extent. As a result of this crisis, previous power relations, trade networks, and handicraft traditions were disrupted, settlement structures transformed, and the entire world view of people changed.

In the middle of the 6th century a change occurred in the material culture in Estonia as well as in Scandinavia and Finland. New jewellery types were adopted, and the symbols decorating jewellery changed. One can assume that the handicraft tradition was disrupted due to the massive and sudden death of craftsmen. New craftsmen in the Pre-Viking Age were not apprentices of former masters.

In the middle of the first millennium significant changes in burial customs took place across northern Europe that reflected a transformation in the entire world view. In Estonia those changes started to appear already in the Migration Period, when weapons and riding equipment emerge in burials as grave goods. The hardship people experienced during the 6th century crisis might have accelerated and affirmed the change already in progress.

In Finland, where hunting and fishing were the main livelihoods and thus land cultivation was of marginal importance, the climate catastrophe does not show in the archaeological record as a decrease of archaeological finds as it does in Estonia or eastern Sweden. One can, though, observe disruptions of the previous trade networks due to the events of 536–537 and the formation of new ones. These changes had an important role in forming both the unique Finnish Merovingian material culture and in expanding land cultivation in the area of southern Finland during next few hundred years.

The extraordinary climate catastrophe may have influenced the development of agriculture in Estonia. The cooler climate may have caused barley crops in fields to fail, while rye, as a less demanding cereal, still produced seed grain. The predominance of rye cultivation in Estonia in the second half of the first millennium was probably a result of the climate anomaly of 536–537.

The impact of the catastrophe of 536 was so substantial that it could be considered an important threshold in the Estonian archaeological chronology. It is then that the greatest cultural upheaval since the major changes between the Early and Late Bronze Age are visible. Because the present dating methods enable Estonian Iron Age sites and artefact finds to be dated within a quarter of a century, it would be appropriate to set the border date between the Migration Period and Pre-Viking Age approximately to the year 550. Another advantage of this date is that it allows the Estonian Iron Age periodization to be synchronized to those used in Scandinavian countries and Finland.

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Andres Tvauri

536.–537. AASTA KLIIMAKATASTROOFI MÕJU EESTIS JA NAABERALADEL

Resümee

536.–541. aastal toimus põhjapoolkeral lühiajaline ja järsk kliima jahenemine. Vahemeremaade kirjalikes allikates on juttu tolmuloorist, mis varjutas 536.–537. aastal päikese enam kui aastaks. Loodusteadlased pole selle ilmastikunähtuse põhjuses veel üksmeelele jõudnud. Samas on selge, et see on puude aastarõngakogumite põhjal otsustades olnud viimase 2000 aasta jooksul kõige hullem looduskeskkonda tabanud globaalne vapustus.

Arheoloogilisest ja palünoloogilisest allikmaterjalist nähtub, et 536.–541. aasta sündmused põhjustasid viljaikalduse ka Eesti alal. Sellest vallandus hirmus näljahäda, mis põhjustas rahvastikukatastroofi, millest taastumiseks ja endise rahva-

arvuni jõudmiseks kulus tõenäoliselt kogu eelviikingiaeg ning viikingiaja varasem pool vähemalt kuni 9. sajandi lõpuni. Mitmes õietolmudiagrammis on näha oluline inimmõju vähenemine loodusele vaadeldaval perioodil. Rooma rauaaja ja rahvasterännuaja suhteliselt arvukate kinnismuististe ning esemeleidude kõrval on eelviikingiaeg, eelkõige selle esimene pool, peaaegu leiutühi. Samaaegselt on jälgitav rituaalsete peitleidude kuhjumine just 6. sajandisse, mida võib seletada erakordselt ebasoodsa ilmastiku põhjustatud ohvriandidena.

6. sajandi kriis ei olnud lihtsalt järjekordne (kuigi katastroofilisemate mõõtmetega) näljahäda. Selle tagajärjel katkesid senised võimu- ja vahetussuhted ning käsitöötraditsioonid, muutus asustusmuster ja teisenes inimeste maailmapilt. 6. sajandi keskpaiku toimus muutus ainelises kultuuris, seda nii Eestis kui ka Skandinaavia maades ja Soomes. Võeti kasutusele uued ehtetüübid, muutus ka ehete ornament. Võib arvata, et käsitöömeistrite äkilise ja massilise surma tõttu katkes manuaalne traditsioon: uued, eelviikingiajal peale kasvanud käsitöölised ei olnud rahvasterännuaegsete meistrite õpilased. I aastatuhande keskpaigas toimus kogu Põhja-Euroopas matmiskommetes nii suur muutus, et seda on peetud maailmavaate muutuseks. See hakkas ilmnema Eestis relvade ja hobuseriistade surnutele kaasapanemise kujul juba rahvasterännuajal. 6. sajandi ilmastikukatastroofi käigus kogetu võis juba toimuvaid muutusi kiirendada ja kinnistada. Erakordsel kliimakatastroofil võis olla oluline mõju ka põllumajanduse arengule. Võimalik, et 536. aastal alanud ikalduse mõjul hävis Eesti alal tollal peamise teraviljana kasvatatud odra saak, kuid rukis vähenõudlikuma liigina andis seemet. Seega võib oletada, et rukis sai Eesti alal I aastatuhande teisel poolel 536.–541. aasta kliimaanomaalia tagajärjel peamiseks kultuurkõrreliseks.

Soome alal, kus maaharimisel oli küttimise ja kalastuse kõrval vähene osakaal, ei avaldunud kliimakatastroof arheoloogiliste leidude vähenemisena, nagu seda võib märgata näiteks Eestis ning Ida-Rootsis. Küll aga on Soome rannikul 536.–541. aasta sündmuste tagajärjel nähtav seniste kaubanduskontaktide katkemine ja uute kujunemine. Sellel oli Lõuna-Soome aladel järgnevatel aastasadadel suur mõju nii Soome omanäolise Merovingide-aegse ainelise kultuuri kujunemisel kui ka põllumajanduse ekspansioonis.

Vaadeldava kliimakatastroofi mõju oli sedavõrd suur, et seda võib pidada Eesti muinasaja periodiseeringu oluliseks piirdaatumiks. Tegemist oli suurima kultuurilise murranguga siinsetel aladel pärast vanema ja noorema pronksiaja piiril toimunud muutusi. Kuna olemasolevad dateerimismeetodid ei võimalda Eesti rauaaja muistiseid ja esemeleide reeglina dateerida täpsemalt kui umbes veerandsajandi täpsusega, võiks eelnevast lähtudes pidada vanema ning noorema rauaaja (ühtlasi rahvasterännu- ja eelviikingiaja) piirdaatumiks Eestis umbes 550. aastat. See oleks sobilik ühtlasi seeteõttu, et nii muutuks ka Eesti rauaaja periodiseering sünkroonseks Skandinaavia maades ja Soomes kasutatavaga.