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ECHOES OF ANCIENT CATACLYSMS IN THE BALTIC SEA

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The observation that human societies are shaped by the natural environment appears in the earliest treatises on cultural diversity. Scholars have focused their attention on the ordinary conditions of the environment (weather patterns, topography, natural resources, and other enduring features) or on recurrent events in an area (earthquakes, floods, droughts, etc.), when trying to account for local inhabitants' distinctive customs and beliefs. Yet recent investigations of ancient cataclysms suggest that truly extraordinary events can also have a great and lasting impact.

For example, the recent underwater exploration of the Black Sea by Robert Ballard (2001), featured in *National Geographic* magazine, confirmed the findings of the geologists William Ryan and Walter Pitman in *Noah's Flood* (1998), pointing to a catastrophic flood circa 5600 BC. Salt water from the Mediterranean Sea broke through the Bosporus into what is now the Black Sea but was once a glacial freshwater lake about 150 meters below present sea level. The sudden inundation of human settlements along the old shoreline is a plausible source of accounts of a world flood: in the Sumerian epic of Gilgamesh, the Bible, and other ancient writings.

Another example involves the massive volcanic explosion, described by David Keys in *Catastrophe* (1999) that apparently split the Indonesian islands of Sumatra and Java around 535 A.D. It spewed enough volcanic dust into the atmosphere to darken the sun for a year or more. This led to drastic weather shifts, crop failures, plague outbreaks, the collapse of old civilizations, and the rise of new ones around the globe.

What separates these studies from mere ruminations is the hard scientific evidence for the cataclysms. In the first case, there is an underwater beachline in the Black Sea, below which the remains of freshwater mollusks and sediments have been found, with a radiocarbon date of 7,500 years ago. In the second case, ice core samples from both Greenland and Antarctica show unusual amounts of

sulfuric acid in the annual snow layers that fell some 1,500 years ago, and dendrochronological analyses show a drastic reduction in tree growth around the globe at the same time.

Has anything of the kind happened in the Baltic Sea area? If so, there is an opportunity to study how a scientifically verifiable cataclysm could affect the folklore and history of an area, for many generations. The Finnic and Baltic peoples, in particular, are noted for their extensive collections of folk songs and tales, compiled mostly in the 1800's – a product of their deep reverence for the oral traditions of their ancestors and their recent and wholehearted conversion to literacy. These peoples are also noted for their tenacious commitment to their homelands. Compared to most other parts of the world, the population of this area has been relatively stable for millennia. Archeological, linguistic, and genetic evidence all point to continuous occupation of the shores of the Baltic Sea since the end of the Ice Age (Uibopuu 1984: 77–78; Vahtre 1992: 8; Mark & Heapost & Sarap 1994: 241–53; Kriiska 1997; Künnap 1997, 2000; Wiik 1997; Heapost 2000; Villems 2000). Even when major shifts took place, as with the arrival of agricultural and metalworking Indo-Europeans, the process of change seems to have been rather gradual, with no wholesale displacement of the earlier inhabitants by the arriving settlers. The proto-Finnic aboriginal population intermingled with the arriving proto-Balts, which meant that lore about ancient cataclysms could have been preserved through the acculturation process.

One type of cataclysm that can be proven in the Baltic Sea area is the sudden drainage of periglacial lakes at the end of the last Ice Age. As pointed out by Ryan and Pitman (1998), Baker (2002), and Colman (2002), the retreat of glaciers leads to the trapping of the melting fresh water in huge lakes, which get new drainage channels as the glacial retreat continues. These channels enlarge rapidly due to erosion, which can lead to the sudden release of large volumes of fresh water into the ocean, affecting the circulation of currents and even the global climate.

The Baltic Sea experienced two such major drainage events. The first was the draining of the Baltic Glacial Lake across south-central Sweden (through the Mälaren Valley) in 8213 BC, leading to the sudden lowering of the water level by 25–30 meters. Such pre-

cise dating was made possible by counting clay-sediment layers, and confirmed by radiocarbon dating of the freshwater and saltwater strata. Then the connection with the ocean was gradually cut off again due to isostatic rebound after Scandinavia was freed from the weight of the glaciers. Thus, a new freshwater glacial drainage lake was born, around 7300 BC. Some centuries later, about 6500 BC, this elevated Ancylus Lake broke through to the ocean across the straits of Denmark. Again, there was a significant lowering of the water level, this time by almost 20 meters (Kessel & Punning 1995).

In his books *Hõbevalge* (1976) and *Hõbevalgem* (1984), Lennart Meri (the scholar, anthropological filmmaker, and diplomat who became Estonia's first post-Soviet president) notes that another, literally earth-shattering, cataclysm took place in the area, when a meteorite broke apart in the atmosphere and the pieces smashed into the Estonian island of Saaremaa to form the crater of Kaali and several smaller ones. He presents an intriguing argument that this had a major impact on Estonian-Finnish mythology, folklore, involvement in iron-making and trade, etc. The date he reports for this event, 600–700 B.C., was based on radiocarbon dating of charred wood from the craters.

Some subsequent research suggests that this wood may have been deposited later, after a much earlier formation of the crater around 2000 B.C. or even 5500 B.C. Both of these datings are based on radiocarbon testing – of the lowest layer of organic sediment at the bottom of Kaali Crater and of the lowest bog deposit layer holding meteoric debris in the nearby landscape, respectively (Tiirmaa 1994; Raukas 1995). We think the date of 2000 BC is more plausible, for it is harder to account for the absence of an organic layer during the long period from 5500 BC to 2000 BC than it is to accept the possibility that subsurface water flow led to the percolation of the minute meteorite fragments into lower strata. The earlier date is also problematic because the site was under water until about 3000 BC and the crater has never yielded any marine organic matter (Tiirmaa 1994: 46–47). In any case, there is strong scientific evidence that a meteorite did hit Saaremaa during the ancient times, when the area was occupied by humans.

More recent analyses tend to support the original date of 600 B.C. relayed by Meri. Confirming the findings of a 2000 study by Rasmussen et al., Veski (2002) reports that unusually high levels of iridium (widely accepted as a marker of a meteorite impact) have been found in a bog 6 km from the Kaali crater, in association with mineral particles, charcoal, and major shifts in pollen types—which can plausibly be interpreted as signs of impact ejecta, conflagration, and disruption of vegetation, respectively. The peat layers containing these traces have been radiocarbon-dated to 800-400 B.C. How the older organic matter reported by Tiirmaa could have ended up inside Kaali crater is still a mystery, since the groundwater that filtered into the pit seems unlikely to have transported more than minute particles of more ancient sediments. In addition, Lõugas (1996:146) finds it hard to believe that such a thick layer (6 meters) of sediment (mud, fallen trees/leaves, peat) could have formed in the bottom of the crater only since the 7th century B.C. While we await further studies to clear up such lingering puzzles with regard to the dating of the event, it is at least safe to say that a meteorite did hit Saaremaa during an ancient time, when the area was occupied by humans.

In this paper, we consider how these cataclysms might have affected the human observers of the time, and we look for possible references to such events in the cultural heritage of the peoples living around the Baltic Sea today. For any apparent echoes we identify, we also consider alternative explanations, such as pure coincidence, other disasters of a less unusual type, and diffusion of fantastic tales from other regions. We also consider how explanations for a unique event could evolve into more general themes for folk tales or songs, and eventually into reinforcements of ancestor reverence and conventional morality.

CREATION-MYTHS IN THE PERIGLACIAL ENVIRONMENT

At the time of the sudden drainage of the Baltic Glacial Lake (10,200 years ago), the Baltic Sea was in a barren Arctic tundra environment, but by the time of the draining of Ancylus Lake (8,500 years ago), there was a more hospitable Boreal climate, with pine forests and hazel coppices predominating (Kessel & Punning 1995: 224–

226). Archeological finds indicate that there was human habitation in the area throughout this period. The inhabitants camped along the coast and made expeditions out to the few islands that protruded above the high water level at that time (portions of Hiiumaa, Saaremaa, and the current mainland), where they fished and hunted seals and waterfowl (Selirand & Tõnisson 1984: 14–21; Kriiska 1998).

Even if the drop in the water level took some years (about 20 in the case of the Ancylus drainage, according to Kessel & Punning 1995: 226), the human observers in the area would have seen an amazing transformation. The shoreline would have advanced perceptibly, the islands would have grown in size, new sand bars and reefs would have appeared at the surface of the water, and beds of underwater plants would have become permanently exposed. Because the exposed areas were soaked with fresh water, not salt, they would have become habitable for plants, animals, and people in a relatively short time. From the perspective of the eastern side of the Baltic Sea, where the channel of outflow would not have been visible, it would have been understandable for people to think that the land was rising rather than that the water was draining away.

There are folk songs and poems among the Baltic Finns that seem to allude to such an event. There is a folk song from western Estonia (Tedre & Tormis 1999: 47), which recounts various ways in which the sea shore and bottom can turn into productive land:

Ma laulan mere maaksi,	I sing the sea into land,
mere kaldad karjamaaksi,	The sea's shores into grazing land,
mere ääred heinamaaksi,	The sea's edges into a hay meadow,
mere põhja põllumaaksi,	The sea's bottom into a planting field,
mere kivid killingiksi!	The sea's stones into shillings!

(Translated by A. Haas)

As the point is to illustrate the power of song, it is possible that the original narrator simply imagined an amazing feat, without knowledge that such a transformation had actually happened. Yet the description is quite realistic, devoid of fantastic embellishments, and it comes from the region where the water level has the greatest impact on the extent of the shoreline. In northern Estonia, much of the shore is a high cliff; a change in the water level would change

the height of the cliff but not yield as much of an increase in land area as in western Estonia.

There is a similar song from Northern Estonia (Rüütel 1997: 192), but it turns the process around so that land becomes sea.

Nüüd laulan mered murusta,	Now I'll sing the sea into grass,
merekalda'ad kalaksi,	The seashore into fish,
mereliiva linnastesta,	The sea sand into malt,
merepõhja põllumaaksa.	The sea bottom into a field.

(Translated by A. Haas)

Yet it is interesting that even here, the process ends with the sea turning into land again. It is unlikely that this song was inspired by the filling of the ancient Baltic Glacial Lake or Ancylus Lake, which would have been too slow to be noticed during a human lifespan. Of course, if people had once observed land emerging from water, then the opposite could also be conceived. A singer many generations removed from the original event, and at some distance inland, could easily transpose things, if the point was to illustrate the power of song rather than to preserve the news of a seemingly fantastic event long ago.

In the opening rune of the Finnish-Karelian epic *Kalevala*, which Elias Lönnrot compiled on the basis of traditional songs, the world is created when a tireless swimmer (Väinämöinen in the original version, his mother Ilmatar in the revised version of the epic), drifting in the sea, raises a knee – whose round shape would resemble an emerging sandbar or wave-battered skerry – and thus provides a nesting place for a bird (a goose, eagle, scaup or redheaded duck in various versions). When the heat from the hatching eggs causes the swimmer to stir, the eggs tumble out of the nest, crack open, and turn into the earth and heavens (Pentikäinen 1989: 131–139; Honko *et al*. 1994: 96–97). A similar creation-myth is found among the Estonians and Ingrians as well, but without superhuman or divine characters. This has been taken as evidence that these more naturalistic versions are the closest to the original form of the myth (Honko *et al.* 1994: 83). An Ingrian song has a swallow nesting on a ship, which then wrecks into the black mud and sand of the sea, from which an island arises (Pentikäinen 1989: 139–140).

An Estonian creation-song has a bird flying over "the world's great lake" and rejecting a blue bush and red bush, before deciding to nest on a yellow bush. The chicks hatch and turn into a berry, a field stone, the moon, and the sun. These in turn develop into ground for berry-picking (symbolizing food gathering), a place for beer brewing (symbolizing agriculture; heated stones are used for the wort), and the heavenly bodies by which time is reckoned (Honko *et al.* 1994: 83-84, 95). The reference to the world's great lake (Estonian *ilma suur järv*), not sea, implies a huge body of fresh water, which fits with a periglacial lake. The bird nesting in the yellow bush may allude to a tiny exposed island covered with yellowish sand and/or dried aquatic plants. The more literal explanation of a bush with yellow leaves is unlikely because that would have the bird nesting in autumn, which has not been known to occur in northern Europe. Moreover, spring is the most likely season for a meltwater lake's level to overtop its potential outlet, because of the additional melting of snow from the preceding winter. The rejected blue and red bushes may be metaphors for the water at midday and at sunrise or sunset, or they may represent different colors of underwater plants that have suddenly risen above the water. On the other hand, the choice of these colors may just be a poetic convention, for the blue-red-yellow combination appears in many folk poems that have no apparent connection to the drainage of a lake (Jaago 1997: 64–67).

The myth about the creation of the world from an egg is known over a very wide area extending from the Mediterranean to India, Japan, Polynesia and Peru (Honko *et al.* 1994: 83). This is not surprising, as humans everywhere know that an egg can turn into something bigger and thus serves as an apt symbol of birth and development. Even the connection of the egg to an initially water-covered world is not unknown in a southern land like India (Pentikäinen 1989: 141–142). For coastal peoples, an open expanse of water can symbolize the emptiness that preceded the creation of the world; for an inland people like the Mordvins, a Volga Finnic group in the Russian interior, the primordial emptiness is easier to visualise as a barren landscape (see the creation-myth in Honko *et al*. 1994: 84, 97). Yet the Baltic Finnic creation myths present unusually vivid descriptions of the process by which the water turns to land, with many details that coincide with the actual process of draining periglacial lakes. The same principal character (a bird)

occurs in the "earth diver" myth common in the Arctic (Honko *et al*.1994: 83), among the Ob-Ugrians of the Boreal zone (Lintrop 1997: 20–22), and among the Native Americans whose ancestors passed through a periglacial environment. Such myths about a bird that builds up a land form with mud from the bottom of the sea are likewise relatively naturalistic accounts that fit the images that ancient eyewitnesses would have seen when periglacial lakes in Eurasia and North America suddenly drained.

The most plausible alternative explanation for such creation-myths would be isostatic rebound, the gradual rising of the land that continues long after a glacier has melted. As a result of historical maps and documents, today's residents along the Baltic shore are aware that the land is gradually rising. Old seaside castles and towers in Tallinn and Kuressaare, for example, are now at quite a distance from the shore. But the rate at which the land is rising is so slow (2 mm a year, according to Tiirmaa 1995: 21) that it would be difficult to notice without written records going back centuries. In ancient times, preliterate people with sharp minds, long memories, and old relatives might have been able to discern a slight, gradual rise in the land along the shore, but it would not be any more amazing than the movement of sand dunes pushed by the wind – not the kind of attention-grabbing event that would inspire composition of songs and stories.

THE CRASH OF THE SUN

The Kaali meteorite crash is the kind of unique and astounding event that must have become a topic of storytelling and singing for many generations afterward. As mentioned above, it evidently occurred around 2000 BC, on Saaremaa Island in the Baltic Sea. As recent scientific studies have established (Tiirmaa 1994), a meteorite of iron streaked from east to west over the Estonian mainland, broke apart as a result of atmospheric friction, and hit the island in at least 9 places, leaving craters that can be seen to this day. Tiirmaa (1994: 63) likens the event to a small nuclear explosion (minus radioactivity). The calculations reported in Tiirmaa and our own estimate, based on the size of the crater and the hardness of the dolomite crust, lead to the conclusion that the amount of energy needed to form the main crater was equivalent to 1-4 kilotons (1–4 million

kg or 2–8 million pounds) of TNT explosive. The largest fragment hit the ground and exploded with enough energy to create a crater 110 m in diameter, 22 m deep, with a rim 4–7 m above the ground. Near the rim are the tips of dolomite blocks that were thrust upward, and the dolomite layer under the crater was crumbled to a depth of 10 m and severely fractured up to 50 m deep. Ground water flowed into the bottom of the crater, to make a round lake (now varying seasonally from 30 to 60 m across, but the lake must have been larger in ancient times, before the land rose to its present level).

It is hard to imagine what went on in the minds of the humans who saw flaming chunks of the sky fall to earth, heard the sonic boom of the streaking fragments and the ear-splitting crash, felt the ground shudder beneath their feet, and were engulfed by a great cloud of dust and ash. Trees, animals, and dwellings within a radius of 2–5 km from the site would have been destroyed, a forest fire would have been ignited, and the survivors would have had to run for their lives to avoid asphyxiation from the vaporized and pulverized matter and gases. This may have been the greatest meteorite impact ever in a populated area. It was truly a fearsome and spectacular event, more than enough to alter existing world-views and to inspire new tales and songs.

The long-tailed fireball would have been brighter than the sun, visible not just on Saaremaa but as far as 700 km (450 miles) away (Meri 1984: 55; Tiirmaa 1994: 65). Included in the area of direct observability are much of southern Finland and Karelia, the Novgorod area of Russia, the Polish coast, and lower Sweden. To the witnesses in this vast area, it would have appeared that a heavenly body, perhaps the sun, was chased through the sky by something long and fiery and was annihilated. If the event occurred at night, there would have been no sun in the sky at the moment of impact to contradict this interpretation.

There is an Estonian chant to encourage the sun to come out from its stone cellar (Tedre 1971 III: 1016; Vissel 1995: 125). It is also noteworthy that a traditional explanation for the shortening of the day after Midsummer is that the sun stumbles on stones in its path (Hurt 1989 [1899]: 96). If these are echoes of the ancient disaster, they are faint indeed, and could easily be explained in other ways.

Photos 1–2. The Kaali meteorite crater lake on the droughty summer of 2002. Photo by Andres Kuperjanov.

Photo 3. Kaali crater. Stone layers dislodged by the explosion. Photo by Andres Kuperjanov, 2002.

Photo 4. A cleaned-out smaller meteorite impact locus. Pieces of meteorite iron have been found here. Photo by Andres Kuperjanov, 2002.

As the sun goes down in the west and rises in the east, it looks like it spends the night underground, hence the image of a stone cellar would be appropriate, apart from the meteorite crash. This is the kind of interpretation we find in the artwork of the Finno-Ugrians of the Perm district of Russia, where carved boards at the top and bottom of windows, respectively, show images of the sun on its daytime journey across the sky and on its nocturnal return trip through the underworld, symbolized by a lizard's claws (Põllu 1985: 52–53).

From a vantage point on the Estonian mainland, the meteorite would have had the appearance of a streak in the sky. This might explain why we can more easily find Estonian tales of flying, fiery serpents and the like (see below). It is noteworthy that a shooting star is called *pisuhänd* 'spark-tail' in Eastern Estonia, but *tulihänd* 'fire-tail' in Western Estonia, perhaps reflecting the relative harmlessness versus destructive reality of the meteorite from those respective vantage points (Tiirmaa 1994: 66, citing Andrus Saareste's article in *Eesti Keele Arhiivi Toimetised* 1).

From the vantage point of Sweden, on the other hand, the tail of the meteorite would have been less prominent and it would have been more natural to think of the event as a falling fireball. This may explain why Scandinavian mythology shows more concern about the sun being brought down to earth. It is noteworthy that the prophecy of the end of the gods involves the monstrous Fenrir-wolf, in a distant "iron forest" to the east, who swallows the sun, causes earthquakes powerful enough to split and crumble mountains, and causes the gods to perish in fire and battle (*Larousse Encyclopedia of Mythology* 1959: 283; Meri 1984: 92-3).[1] What's more, the prophesied end of the world includes a battle between the thunder god Thor and the great earthquake-causing serpent of Midgard, which leads people to flee their homes, turns the sun black, brings hot stars down from the heavens, burns the land, poisons the air, and causes the earth to sink into the sea (Bellows 1969 [1923]). As the shoreline was quite close to the Kaali crater at the time of the disaster (Tiirmaa 1994: 21–23), the appearance of a lake in the bottom of the pit could certainly look like a sinking of the land. In these myths, there is not just a vague reference about the sun's being hidden or hampered by stones, but a whole series of details that fit the meteorite crash quite well.

Of course, some of these details would have had to derive from eyewitness testimony from Saaremaa itself. Among the earliest historical references to the island are Henry's reports in the Chronicle of Livonia in the early 13th century, strongly implying that the inhabitants of Saaremaa and the Swedish island of Gotland had long-standing treaties and trade relations. In fact, among the rare archeological finds from the site of the crater itself is a Bronze Age Scandinavian-style disk pin (Lõugas & Selirand 1989: 210). This is displayed at the Archaeological Museum in Tallinn, together with pieces of the mold used to make this very pin, which were found at Asva, only about 20 km from Kaali. This means that a local smith on Saaremaa either originated from Sweden or was heavily influenced by Swedish fashion, which points to a sustained relationship rather than just incidental contact between Saaremaa's inhabitants and their Scandinavian neighbours on the western shore of the Baltic. In the Late Bronze Age and early Iron Age (6th and 7th centuries BC), there was a settlement by the crater, and part of the rim itself was topped by a strong stone fortification. There are also indications that there was a stone wall around the outside of the crater, built some centuries later at the beginning of the first millennium AD. These constructions have been interpreted as evidence that the site was considered sacred in ancient times (Lõugas & Selirand 1989: 210; Tiirmaa 1994: 62–63). As there is evidence both of the great importance of the site to ancient Estonians and of well-developed contacts with Sweden at that time, we can be sure that lore about the crater was passed on to residents of Scandinavia.

In the folkloric sources of the peoples living in the vicinity of the cataclysm, the description that is the most detailed and seems closest to the reality of the meteorite crash can be found in the *Kalevala* epic. The 47th rune of the revised (1849) version (excerpted in our Appendix) is as vivid, comprehensive, and accurate as one could ever expect, if an account of the disaster had been passed down through some 4000 years (or about 160 generations) of oral tradition. The poem's reference to the fiery fragments of heaven speeding and crashing along the cloud-line fits with the scientists' calculation that the meteorite came in at a 30–45° angle with respect to the horizontal surface (Tiirmaa 1994: 55, 90). The white-hot fire that consumed people, a spruce forest, and boglands also fits. Even the heaving of fish onto dry land fits with the earth tremor that the

impact would have caused. The mention of a crash into the water of a Lake Alue seems to contradict the scientists' conclusion that the crater was formed above sea level, but the reference here may be to merely an additional fragment that landed in the nearby sea; otherwise it would be hard to explain the fire on land. Or perhaps the narrator is referring to the lake within the crater that actually formed shortly after the crash.

One can find somewhat similar myths in other regions of the world. For example, the ancient Greeks told of Phaëthon, who begged his father Helios, the sun god, for a chance to steer the solar chariot for just one day. The inexperienced driver lost control of the chariot, which veered off the sun's proper path and tumbled to earth in a fiery catastrophe, burning fields and forest. The culprit earned a fatal lightning stroke from an angry Zeus, and Phaëthon's grieving sisters were turned into quaking poplar trees. There is certainly a parallel to the *Kalevala* account, where the disaster is set in motion when the sky-god Ukko gives the maiden Imbi the task of caring for a heavenly fire, which was to become a new moon and a new day; Imbi lets it slip through her fingers and fall to the earth. But the emphasis in the Greek tale is on the relationships between the gods, while the Finnic tale goes into great detail about the earthly consequences at the site of impact. If the two myths are in fact linked, then the spread from the Baltic area (with an impact crater formed in the presence of human witnesses) to Greece seems more likely than *vice versa*. Baltic amber has been found in Greece, so there was an ancient trade network that could have served to transport news and tales, as well as goods, from the Baltic to Greece. Is it just an intriguing coincidence that the amber tears of Phaëthon's sisters became the golden leaves of the poplar trees (Grimaldi 1996: 149)?

FLYING REPTILES AND AMPHIBIANS

Meri (1976: 250–253) notes that the streaking meteorite could have been the inspiration for the many references to flying, fiery snakes in Baltic Finnic lore. The chronicler Henry of Livonia reported in the early 13th century that a hill in northeastern Estonia (probably Mount Ebavere near Väike-Maarja, possibly Emumägi near Jõgeva) was the place where Tharapitha, the great god of the people of

Saaremaa, was born and whence he flew to Saaremaa (Tarvel & Kleis 1982: 217; Remmel 1998: 34–35). Can it be just a coincidence that the Kaali meteorite first became visible almost directly overhead at this place and then flew west to Saaremaa? Tharapitha has been deciphered variously as "Taara, help!", "Taara's lightning", or "Taara's long-bodied dragon-snake" (Meri 1984: 97). In 1544, Sebastian Münster, who must have heard persistent stories about fiery objects in the sky, wrote that "At nighttime there often appear in this country [of Estonia] flying fiery snakes and other monsters of the devil" (Meri 1984: 65). Long after that, Estonians preferred to use euphemisms like 'the old long one', 'long-tail', 'the mountain eel', 'the white man', or 'the flying man', to avoid offending and calling forth a dangerous flying snake (Meri 1976: 250). If a tale merely mentions a dangerous flying snake, without mention of the ability to cause fire or earthquakes (*Eesti muinasjutud* 1967: 329), the connection to the Kaali meteorite is dubious, but when details about the reptile's destructive powers are added, which fit the crater's formation process and aftermath, then the argument for a connection is on much stronger ground.

Meri also suggests that there may be some connection to the unusual preoccupation with snakes of the more natural kind among the Baltic Finns. The earliest cult object (with no apparent practical value) found in Estonia is an elk-antler carved to look like an adder, but its dating to the 5th millennium BC (Selirand & Tõnisson 1984: 24) makes it unlikely that it was inspired by the Kaali meteorite. Estonian seafarers from Saaremaa took adders with them as an aid to finding directions, getting favorable weather, and warding off disasters (Meri 1976: 253). Could the navigational reputation of the snakes have something to do with the fact that the iron fragments from the streaking meteorite turned into magnetite as a result of impact metamorphosis (Tiirmaa 1994: 58-59), and thus could have been used to make a compass? This seems unlikely, since more than three millennia elapsed between the snakelike meteorite's transformation into magnetite fragments and the first known use of such material for a navigational device in European waters. Whatever its source, the notion of snakes as an aid to seafarers might explain the origin of dragon decorations on ships – symbolism which the Vikings may have adopted from the Baltic Finns. The Finnish historian Matti Klinge (1984: 93–107) points out that

as late as 1690, the Karelians of the White Sea decorated their ships with snake- or dragon-like masthead figures.

Christian missionaries and priests put a special emphasis on getting Finnic converts to abandon their benign, respectful views of snakes (Klinge 1984; Gustavson 1981: 62–63). Meri (1976: 250) notes that Estonian peasants saw grass snakes as protectors of the farm and even gave them milk. Such reverence for these creatures was also reported among the Balts (Jones & Pennick 1999: 177–178). But one does not need a serpentine meteorite to explain this. Snakes ate rodents and thus were appreciated for reducing loss of grain to such pests (Viires 1976: 566). As the Baltic Finns would have gotten cats later than their Indo-European neighbours, such help from snakes might have seemed more important to the former, for a longer period.

Yet the clergy noted in 1428 that the inhabitants of the province of Livonia (southern Estonia and northern Latvia – once Liv territory) had a peculiarly strong belief in the powers of snakes and lightning (Remmel 1998: 32, citing Ants Viires *Puud ja inimesed* 1975: 47). Even in coastal Lithuania, which seems to have been a Finnic territory in ancient times, the inhabitants worshipped snakes and fire until the advent of Christianity. There is even a Lithuanian folk tale about serpents threatening to set a house on fire if the human occupants do not keep their promise to them (Zobarskas 1959: 1–5), which is reminiscent of the 17th century reports of Estonian and Liv shamans or wizards who could call upon dragon-snakes to set fire to the houses of people who had crossed them (Meri 1976: 110). This might be a faint echo of the snake-like meteorite that set many houses on fire on Saaremaa long ago. Here again, however, a more mundane explanation could be offered: snakes might tend to bask in the warmth of compost piles, haystacks, and other heaps of rotting vegetation, which could ignite spontaneously. Snakes' preference for the warmth of farmhouse stoves (Jones & Pennick 1999: 177) could also be a source of their association with fire.

It should be noted that the Baltic Finns, despite their special awe of reptiles, also displayed a concern about safety around them, in the form of incantations encouraging snakes to bite other things instead of people (Tedre III 1971: 1044 ff., IV 1974: 344). Moreover, tales of snakes as evil extortionists and people-eaters were not alto-

gether absent among groups like the Estonians (Viidalepp 1959: 397), although the antiquity of such tales might be questioned. But even in the stories of snakes posing a danger to people, there are often references to the sky. Snakes were said to slide up fence poles to chew cloud strings, thereby causing cloud-pieces to fall to earth, which are poisonous and can cause dogs to get rabies. The bark must be removed from poles and their tips must be sharpened, to keep snakes from bringing such dangers down from the sky (Hurt 1989 [1899]: 94). Jürgenson (1997; 1999) suggests that the poisonous cloud-pieces might be slime molds or mushrooms that thrive on rain-soaked ground, but that does not explain why snakes in the sky would bring them down.

Among neighboring Indo-European peoples, snakes and dragons are more likely to be seen as creatures that are evil and capable of being vanquished (e.g., by St. George, St. Michael, or St. Margaret), and even in Estonia many such tales have been collected (Järv 1999). But occasionally there are intriguing hints that even these tales may contain some echo of the meteorite crash. For example, from the northern coast of Germany (Pomerania and the isle of Rügen) comes a tale about a fire-breathing dragon which terrified people and animals, but eventually ended up in the Baltic Sea, swimming in the direction of Sweden (Jahn 1999: 137), which loosely fits the trajectory of the Kaali meteorite.

It may not be out of place here to note that the Anglo-Saxon hero Beowulf of southeastern Sweden perishes in his last battle, against a fiery dragon. The "sky-plague" that was Beowulf's nemesis was a long creature that flew at night over a coast of gray stone cliffs with vaults that hid treasure-troves of ancient heathens "of another race". It used its fiery, poisonous breath to scorch and depopulate the countryside, reducing forts and earthworks to dust and ashes (Heaney 2000: 151–159). The description of the dragon and the devastation it causes has much in common with the Kaali catastrophe, and Saaremaa does indeed have gray stone cliffs.

Finally, there is an Estonian tale of a flying frog-like monster (Põhja Konn, or Northern Frog) with glowing, hypnotic eyes and a long tail – an image that is compatible with a streaking meteorite. It was said to jump great distances and cause earthquakes, and its dead body caused diseases (Kreutzwald 1976: 206–216). The north-

ern origin of the monster does not fit the appearance of the Kaali meteorite from the east, but it would make sense if the story originated from southern Estonia, where the observer would have seen a strange object streaking across the northern sky. An interesting detail is that this insatiable people- and animal-eating monster had metal scales. Since the Kaali meteorite left small granules of iron around some smaller craters, this could be still another echo of the ancient catastrophe in folk tales.

Meri even suggests that the iron helped make Saaremaa an important center of smithing and trade. Tiirmaa reports, however, that meteoritic iron has a distinctively high nickel content, which has not been found in any of the iron objects from Saaremaa. The meteorite was mostly vaporized on impact. Even if some small pieces could be recovered from the smaller craters, their value for iron smelting would not have been realized in 2000 BC, well before the Iron Age, and the sites would have been overgrown with forest by the time Saaremaa's inhabitants would have realized the value of the nuggets. It would thus also seem unlikely that the meteorite is the source of the concept of an "iron star", in an Estonian folk song (Tedre III, 1971: 142), unless Veski's dating of the crash to around 600 B.C. turns out to be closer to the mark.

HOT SNOW AND THUNDER ROCKS

The aftermath of the meteorite's crash would have included a shower of hot cinders and rocks on the island of Saaremaa. This may explain the curious contradictory phrase 'hot snow', which is found in Estonian folk poetry (Viidalepp 1959: 15; Laugaste 1963: 156).

Ehk tuli tulista lunda	Even though hot snow fell,
ja sadas sula raheda,	and molten hail fell,
valas vihma varda'asta:	rain poured in torrents,
ikka pean ma minema [---]	still I need to go[---]

(translation by A. Haas)

This is a serf's lament about how he is obligated to go to work regardless of the conditions outside. It is possible that the original singer just hit upon the phrase 'hot snow' as an apt expression for showing how ridiculous or extreme the serf's situation was, just as

the American composer Stephen Foster came up with the line for his song "Oh! Susannah!": "The sun so hot, I froze to death."

The meteorite fragments that created the smaller craters near Kaali did not fully vaporize. Moreover, *ejecta debris* from the craters fell to earth. This may be the source of the concept of "thunder rocks", which is found among the Livs, who lived on the shore of the Bay of Riga and had close contact with the Saaremaa Estonians. The Livs' supreme god was Piktul(is) (*pikne* means 'lightning, thunder'; *pik tul* = 'long fire'?), to whom rams were sacrificed. He was credited with excavating a new river bed and punishing evil spirits and witches with lightning. When he hurled thunder rocks to the earth, they made fist-sized holes of great depth (Loorits 1998 [1926–8] I: 48–56). Estonians also had a supreme thunder god Uku (counterpart of the Finnish Ukko, whose name literally means 'Old Man, Grandfather'), who was said to throw chunks of hard black rock, causing holes in the ground (Laugaste 1963: 133; Valk 1998: 494). Saaremaa residents had a peculiar sensitivity to the awesome powers of lightning and an acute sense of fatalism that kept them from fighting the fires it caused, and they persisted longer than other Estonians in characterizing lightning bolts as stony arrows that were reflections of the wrath of the "old man in the sky" (Lõugas 1996: 106–107, 115–116).

While these images are certainly compatible with the consequences of the Kaali meteorite, they could also be borrowed from the Indo-Europeans. The Scandinavian god Thor, whose cart was pulled by he-goats, is a prime candidate as a source of inspiration, but even the Latvians, Germans, Celts, Romans, and Greeks associated thunder with a supreme god hurling objects (Loorits 1998: 49; Jones & Pennick 1999: 95, 147; *Larousse Encyclopedia* 1959). Vulcanism in southern Europe or small meteorites anywhere could have inspired these tales. The Thor (Taara, Tooru) cult was especially strong on Saaremaa and among the coastal Finns (Klinge 1984). There is some evidence that the name Thor might have a Finno-Ugric root (Meri 1984: 96–7; Remmel 1998: 35; Valk 1998: 494), but the sky deities of the non-Baltic branches of this language group do not seem to have much in common with their counterparts in the Baltic area (Lintrop 1993: 21–32; 1997a: 23–27; 1997b: 24–29). Derivation of the name Thor from the ancient German Donar (thunder) seems more likely. In any case, it is interesting that the ancient Baltic Finnic peoples

chose not to give the same honor to others in the pagan Indo-Europeans' pantheon.

SAAREMAA BURNING

The meteorite crash caused an immense forest fire on Saaremaa. This might be the reason for the association of Saaremaa with a holocaust, in the folk songs of Estonians and Finns (Meri 1976: 111–112). Could the fire recalled in these songs not be due to a lightning strike or unattended campfire? Then why would such an event on Saaremaa be considered newsworthy in Finland, where there must have been such ordinary fires as well? The connection with the Kaali meteorite is made more plausible by the details in an Estonian song, which refers to whirling stones, objects thrown by the stars, thunderous noise, and even a burning lake!

Nägin Saaremaa põlema,	I saw Saaremaa burning,
tule luugista tulema,	I saw the pyre rampaging,
sood süütsid, järved põlesid,	The fen caught fire, the lakes blazed,
kivid keereldi ojusid,	Stones swam in the whirlwind,
tähed lõivad tääringida,	Stars were tossing dice,
mõõga otsad mõõringida.	Swords were howling thunder.

(Translated by Juhan Kurrik, 1985: 250–251)

The song goes on to lament the human casualties, in a manner reminiscent of the Kalevala rune in our Appendix.

WANDERING LAKES

When looking in Latvian sources for folk tales that might contain some echo of the Kaali catastrophe on Saaremaa, we found an interesting pattern. There are many stories about lakes that fly to new homes, accompanied by one or more of the following phenomena: a dark sky, tremendous racket, warning calls from birds, fish landing on the ground, buildings getting swamped, and people drowning (Sterlete 1958: 128; Šmits 1970: vol. 15, 428, 437; Ancelane 1991: 84, 148, 204, 206, 219, 221, 223, 229, 241, 243, 248–249, 260, 280, 297). Latvia has many lakes all over the country, but these stories are concentrated in the coastal area formerly occupied by the Livs,

particularly around the Bay of Riga. The Livs themselves also have such stories (Loorits 1998 I: 130), so they could have passed them on to the Latvians arriving in their territory.

A possible explanation is that the meteorite crash shook the earth so much that it generated a tsunami. Obviously, the darkened sky and great noise could have been the consequences of the crash on Saaremaa. Given the proximity of Kaali Crater to the southern coast of Saaremaa Island in 2000 BC, some kind of wave would have been generated by the impact, which would have radiated southward to the shores of the Bay of Riga. Water birds floating near the Latvian shore might have been alarmed by the approaching tsunami, and humans might have interpreted their panicked, noisy flight as a last-minute warning of the wall of water. If the wave was big enough to get over the coastal dunes and ridges, it could have created new ponds and lakes near the seashore.

Could the blast energy, calculated to be equivalent to 1 to 4 kilotons of TNT, be enough to cause a devastating tsunami in the Bay of Riga? To get an upper bound on the magnitude of the possible water wave height, let us assume that the explosion took place at the level of the bay's water but at the location of the actual impact point (just a bit inland), and that the water depth was approximately 20 m. Using linear theory, the impulse coupled to the water to generate a water wave is about 9% of the available energy. This would generate a 2 m wave at about 2 km from the point of impact. At the closest point to the southwest, Kolka, the wave would be only a few centimeters high. Even with some build-up from run-up (heightening of the wave as it approached the beach), it is not likely that the wave would have been observed as all that unusual, since 2 m waves are common in the area. But it might have been enough to catch some birds and fish by surprise, hence the references to squawking birds and fish heaved onto land. (The latter phenomenon is mentioned not only in the Latvian tales but also in the 47th rune of the *Kalevala*.)

It seems more likely that the stories might have been generated from the appearance of a lake in the middle of Kaali Crater, following the meteorite crash. The news about this odd event could easily have been transported around the Bay of Riga. People across the

bay would have heard the noise, seen the dark cloud following the explosion, and had some curiosity about what happened on Saaremaa.

Estonians also have many tales of wandering lakes, with similar elements (dark sky, terrible noise, etc., but the warnings tend to be delivered by a dark ox rather than a bird (Laugaste & Room 1958: 55; Laugaste 1963: 261; Vint 1964: 12; Kreutzwald 1967: 340, 374; Laugaste & Liiv 1970: 185, 593; Gustavson 1981: 107–109, 115–117, 124–126; Peebo & Peegel 1989: 184).[2] Estonian stories about wandering lakes are typically from far inland, but there is a curious pattern: a concentration of such stories from the vicinity of Mount Ebavere, whence the meteorite flew to Saaremaa! As the knowledge about the meteorite's path and its arrival in Saaremaa seems to have been preserved deep in the Estonian interior at least until the 13th century, it is not far-fetched to think that news of the consequences (including the sudden appearance of a lake) would also get back to the Mount Ebavere area and influence the locals' views on the permanence of their own lakes.

Wandering lakes can be explained in other ways, such as a drought, tornado, or bursting dam. The Estonians recall the occasional drainage of Lake Ülemiste and the flooding of Tallinn on the slope below, when they tell the tale of the Old Man of the Lake who is ready to flood the city, should anyone respond with a "Yes" to his annual question about whether the construction projects in Tallinn have been completed (Kreutzwald 1976 [1866]: 333). We also find tales of insulted and departing lakes among the Mari, a group of Volga Finns deep in Russia (Sebeok & Ingemann 1956: 65, 98, 113). But when a tale in the Baltic region deals with the unexpected arrival of a lake, following a great noise and dark sky, a connection to the Kaali meteorite is plausible.

THE PERSISTENCE OF MEMORY

Our argument that ancient cataclysms might be reflected in recently collected folklore obviously rests on the assumption that oral tradition can transmit such lore relatively undistorted for many generations. The Kaali crash seems to have occurred about 4,000 years ago, while the periglacial lakes in the Baltic area drained some 8,500–10,200 years ago. Is it realistic to think that the news

about these events could travel through about 160 generations in the former case and through an even longer intergenerational chain in the latter case (340–408 generations, if the generation gap averages 25 years)?

Viidalepp (1959: 442–443) notes that the Estonians on Muhu Island remembered details of the construction and use of a fort built before the conquest of Estonia in the early 13th century. On Saaremaa Island, the locals insisted that a field at Linnamäe had been an ancient hill fort, although no signs of such remained; when archeologists finally started digging in the area, they found the remains of an old fort, which had been in use for about a thousand years, from the beginning of the first millennium BC. So a memory without visible evidence had been accurately preserved for about 2,000 years. A similar period of recall has been verified in Denmark, where the people in Bøllinge township told stories about a gold-filled wagon at the bottom of a bog. Archeologists found the remains of two wagons at the spot, and dated them to the pre-Roman Iron Age (Alver 1989 [1962]: 138). The gold, however, was missing, either because storytellers had decided to add this element to make the tale more interesting, or because it had been secretly removed at one time. Alver gives other examples from Scandinavia, and notes that in other regions, accurate recall of events up to 4,000 years ago has been established. It should also be noted that there is a gap of 4,000 years between the catastrophic flooding of the ancient Black Sea shoreline, the probable source of the story of the world's great flood, and the oldest written account of such an event in the epic of Gilgamesh.

So it seems quite plausible that memories of the Kaali catastrophe could have been transmitted through the ages to our own day. The argument for accurate recall over millennia is harder to make in the case of the periglacial lake drainages, since they occurred much longer ago. Important details about what happened would certainly get distorted and forgotten over such a long period, but we think a vague memory of even such distant events could have survived, for reasons explained in the next section.

THE SOCIAL FUNCTIONS OF REMEMBERING CATACLYSMS

There can be no doubt that after the sudden periglacial lake drainages and the meteorite crash occurred, the cataclysms became a main topic of conversation for the observers and their descendants for a long time to come. People would have tried to interpret the unprecedented events in terms of more familiar concepts, speculated about what unseen forces or supernatural beings might have made Nature take such unexpected turns, and worked the amazing events into the stories, songs, incantations, and other lore passed on to subsequent generations. Those who were eyewitnesses to the events would have related their experiences with firm conviction and strong emotion. Those who were born shortly after the event would have taken the claims most seriously and passed them on without casting doubt on the veracity of their elders. In those days, people lived a precarious existence, had to pay close attention to the dangers and opportunities in the natural environment, and could not afford to believe only what they had directly experienced themselves.

Many generations later, the lore connected to the cataclysms would have receded in importance. Without recurrences, interest in the ancient events was bound to wane eventually. New disasters and extraordinary events would come to the fore – wars, plagues, religious conversions, etc. – and compete for the attention of storytellers and singers. New characters might be connected to old sites, as in the mainland Estonian tale about Vanapagan (Old Pagan) doing his sauna-whisking and bathing at Kaali (Laugaste & Liiv 1970: 353). But there would still be an important reason to pass on ancestral lore about the environment of the past. Remembering something about what was considered noteworthy by one's elders and those before them would be a way of honoring ancestors and affirming one's affiliation with a long chain of generations of one's own kind, even if the relevance of the information to contemporary problems seems minimal (Jaago & Jaago 1996: 36–38, 42–44).

Finally, the storytellers and singers may modify the ancient lore in some manner, combining components of different tales or songs, or adding some new elements. This could make their presentations more interesting, entertaining, congruent with other lore or a cer-

tain poetic style, or instructive to the next generation. This process has been documented in studies of how the same person presents different versions of the same basic tale or song on different occasions, or how different storytellers and singers put their own spin on a widely known plot or theme (Dubois 1995; Hiiemäe 1978. See also Pentikäinen 1989: 112–120; Lintrop 1999; Sarv 1999).

If a moral is added to a story or song, a possibly irrelevant description of what happened long ago becomes a way of instructing youth and reinforcing the values and norms of society. For example, the Kalevala rune about the butterfingered Imbi, who let the heavenly fire that Ukko entrusted to her slip from her grasp, can be interpreted as a warning to young listeners to respect their elders' experience and to take seriously the responsibilities that their elders bestow on them. A story about a vengeful snake or sun that sets fire to people's houses (Zobarskas 1959: 1–5; Kreutzwald 1976: 312) reinforces the principle that we must control our greed and keep our promises, lest we bring others' wrath down on our heads. When a wandering lake is explained as a consequence of someone's washing a soiled diaper in it, being stingy with offerings to God, giving the lake a distasteful name, or otherwise being bad (Kreutzwald 1976: 340; Ancelane 1991), and those who ignored the warnings are said to have drowned, the listener is cautioned against submitting others to egregious insults, reminded to think about the consequences of seemingly small signs of disrespect, and taught to take others' warnings seriously. Like a shaman who uses a patient's illness as an opportunity to inquire about possible violations of taboos and to tell people that angry spirits might be behind a mysterious ailment, a storyteller or singer can use a natural catastrophe to remind listeners how they should behave, in order to avoid another disaster.

With his famous dictum that social phenomena must have social origins, Durkheim (1966 [1895]: 110) implied that lore has this function of moral teaching or upholding the social order from the very beginning. Our analysis suggests, on the other hand, that a description of a natural cataclysm can initially be passed on as a form of fairly straightforward reporting about what transpired, and moral lessons may or may not be drawn from it later. It is not clear, for example, what the listener is supposed to take to heart, from the

description about a bird's search for a nest over the great lake or from the account about Saaremaa's burning. Much of the lore that seems to reflect the ancient cataclysms retains its descriptive character, with an emphasis on the amazing natural phenomena. The moral lessons often seem to be secondary in importance, appended as an afterthought. This fits with another of Durkheim's assertions that the original cause of a phenomenon may not be the same as its subsequent function (1966: 90, 110).

CONCLUSION

The spectacular geophysical events that occurred in ancient times seem to reverberate in the folk tales and songs of the peoples in the Baltic area even today. While there are plausible alternative explanations for some of our examples, it seems unlikely that all of them can be dismissed, particularly the ones where multiple and realistic features of the cataclysms seem to be preserved in the account.

It would indeed be remarkable if no traces of any kind were left in the lore that came down to contemporary descendants of the original observers. When the Estonian rock group Ruja sings about the Northern Frog in its tune "Rävala Rock" or the Liv-Estonian folk-jazz ensemble Tulli Lum chooses "Hot Snow" for its name, they and their fans may not realize the possible connection to ancient cataclysms. Yet they are drawing from a store of images and accounts that are part of their cultural heritage, which has been shaped not just by the ordinary conditions and recurrent features, but also by the extraordinary events of their ancestors' natural environment.

Many of the metaphors that are preserved in the lore will remain mysterious, but a clearer understanding of some of them is possible if we start from an examination of what our ancestors' world was actually like and think about what they might have wanted to emphasize in their tales and songs. Vladimir Propp (1984: 57) warned against starting with a preconceived hypothesis and then selectively sifting through folkloric sources to look for things that might support it. But Klinge's research (1984) suggests that it can be a fruitful approach to clearing up otherwise intractable mysteries in those sources. If we start from a verified reality, keep possible alternative explanations in mind, and make comparisons with other peoples'

traditions, then the danger of going astray is lessened considerably. We will never have a full understanding of what our ancestors wanted us to know about their world, but it is only human to try to fathom their lore. After all, the ability to receive and interpret messages from others who experienced something that we have not is the root of humankind's evolutionary advantage.

Comments

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[1] Meri also notes that the etymology of the name 'Fenrir' seems to be linked with 'Finn', which was a generic term applied even to the Estonians and other Finnic speakers to the east.

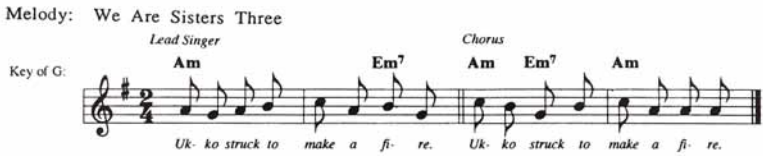
[2] This may be just a coincidence, but the story presented by Kreutzwald about the Northern Frog describes a part of the creature's body as being ox-like.

APPENDIX

Each song line is to be sung first by the lead singer [storyteller], and repeated by the chorus [listeners].

Kaali Meteorite Song

Narrator: The night was dark. The sky-god Ukko decided to shed more light on earth.

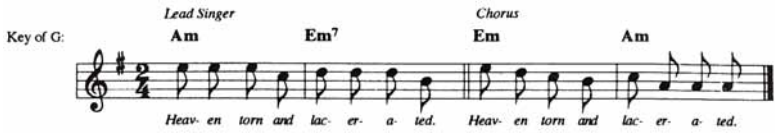


Uk-ko struck to / make a fi-re,
Struck a white-hot / light-ning fi-re.

From his flam-ing / sword he struck it,
As the sparks did / fly and sput-ter;
Fi-re hit a- / gainst his fin-gers,
Sput-tered sparks from / sa-cred fin-gers,
High a-bove a- / loft in heav-en,
On the star-ry / plains of heav-en.

Narrator: He entrusted the care of the fire to the maid of air, for her to form and shape.
In-to a new / moon to form it,
In-to a new / day to shape it.
Narrator: But this did not turn out well.
Im-bi rocked the / ba-by fi-re,
Back and forth the / lit-tle white one.
On her hands she / held the fi-re,
Put the spark up- / on her fin-gers:
Fi-re fell from / but-ter-fin-gers [---]
From the fin-gers / of the guard-ian.
Narrator: The catastrophe followed

Melody: Burning Gold



Heav-en torn and / lac-er-a-ted,
Sky-vault be-came / per-fo-ra-ted; [---]
Fi-re tore through / sky like bliz-zard,
Sped and crashed a- / long the cloud-line,
Through nine heav-ens / it des-cend-ed,
Through six span-gled / vaults of heav-en. [---]
E-vil deeds it / then ac-com-plished,
Cru-el deeds it / per-pe-tra-ted:
Burn-ing up the / daugh-ters' bos-oms,
Tear-ing at the / breasts of mai-dens,
And the knees of / boys des-troy-ing,
And the mas-ter's / beard con-sum-ing. [---]
And of all its / deeds most e-vil:
Burned the ba-by / in his crad-le. [---]
Went on burn-ing / man-y up-lands,
Man-y up-lands, / man-y bog-lands,

Crashed at last in- / to the wa-ter,
In the waves of / Lake A-lu-e:
And the fi-re / rose up flam-ing,
And the sparks a- / rose all crac-kling.
Three times in a / night of sum-mer,
Nine times in a / night of au-tumn,
Roared up to the / height of spruce trees,
Sprang up high a- / gainst the shore-banks
With the strength of / fu-rious fi-re,
With the might of / an-gry white heat.
E-ven threw the / fish on dry land,
Heaved the perch a- / cross the beach-es.

Arranged by Andres Peekna, combining Estonian folk melodies and translations of the Finnish Kalevala epic into English (Kirby, 1985 [1907]) and Estonian (Annist, 1981 [1959]). Meri (1976) brought attention to most of these Kalevala lines as relating to the Kaali meteorite.

References

Alver, Brynjulf 1989 [1962]. Historical Legends and Historical Truth. Kvideland, Reimund & Sehmsdorf, Henning K. & Simpson, Elizabeth (eds.). *Nordic Folklore: Recent Studies.* Bloomington: Indiana University Press, pp. 137–149. [Original Norwegian version: Alver, Brynjulf. Historiske segner-historisk sanning. *Norveg.*]

Ancelane, Alma 1991. *Latviešu tautas teikas* [Latvian Folk Legends]. Riga: Zinatne.

Baker, Victor R. 2002. The Study of Superfloods. *Science* 295, pp. 2379–2380.

Ballard, Robert D. 2001. Black Sea Mysteries. *National Geographic,* May, pp. 52–69.

Bellows, Jerry Adams (trans.) 1969 [1923]. *The Poetic Edda.* New York: Biblo & Tannen.

Colman, Steven M. 2002. A Fresh Look at Glacial Floods. *Science* 296, pp. 1251–1252.

Dubois, Thomas A. 1995. *Finnish Folk Poetry and the Kalevala.* New York: Garland.

Durkheim, Émile 1966 [1895]. *The Rules of Sociological Method.* New York: Free Press.

Eesti muinasjutud = Mälk, Vaina & Sarv, Ingrid & Viidalepp, Richard (compil.) 1967. *Eesti muinasjutud*: *Antoloogia* [Estonian Folktales: An Anthology]. 1967. Tallinn: Eesti Raamat.

Grimaldi, David A. 1996. *Amber: Window to the Past.* New York: American Museum of Natural History.

Gustavson, Heino 1981. *Igal kohal oma lugu: muistendid* [Every Place has a Story: Legends]. Tallinn: Eesti Raamat.

Heaney, Seamus (trans.) 2000. *Beowulf*. New York: Farrar, Straus & Giroux.

Heapost, Leiu 2000. Eestlaste antropoloogiast ja kohast Euroopas [On the Anthropology and the Place of Estonians in Europe]. *Keel ja Kirjandus* 7, pp. 503–515.

Hiiemäe, Mall 1978. *Kodavere pajatused: Kujunemine ja koht rahvatraditsioonis* [Kodavere Stories: Emergence and Role in Folk Tradition]. Tallinn: Eesti Raamat.

Honko, Lauri & Timonen, Senni & Branch, Michael & Bosley, Keith 1994. *The Great Bear*: *A Thematic Anthology of the Oral Poetry in the Finno-Ugrian Languages*. New York: Oxford University Press.

Hurt, Jakob 1989 [1899]. Eesti astronoomia: Kõne Eesti Jaani koguduse Noortemeeste Seltsis 10. jaanuaril 1899 [Estonian Astronomy]. Hurt, Jakob. *Mida rahvamälestustest pidada: Artiklite kogumik.* Tallinn: Eesti Raamat, pp. 91–130.

Jaago, Tiiu 1997. Mis sealt tõuseb – soost sinine, maast punane? [What Rises There – Blue from Swamp, Red from Ground] *Mäetagused* 5, pp. 54–72. Also available at http://haldjas.folklore.ee/tagused.

Jaago, Tiiu & Jaago, Kalev 1996. *See olevat olnud…: Rahvaluulekeskne uurimus esivanemate lugudest* [This is Said to have Happened ...]. Tartu: Tartu Ülikooli Kirjastus.

Jaanits, Lembit & Laul, Silvia & Lõugas, Vello & Tõnisson, Evald 1982. *Eesti esiajalugu* [Estonian Ancient History]. Tallinn: Eesti Raamat.

Jahn, Ulrich 1999. *Vokssagen aus Pommern und Rügen.* Bremen: Edition Temmen.

Jones, Prudence & Pennick, Nigel 1999 [1995]. *A History of Pagan Europe*. New York: Barnes & Noble.

Järv, Risto 1999. Vale-Jüri kiusatus: Valekangelasest 'Lohetapja' (AT300) põhjal [Temptation of the False-George: on Type AT 300]. Hiiemäe, Mall & Oras, Janika & Tamm, Kadri (eds.) *Lohetapja.* Pro Folkloristica 6. Tartu: Eesti Kirjandusmuuseum, pp. 52–69.

Jürgenson, Aivar 1997. Puugipask, mahasadanud pilved ja taevased seened [Mushrooms in Folk Tradition]. *Mäetagused* 4, pp. 57–64. Also available at http://haldjas.folklore.ee/tagused.

Jürgenson, Aivar 1999. Kes külvab seeni? Pilguheit mükoloogia ja mütoloogia piirile [Who Sows Mushrooms?]. Hiiemäe, Mall & Oras, Janika & Tamm, Kadri (eds.) *Lohetapja*. Pro Folkloristica 6. Tartu: Eesti Kirjandusmuuseum, pp. 69–74.

Kessel, H. & Punning, Jaan-Mati 1995. Läänemeri ja tema arengulugu 1 [The Baltic Sea and Its History 1]. Raukas, Anto (ed.). *Eesti: Loodus.* Tallinn: Valgus & Eesti Entsüklopeediakirjastus, pp. 219–228.

Keys, David 1999. *Catastrophe*. New York: Ballantine.

Klinge, Matti 1984. *Östersjövälden* [Ancient Baltic Sea Power]. Borgå [Porvoo], Finland: Askelin & Hägglund. Translated by Jan-Ivar Lindén, revised from 1983 Finnish version, *Muinaisuutemme merivallat.*

Kreutzwald, Friedrich Reinhold 1978 [1866]. *Eesti rahva ennemuistsed jutud* [Traditional Folk Tales of Estonians]. 2nd ed. Tallinn: Eesti Raamat.

Kriiska, Aivar 1997. Kroodi ja Vihasoo III asula Eesti varaneoliitiliste kultuurirühmade kontekstis. [The Settlement Sites of Kroodi and Vihasoo III in the Context of the Early Neolithic Cultural Groups of Estonia]. Summary in English. *Eesti Arheoloogia Ajakiri* [Journal of Estonian Archaeology] 1, pp. 7–23.

Kriiska, Aivar 1998. Mesoliitilised asustusjäljed Loode-Saaremaal [Mesolithic Habitation Marks in North-East Saaremaa]. *Ajalooline Ajakiri* 1 (100), pp. 13–22.

Kuusi, Matti & Bosley, Keith & Branch, Michael 1977. *Finnish Folk Poetry: Epic.* Helsinki: Finnish Literature Society.

Künnap, Ago 1997. Potential Finno-Ugric Substratum in Slavic. *Linguistica Uralica* 33:4, pp. 253–257.

Künnap, Ago 2000. European Languages and Estonians from the Ice Age to Today. *Estonia: Candidate for membership in the European Union: International business handbook*. Tallinn: Euroinformer, pp. 221–229.

Larousse Encyclopedia of Mythology 1959. New York: Prometheus Press.

Laugaste, Eduard 1963. *Eesti rahvaluuleteaduse ajalugu: Valitud tekste ja pilte* [History of Estonian Folkloristics]. Tallinn: Eesti Riiklik Kirjastus.

Laugaste, Eduard & Liiv, Ellen 1970. *Eesti Muistendid 3: Muistendid Vanapaganast* [Estonian Legends 3: Legends of *Vanapagan*]. Monumenta Estoniae antiquae II. Tallinn: Eesti Raamat.

Laugaste, Eduard & Rõõm, Anita 1958. *Kalevipoja jälgedel* [On Kalevipoeg's Trail]. Tallinn: Eesti Riiklik Kirjastus.

Lintrop, Aado 1993. *Udmurdi rahvausundi piirjooni* [Outlines of Udmurtian Folk Belief]. Tartu: Tartu Ülikool.

Lintrop, Aado 1997 a+b. Palakesi obiugri mütoloogiast I–II [Pieces of Ob-Ugrian Mythology]. *Mäetagused* 4, pp. 20–33; 5, pp. 23–33. Also available at http://haldjas.folklore.ee/tagused.

Lintrop, Aado 1999. The Great Oak, the Weaving Maidens and the Red Boat, not to Mention a Lost Brush. *Folklore: An Electronical Journal of Folklore* 11, pp. 7–30. Also available at http://haldjas.folklore.ee/folklore. Estonian version is in *Mäetagused* 10, pp. 7–23, http://haldjas.folklore.ee/tagused.

Loorits, Oskar 1998 [1926–1928]. *Liivi rahva usund* I–III: *Mit einem Referat: Der Volksglaube der Liven*. Tartu: Eesti Keele Instituut.

Lönnrot, Elias 1981 [1849]. *Kalevala*. Moorestown (NJ): Symposia Press. Translated into Estonian by August Annist. Reprint of 1959 edition.

Lönnrot, Elias 1985 [1849]. *Kalevala: The Land of the Heroes.* London: Athlone. Translated into English by William F. Kirby, originally published in 1907.

Lõugas, Vello & Selirand, Jüri 1989. *Arheoloogiga Eestimaa teedel* [With an Archaeologist on Estonia's Roads]. 2nd ed. Tallinn: Valgus.

Lõugas, Vello 1996. *Kaali kraatriväljal Phaethonit otsimas* [Looking for the Phaeton on the Kaali Crater Field]. Tallinn: Eesti Entsüklopeediakirjastus.

Mark, Karin & Heapost, Leiu & Sarap, Galina 1994. *Eestlaste antropoloogia seoses etnogeneesi küsimustega: Monograafia* [The Anthropology of Estonians from the Point of View of Ethnogenesis: Monograph]. Tallinn: Teaduste Akadeemia Kirjastus.

Meri, Lennart 1976. *Hõbevalge: Reisikiri tuultest ja muinasluulest* [Silver White: A Travelogue of Winds and Ancient Poetry]. Tallinn: Eesti Raamat.

Meri, Lennart 1984. *Hõbevalgem: Reisikiri suurest paugust, tuulest ja muinasluulest* [Silver Whiter: A Travelogue of the Big Bang, Wind and Ancient Poetry]. Tallinn: Eesti Raamat.

Peebo, Kadri & Peegel, Juhan 1989. *Igal puul oma juur: Murdetekste Jakob Hurda kogust* [Every Tree has a Root: Dialect Texts from the Collections of Jakob Hurt]. Tallinn: Eesti Raamat.

Pentikäinen, Juha Y. 1989. *Kalevala Mythology.* Translated and edited by Ritva Poom. Bloomington: Indiana University Press.

Propp, Vladimir 1984. *Theory and History of Folklore.* Translated by Ariadna Y. Martin & Richard P. Martin. Minneapolis: University of Minnesota Press.

Raukas, Anto 1995. Kaali meteoriidikraatrid on palju vanemad kui arvati [Kaali Craters Older than Thought]. *Eesti Loodus* 11/12 (Nov.-Dec.), pp. 351–353.

Remmel, Mari-Ann (compil.) 1998. *Hiie ase: Hiis eesti rahvapärimuses* [Sacred Grove in Estonian Folk Tradition]. Tartu: Eesti Kirjandusmuuseum.

Rüütel, Ingrid 1997. *Ühte käivad meie hääled* I: *Eesti rahvalaule Väike-Maarja kihelkonnast* [We Sing Together 1: Folk Songs from Väike-Maarja Parish]. Tallinn: Eesti Keele Instituut.

Ryan, William & Pitman, Walter 1998. *Noah's Flood*. New York: Simon & Schuster.

Sarv, Mari 1999. Regilaul: Clearing the Alliterative Haze. *Folklore: An Electronical Journal of Folklore* 10, pp. 126–140. Also available at http://haldjas.folklore.ee/folklore.

Sebeok, Thomas A. & Ingemann, Frances J. 1956. *Studies in Cheremis: The Supernatural.* New York: Wenner-Gren Foundation for Anthropological Research.

Selirand, Jüri & Tõnisson, Evald 1984. *Through Past Millennia: Archaeological Discoveries in Estonia.* Tallinn: Perioodika. Translated by Ingrid Maidre, revised from 1974 Estonian version, *Läbi aastatuhandete*.

Šmits, P. 1970. *Latviešu tautas teikas un pasakas* 15 [Latvian Folk Legends and Folk Tales]. Waverly (IA): Latvju Gramata.

Sterlete, Veronika 1958. *Latviešu tautas teikas* [Latvian Folk Legends]. Uppsala, Sweden: Appelberg.

Tarvel, Enn (ed.) & Kleis, Richard (trans.) 1982. *Henriku Liivimaa kroonika* [Henrici Chronicon Livoniae]. Tallinn: Eesti Raamat.

Tedre, Ülo 1969–1974. *Eesti rahvalaulud: Antoloogia* I–IV [Estonian Folk Songs: Anthology I–IV]. Tallinn: Eesti Raamat.

Tedre, Ülo & Tormis, Veljo 1999. *Regilaulik* [Folk Song Textbook]. Tallinn: SP Muusikaprojekt.

Tiirmaa, Reet 1994. *Kaali meteoriit* [The Kaali Meteorite]. Tallinn: Estonian Academy of Sciences, Geology Institute.

Vint, Endel 1964. *Kalevipoja radadel: Turismijuht* [On Kalevipoeg's Tracks: Tourism Guide]. Tallinn: Eesti Riiklik Kirjastus.

Uibopuu, Valev 1984. *Meie ja meie hõimud: Peatükke soomeugrilaste minevikust ja olevikust* [We and Our Kin: The Past and Present of Finno-Ugric Nations]. Lund, Sweden: Eesti Kirjanike Kooperatiiv.

Vahtre, Lauri 1992. *Teekond läbi aja: Sugemeid eestlaste kultuuri ajaloost* [A Journey Through Time: On the History of Estonians' Culture]. Tartu: Sõltumatu Infokeskus.

Valk, Ülo 1998. Inimene ja teispoolsus eesti rahvausundis [Afterlife in Estonian Folk Belief]. Viires, Ants & Vunder, Elle (eds.). *Eesti rahvakultuur*. Tallinn: Eesti Entsüklopeediakirjastus.

Veski, Siim 2002. *Kaali Meteorite impact induced Ecological catastrophe 800-400 B.C., as revealed by pollen, XRD, LOI and 14C analyses of peat containing impact ejecta.* Paper presented at conference on "Environmental Catastrophes and Recoveries in the Holocene", Brunel University, Uxbridge, United Kingdom.

Viidalepp, Richard (ed.) 1959. *Eesti rahvaluule ülevaade* [An Overview of Estonian Folklore]. Tallinn: Eesti Riiklik Kirjastus.

Viires, Ants 1976. Kus lõpeb luule, kus algab ajalugu? [Where Does Poetry End, History Begin?; Review of Meri's 1976 book, *Hõbevalge*]. *Keel ja Kirjandus* 9, pp. 562–566.

Villems, Richard 2000. On the Background of the Biological History of the Estonian Speaking People. *Estonia: Candidate for membership in the European Union: International business handbook*. Tallinn: Euroinformer.

Vissel, Anu 1995. Estonian Herding Songs. Wolf-Knuts, Ulrika (ed.) *ARV: Nordic Yearbook of Folklore* 51. Uppsala, Sweden: The Royal Gustavus Adolphus Academy, pp. 123–133.

Wiik, Kalevi 1997. The Uralic and Finno-Ugric Phonetic Substratum in Proto-Germanic. *Linguistica Uralica* 33: 4, pp. 258–280.

Zobarskas, Stepas 1959. *Lithuanian Folk Tales.* 2nd ed. Brooklyn (NY): Gerald J. Rickard.

ARTICLE COMMENT: *ECHOES OF STONE AGE CATACLYSMS IN THE BALTIC SEA*

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The paper discusses the reverberation of Stone Age cataclysms in the folk tales and songs of the people of Estonia and the surrounding countries, with a focus on the Kaali meteorite crash and the following repercussions. The archaeological context of the event has only been mentioned briefly, which is quite logical considering the small number of articles published on the subject. After several decades of recess, the recent years have seen the study of the ancient construction on the shore of the Kaali Crater and its different interpretations, though most of these studies have not yet been published.

The article states that the Kaali meteorite must have hit the island of Saaremaa around the year 3000 BC at the latest, since before that date the part of the island must have been under water. There is, unfortunately, no truth in the statement. The Kaali Crater is located 20 m above the contour line of the water level in about 6000 BC. Also, the author does not seem to be familiar with the varying dating of the event, some of which have fixed the meteorite crash to a considerably earlier date (see e.g. Raukas et al. 1995). We definitely should not overlook the new datings based on the iridium concentration in the bogs of the region, published in the recent years by researchers from Denmark and Estonia. According to these, the Kaali meteorite crashed either between 800–400 BC (Rasmussen et al. 2000) or between 820–570 BC (Veski et al. 2001). Archaeological finds from the edge of the crater support the latter dating: the earliest finds from the site originate in the very end of the Bronze Age, i.e. the 7th-6th century BC. Since modern archaeologists have consentingly interpreted the constructions at the edge of the crater as a place of worship, it is by no means surprising that it was erected quite soon, perhaps only a few decades after the catastrophe. Also, the possible connection to the "iron star" mentioned in the Estonian folk tales and the Kaali meteorite would deserve further study.

Traces of iron founding have been discovered also at the edges of the Kaali crater. The northern coast of the lake was rich in iron

slag, where iron has also been mined. And even though most of the finds have been associated with the newer forge, it is generally accepted that iron founding took place on the coasts of the lake already in prehistoric times. A relatively great amount of iron slag was discovered during the excavations at the place of worship, i.e., according to the intermediate assumption, at the site of the fortified settlement. Contrary to the general belief, this information suggests that men have used iron of meteoritic origin.

The author has made conspicuously frequent references to the works by Lennart Meri, and, surprisingly enough, to the work on the ancient maritime state of the Balto-Finnic people by Matti Klinge. All these works can be classified among science fiction rather than true scientific literature. Judging by the above, it is fairly surprising that the author has overlooked *Kaali kraatriväljal Phaetonit otsimas* (Looking for Phaëthon in the Kaali crater field) by Vello Lõugas (Lõugas 1996), which would belong to the same genre. This should not be taken as a provocation to use more science fiction in research, though this book would have contributed more useful information on the archaeological findings of Kaali and the entire Saaremaa Island. Lõugas also discusses the close relations of the Estonian islands and coastal regions with Scandinavia, which was a considerably wider phenomenon and cannot be limited merely to the types of pins. Hille Jaanusson has also studied these contacts of the Bronze Age (Jaanusson 1981).

I definitely cannot agree with the argument that the transformation of the earth into the sea, described in folklore, would indicate at Stone Age cataclysms. I dare to argue that at certain periods this process could be noticed during a human lifespan. As the rising of the land in the countries surrounding the northern part of the Baltic Sea was closely related to the changes in the water level, then during some periods the process was considerably faster. In the 12th and early 13th century, for example, the sudden drop in the sea level and the continuous rise of the earth changed the coastline of southern Saaremaa and of the coastal plains of western Estonia during a relatively short period beyond recognition. The Viking era, on the other hand, was characterised by a sudden rise in the water level caused by the warming climate, as a result of which the land did not rise from the sea, but rather "drowned". Perhaps this "ag-

gression of the sea during the Viking era" serves as an explanation to the folk songs describing the disappearance of the earth into the sea? The coastal line receded more rapidly also during the late 17th century and the previous century. On the map of Saaremaa and West Estonia from the year 1650 we can still see several straits and bays that will be drawn as boggy areas on the maps issued later in the same century. Particularly rapid changes in the landscape took place in the 20th century, mostly due to draining, the straightening of rivers and other land-improvement works. During the periods mentioned this process was noticeable and may have influenced the emergence of folk songs related to this subject. The cases where the memory of a nation reaches long back into the prehistoric age, are very rare indeed, and even then are mainly distant reverberations from the ancient times. Information related to Asva (popularly called *Linnamäe põld*, or the 'field of the fortress hill') is inaccurate, as the fortified settlement of the Bronze Age was replaced by the fortification during the early Viking era. The fortress hill assumed its present appearance, which is also analogous to other rural fortresses in Saaremaa, only during reconstructions in the Viking period. For comparison – neither the second Bronze Age fortification, the Ridala fortress in the vicinity, nor the construction on the coasts of Lake Kaali are mentioned in folklore. The argument that Lake Kaali was once considered sacred roots in the assumptions of some Baltic-German authors and was originally not associated with folklore. Several higher hills on the former southern coast of Saaremaa, which is now a boggy area, are popularly called 'fortress hills'. But since these hills lack any cultural stratum, it is possible that people have given the name based on the outward appearance.

As to the ancient Balto-Finnic gods mentioned in the article, their emergence is generally dated to more recent period and is largely associated with the wave of National Romanticism. The reference to the ancient thunder god Uku in the studies by Ülo Valk says nothing about the ancient descent of the god, and is limited to the assertion that its name is a parallel name for thunder, and also denoted forefather. The supposed thunder god of the Livs, Pitkul, has been mentioned in the book by Loorits, as the author has correctly pointed out, but Loorits also seems to argue that Pitkul was the ancient supreme god introduced by the national romanticists.

The supposed worship of Taara-Thor by the inhabitants of Saaremaa is also very questionable (again, the author has referred to Klinge!).

And another minor remark on archaeological data: the earliest cat bones in Estonia were discovered in the grave burial of Tõnija, Saaremaa, and dated to the 2nd-3rd century. Domesticated cats appeared in Estonia more or less simultaneously with Scandinavia, and the worship of snakes among the Estonians was hardly related to the need to exterminate rodents. Moreover, snakes are not regarded as entirely positive creatures in the Estonian folklore.

To sum up I would like to say that the article was an interesting and thought-provoking piece of writing, although more extensive background knowledge on the topic would certainly have been useful. Clearly, the phenomenon of the Kaali meteorite crash and its repercussions in the Estonian folklore, following the works by Lennart Meri, requires further study, which makes this extremely intriguing approach even more commendable.

References

Jaanusson, H. 1981. Hallunda. A Study of Pottery from a Late Bronze Age Settlement in Central Sweden. Stockholm.

Lõugas, V. 1976. Kaali kraatriväljal Phaethonit otsimas. Tallinn.

Rasmussen, K. L., Aaby, B., Gwozdz, R. 2000. The Age of the Kaalijärv Meteorite Craters. *Meteorit. Planet. Sci.* 35, 1067–1071 = Rasmussen et al 2000.

Raukas, A.&Pirrus, R.&Rajamäe, R.&Tiirmaa, R. 1995. On the Age of Meteorite Craters at Kaali (Saaremaa Island, Estonia). *Proc. Estonian Academy Sciences, Geology* 44, 177–183 = Raukas et al 1995.

Veski et al 2001 = Veski, S&Heinsalu, A&Kirsimäe, K.&Poska, A.& Saarse, L. 2001. Ecological Catastrophe in Connection with the Impact of the Kaali Meteorite around 800–400 BC on the Island of Saaremaa, Estonia. *Meteorities & Planetary Science 36,* 1367–1375.