Archaeoastronomy and Ancient Technologies **2018**, 6(1), 1-20; http://aaatec.org/art/a_lj1

Archaeoastronomy and Ancient Technologies

www.aaatec.org ***ISSN 2310-2144***

The Wolf's Jaw: an Astronomical Interpretation of Ragnarök

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Abstract

This paper aims to explain the eschatological outbreak that occurred during the X century in Scandinavia and northern Europe, which gave rise to a great iconography of Ragnarök, stemmed primarily from the Old Norse mythology. Our basic hypothesis is that various astronomical phenomena which occurred during in the VIII and IX centuries (total eclipses of the sun and passages of comets, both related to the constellation of Wolf´s Jaw - the Hyades) have aroused in the Nordic man his eschatological fears, impelling him to create a large amount apocalyptic images close of the year 1000 AD. We identified thirteen celestial phenomena (comet passages and total eclipses of the Sun) that may have been collected in the construction of the Ragnarök image among the ancient Norsemen. Our main methodology is the Cultural Astronomy, coupled with the prospects of the cultural history of myths. Aided by several studies on medieval astronomical folklore, especially those related to comets and eclipses. We also use some recent research on the theme of celestial myths and Old Norse Astronomy developed by European and American scholars, such as Gísli Sigurðsson, Thomas DuBois, Christan Etheridge and Dorian Knight.

Keywords: Comets and eclipses, Cultural Astronomy, Folk Astronomy, Hyades, Viking Age, Norse Mythology, Ragnarök.

Introduction: Cultural Astronomy and Mythology

The relationship between astronomical phenomena and mythology is nothing new in academia. During the early nineteenth century, several scholars attempted to study the origin of mythical narratives from the glimpse of nature, as, for instance, Max Müller and Paul A. Krappe Decharmedid. Even among Scandinavian scholars the naturalistic theory was very common, with frequent systematization of that time – as in the book *Northern mythology* by Benjamin Thorpe - who regarded the gods as personifications of meteorological, astronomical or atmospheric events. This simplistic and deterministic view of myths started to be left out little by little. During the twentieth century, but especially after the 1960s, scholars began to discover that many European peoples built ancient monuments which displayed astronomical orientations, such as Stonehenge, Avebury and Carnac, giving rise to the discipline of Archaeoastronomy. It was then that researchers began to apply anthropological references to the study of astronomical

knowledge among people with no writing system, like the American Indians, the Africans and the Polynesians (and then later they expanded this perspective to written cultures, resulting in the Ethnoastronomy).

Currently we can define some paradigms around these two congenerous disciplines: archaeological and ethnological perspective which can help solving some issues from prehistory to the Middle Age by using comparison as their main method (without falling into generalizing, universalistic or psychological schemes though) and the other considering the sky as an abstract and cultural category (Baitty, 1973, pp. 389-422) according to who the aid of language, literature and folklore is also necessary. It must be an interdisciplinary approach that can be accepted between the various scholars of Human and Hard Sciences (Iwaniszewski, 1994, p. 12). Archaeoastronomy must maintain a line of inquiry beyond the sciences, being demarcated within the Archaeological Landscape studies, history of religions and the Archaeology of Power (Avilés, 2005-2006, p. 25). The benchmark may provide important archaeoastronomical additive elements to the study of material culture of ancient religiosity (Polcaro, Polcaro, 2009, p. 242). Archaeoastronomy can not only use modern benchmarks of Astronomy, because the latter is a product of Western rationality and it breaks the concepts of nature and culture. Thus, it is necessary to approximate the celestial events to the social vision of the period studied, going beyond purely material sources (Serrano, Caderot, 2009, p. 11-21)[1].

As to references to the Cultural Astronomy in relation to myths, they usually start from case studies referenced by Anthropology and History of Religions - especially among American archaeoastronomers. For the famous researcher Anthony Aveni (Aveni, 1993, p. 96-148), the sky was a reflection of society, and the astronomical mythology to be an unit that regulates the everyday individual and collective. According to Jean-Pierre Verdet (Verdet, 1987, pp. 11-23), astronomical myths are made up largely of symbolic images that dynamically change according to the historical context. Directly linked to our object, some myths can be adirect reflection of abnormal celestial phenomena (cataclysmic events under the old framework, as the glimpse of comets and eclipses, but especially physical impacts of meteorites), whose social interpretation was defined by religious and symbolic values at a given time, resulting in a mythology preserved iconographically, architecturally or literarily (Bon et al, 2010, pp. 221-222).

Promising studies on classical field made by Amanda Laoupi demonstrated the benchmark analysis of myth as a source for studies of astronomical events. In addition to extensive documentation on the use of the Pleiades (cluster in the Taurus constellation) for navigational guidance, path for seasonal and calendar, periodicities of equinoxes and solstices, this star cluster has also been linked to mythologies related to disasters. The archaeologist Laoupi (Laoupi, 2006a, pp. 1-15; 2006b, pp. 129-142; 2006c, pp. 5-22; 2010, pp. 1-18; 2011, pp. 1-32) has been

[1] Some scholars prefer to use the term Cultural Astronomy, in Archaeoastronomy and that would encompass the Ethnoastronomy and yet according to some traditional History of Astronomy (Polcaro, Polcaro, 2009, p. 223). Some also believe that in reality the Archaeoastronomy is a division of the History of Astronomy and it is not a much defined methodology, while for others it would be a subdivision of Archaeoastronomy in Archaeology (Polcaro, Polcaro, 2009, p. 223). For a historical perspective of studies of Archaeoastronomy and Ethnoastronomy, consult: (Iwaniszewski, 1994, pp. 5-20). According to this author, North American researchers try to explain the causes of ancient astronomical activities, from literary, artistic and cultural sources, while Europeans care about the accuracy of ancient astronomical activities (in quantitative and statistical methodology) (Iwaniszewski, 1994, p. 11). For the Spanish archaeologist Antonio Belmonte Avilés (Avilés, 2005-2006, p. 26) Archaeoastronomy is any investigation of the practices of observing the sky with cultural purposes (religion, divination, architecture, decoration, painting, engineering, calendar, navigation etc.) in any region of the planet that is not considered a direct contribution to the study of the history of modern Astronomy. In this case, the division between North American and European Archaeoastronomy within the S. Iwaniszewski model no longer holds itself. Estonian folklorist Andres Kuperjanov (Kuperjanov, 2006, pp. 37-62) has adopted the term folk astronomy to define the study of astronomical knowledge in medieval and modern people.

conducting a series of studies on the periodicities of catastrophic events in the classical world and their presence in archaeological and mythological data (comets, supernovae, solar emissions, etc.) and their effects on social dynamics of the ancient Mediterranean peoples, in what she calls Astromythology and Archaeology of the disaster.

For our part, we consider a system on myth-based representations in everyday life and religiosity, structured according to social practices and whose meaning is organized in the adequacy of individual experience with symbolic meanings defined by the culture of a given time (Langer, 1997, p. 116). For the study of astronomical myths, we believe that the comparative approach is the one which suits best, not only to improve the understanding of the impact of astronomical phenomena in ancient societies, but also to clarify the interactions and networks that myths have in a given cultural field. The mythologist Marcel Detienne (Detienne, 2004, pp. 109-120) argued about the use of an experimental approach to demonstrate the connection between the mythology with the objects and phenomena of social life and the natural world, demonstrating that the inherent symbolism in the myths has also an objective facet directly related to concrete materials and aspects of a culture, and not merely metaphors or abstract theological products.

Studies on astronomical mythology of Medieval Scandinavia have produced some results, but they are still negligible compared with other areas and seasons. The most detailed study is still the one by Otto Siegfried Reuter (Reuter, 1982, pp. 47-50), originally published in 1934, which relates myths with celestial phenomena, but without further insights into the relationship between mythology and society. The only published book on the topic, *Star myths of the Vikings*, by authorship of the Icelandic medical doctor Björ Jonsson (Jonsson, 1994) has suffered heavy criticism from astronomers and Old Norse scholarships, but has the merit of having aroused Astromythology's interest in the Viking Age. For a critique of Jonsson´s celestial maps consult: (Kuperjanov, 2006, pp. 37-62; Langer, 2013a, pp. 27-35).

The 2000s produced the earliest modern discussions of astronomical knowledge in the Viking Age, in addition to initial research pointing to celestial elements in Northern Mythology. Some case studies have been published more recently by astronomers James Ogier (Ogier, 2002) and Timothy Stephany (Stephany, 2006). Professor Gísli Sigurðsson (2009, pp. 851-861) provided an excellent overview of the relationship between the eddic poems and the *Gylfaginning* with possible records of celestial myths, and a literature review about Old Norse Astronomy in some publications.

The latest studies published in this area were by Christian Etheridge (Etheridge, 2014, pp. 1-12), which deals with mythological and poetic sources on Old Norse Astronomy and its relation with Middle Ages Scandinavia after Christianization. Another author, Thomas DuBois, has been investigating the comparatively astronomical traditions of Scandinavia and the Baltic, through the myths and folklore[2], and an exceptional comparative study on mythologies involving constellations and stars between the Nordic and Sámi and Finnish areas (DuBois, 2014). Another extremely interesting study analyzed beliefs involving Moon and the calendar in Norse mythology (Knight, 2013).

[2] Thomas Dubois held the conference: "Nordic Mythologies: An Areal Perspective" (Old Norse Mythology in its Comparative Contexts, Harvard Universitet, 2013) and "Underneath the self-name Sky Conference: comparative perspective on Sámi, Finnish, Scandinavian Astral Lore in Medieval Nordic Mythologies" (Nordic Mythologies, University of California, 2012). For a more detailed literature review focused on studies of Astromythology and Ethnoastronomy in Medieval Scandinavia: (Langer, 2013a; 2013b, pp. 97-112; 2013c, p. 1-32).

In the next sections, we are going to demonstrate our interpretation of how the Hyades cluster in conjunction with total eclipses of the Sun and Moon and comets during the eighth and ninth centuries contributed to the explosion of literary and iconographic references to Ragnarök in the British Islands and Scandinavia in the 1000 AD.

The Ragnarök and the figure of the wolf

The term Ragnarök means "end of the destinations of the supreme powers" and refers to a series of events that culminated in the death of the most important Norse gods and the destruction of part of the universe, after which some deities and humans survive in a new and renewed cosmic order.

Figure 1. Bracteate of Trollättan, Sweden, 6th century.[3]

Figure 2. Bracteate of Skrydstrup, Denmark, 6th century[4].

Unlike other mythical narratives, the Ragnarök was little represented imagetically during the Viking Age, becoming better known in literary and iconographic sources from the 9th century. Being originally a part of the pagan worldview, why has Ragnarök been so little represented visually before the 9th century? In our previous work (Langer, 2012, pp. 1-30) we suggested that the "awakening" of artistic representations of this theme were caused by the clash of pagan Danes in a Christian world full of apocalyptic and millenarian references (Anglo-Saxon England during the 9th century). Without denying this interpretative route, including the ideological use

[3] https://i.pinimg.com/736x/9c/58/5d/9c585df5a699134264593f23491633e9--viking-jewelry-sweden.jpg (last accessed on 31 January 2018).
[4] http://www.arild-hauge.com/arild-hauge/DR-BR6.jpg (last accessed on 31 January 2018)

by Church towards to narratives of the death of the Norse gods, we believe that there were motivations prior to this outbreak imagery, all related to the constellation of wolf´s jaw[5].

The Figure 1 is interpreted as being the god Týr attacked by the wolf Fenrir, after it had been tricked by the gods. Figure 2 is possibly the god Odin (surrounded by two birds, a horse or deer and a snake, a typical of other odinic basis sets). The canid represented his left hand is threatening, with an open mouth full of teeth and attacking it from behind. According Pluskowski (Pluskowski, 2001, pp. 113-131), figure 2 is a representation of Ragnarök, showing that it was part on the pre-Christian imaginary.

The figure of the wolf is of utmost importance in the history of pre-Christian European religiosity and, as the dog, it had a symbolic relationship with death. In addition, both animals had a connection with the warrior ideology (as Ulfhednar and Odin's two wolves, Geri and Freki) and battles, giving the family names related to wolves in runic inscriptions and ritual initiations of young warriors, as attests Anne-Sofie Gräslund (Gräslund, 2004, pp. 124-129). Another very important and also connected to death association and war is the theme of the wolf in Odin´s wild hunt[6].

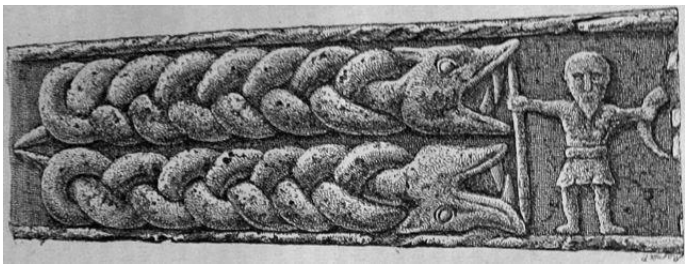


Figure 3. Scene from Gosforth Cross, England, 10th century[7].

Figure 4. Scene from Gosforth Cross, England, 10th century.[8]

The figure 3 represents a spearman fighting a wolf figure. The figure 4 represents a warrior opening the jaws of a wolf figure. Both illustrations were done by Finnur Jónsson in 1913. The dominant motif of Gosforth is the head of a wolf whose body interlaces, finishing another canid head or body structure turning into little wings. One of the heads was carved showing an open mouth facing against an armed knight with a spear, possibly the god Odin (North Face); on the

[5] For ~~a~~ major literary and iconographic sources as well as from academic interpretations of Ragnarök (see Langer, 2012, pp. 1-30). Christopher Abram (Abram, 2011, pp. 157-168) considers that the main source of Ragnarök, the poem *Völuspá* is a cultural product of an Era of instability, the coexistence between paganism and Christianity - that influenced both the cultural syncretism of poets and audience of the season. For a recent discussion of the pre-Christian Norse eschatology, especially around the eddic poem *Völuspá*, consult: (Gunnel, Lassen, 2013).

[6]Langer, 2014. Principal references to canids in Norse mythological sources: *Völuspá* 40, 44, 49, 51, 56, 58; *Grímnismál* 19, 39, 44; *Gylfaginning*11, 33, 37, 49, 50; *Lokasenna* 38; *Fjölsvinnsmál* 14; *Hákornarmál* 20; *Eiriksmál*7.

[7] https://throwbackthorsday.files.wordpress.com/2016/01/gosforth_cross_monsters.jpg?w=920&h=348 (last accessed on 31 January 2018)

[8] https://upload.wikimedia.org/wikipedia/commons/f/f7/Gosforth_Cross_V%C3%AD%C3%B0arr.jpg (last accessed on 31 January 2018)

other side of the cross, two-headed monsters are secured by a spear of a warrior, who in his other hand holds a horn port (West Face, Fig. 3). Some researchers believe that it is the god Heimdall, but possibly should be another representation of Odin and Fenrir. The most famous front face of the cross features two separate scenes (East Face). The first, where a lupinian head is safe for a warrior carrying spear, whose hand opens the upper jaw and the leg enters the forked tongue and the lower jaw extends - an allusion to Vithar killing Fenrir during the Battle of Vigrid (Fig. 4). The Gosforth Cross is a wonderful artistic work that reveals the enormous cultural hybridity that society was experiencing at that moment, attesting to the adaptation of Christianity to pagan values.

The main figure of the wolf in Norse mythology is Fenrir, a wolf which is an enemy of the gods: he is the son of Loki and the giantess Angrboda. Originally, Fenrir meant inhabitant of the swamp, an appropriate term for a monster. Fenrir is also called Fenrisúlf (the wolf Fenrir), but this use has never been properly explained according to John Lindow (Lindow, 2001, p. 111), which still attaches to the entity two roles in mythology: one as mutilator of Týr and the other as the slayer of Odin during Ragnarök. According to Rudolf Simek (Simek, 2007, p. 80), the myth of Fenrir has been divided by Snorri Sturlusson into four separate stories: the arrest of the wolf; the battle of Ragnarök and his death by Vidar; hi escape from Hel, the same route that Garm; devour the sun and moon. Therefore, Simek (Simek, 2007, p. 81) believes Fenrir, Garm, Skoll and Hati are different names for the same entity.

The antiquity of Fenrir's myth can be dated based on images of the migration period in bracteates manufactured between the 5th to 6th centuries, such as in Trollättan, Sweden, which presents a man being attacked by a canine in the hand (Fig. 1). In another bracteate (Skrydstrup, Denmark), a man finds himself surrounded by a horse and two birds, while a third animal, a canidae, attacks from behind (perhaps an early image of Odin in Ragnarök) (Fig. 2). To Aleksander Pluskowski (Pluskowski, 2001, pp. 113-131) these images are evidences of the origin of the image of the wolf as an enemy of the gods and belies the outdated nineteenth-century vision of Sophus Bugge regarding Ragnarök, who considered it as a fully Christian construction. Also in runic inscriptions (such as in Ribe, 8th century), we have the association between the wolf, Odin and Tyr.

Two skaldic poems from the 10th century confirm the presence of the wolf Fenrir as an enemy of gods and animals, also advocating the antiquity of Ragnarök the Nordic pagan imaginary[9]:

Hákonarmál 20 "Mun óbundinn á ýta sjöt Fenrisulfr of fara, Áðr jafngóðr á auðatröð konungmaðr komi."	*Hakonarmál 20* "Unchained will over men's home Fenris wolf fare, as good as before over desolated path comes the king."
Eiríksmál 7 "Hvi namt þuhann sigri þa er þer þotti hann sniallr vera þvi at ovister at vita sagðe Oðenn ser ulfr enn hausve a siot goða."	*Eiríksmál 7* "Then, why you take his victory away when yourself thought him beign a brave? This to be known is uncertain, said Óðinn, however, the gray wolf is looking ghastly to the gods abodes."

[9]Translation of Pablo Gomes de Miranda based an edition by (Jónsson, 1908).

The *Eiríksmál* poem makes reference to Ragnarök by mentioning the wolf Fenrir, who watches the gods, waiting to be released. The color used to describe him, gray, also reveals possible implications with the notion of volcanism (typical in Iceland, see the surveys relating to the Fimbul winter cataclysms of the 6th century in Iceland (Gräslund, Price, 2012, pp. 428-443))[10] or total eclipses of the sun. One of the poem's *Hákonarmál* most famous stanzas is a reference to the wolf Fenrir, telling he would be released soon, evidencing that the Ragnarök was not a late Christian invention, but based on authentic native tradition.

Further evidence of the pagan origin of Ragnarök is a runic inscription Skarpåker (154 Sö, Sweden, dating from the early eleventh century): "Kunarraisþi stain at lyþbiurn sun sin iarþ IFNAR salt ubhimin uk" (Gunnar raised this stone in Lydbjörn; the land must be open and the sky above..."[11]). It is virtually impossible that a narrative - supposedly "invented" by Christians - could have had such a wide distribution between the years 930-1020 AD and containing many literary and iconographic references in such different pagan contexts (in Danish England, Iceland and Sweden). As demonstrated in a previous study (Langer, 2012, pp. 1-30) the Old Norse eschatology perhaps originally did not have the importance of other mythical narratives, but the contact with the Christian tradition changed this perspective - which added to the reasons presented in this study - and it began to hold a much greater importance. Also here we do not deny the fact that the narratives have suffered additions by Christian writers and that some symbolism has been used as propaganda and ideological means for a better conversion of the heathen. Nevertheless, it does not allow us to consider Old Norse eschatology as a totally belated product of the new religion.

The greatest difficulty for researchers is to find the origin of the image of the wolf as an apocalyptic monster, which is non-existent in the Christian cosmology. Various references in the Old Norse tradition belated his representation, whose greatest period of literary and visual representations were from the tenth century developed a hypothesis that may elucidate some aspects of this problem. Starting from the idea created by Otto Siegfried Reuter (Reuter, 1982) in 1934 (Fig. 5 and 6), followed by Jonas Persson (Persson, 2003), we consider that the cluster of the Hyades (in the constellation Taurus, Tau) was interpreted by the Old Norse people as the asterism of wolf´s jaw: it is a set of bright stars forming a V (with ten times the apparent width of the Moon) oblique around the bright star Aldebaran. This cluster is very noticeable during most of the year in the Scandinavian regions, especially from October to March, with more than a dozen stars visible at naked eye as a whole[12].

A direct reference of the association in Scandinavian sources between the Hyades and the Old Norse wolf is found in an Icelandic manuscript (GKS 1812 4th, *De ordine ac positone stellarum*

[10]In a recent conference, archaeologist Neil Price (2013) discussed the possibility of winter that precedes Ragnarök (Fimbul winter) in Norse mythology, was originated by an eruption of a volcano in 536 AD, with devastating impact on the global climate, including a prolonged obscuration of the solar disk.

[11]Translation by Johnni Langer based on the edition of (Marez, 2007).

[12]The open star cluster of the Hyades draws the face of Taurus and the brightest star of this constellation, Aldebaran (that actually belongs to the cluster) was the eye of this animal to the people of Mesopotamia, Greece, Egypt and Rome, and continuity of symbolism in medieval and muslin world. At a distance of 150 light-years from Earth, arm of the Hyades, lies Theta Tauri, visual double star, but the brightest star of the set is Theta 1 (at magnitude 3.1). The Hyades cover 5° of the heavenly firmament. In Greek mythology, the Hyades were the daughters of Atlas and Aethra, and sisters of the Pleiades (Ridpath, 2011, pp. 172-173). The cluster of the Hyades has always been very important to Asian societies, the Middle East, the Mediterranean and South America She was associated with the timing marks on the temple of Mnajdra I on the island of Malta.; India and ancient Egypt; in pre-Inca Peru (Kelley, Milone, 2011, p. 202, 271, 294, 444). In a provocative study (Boutsikas, Hannah, 2011, pp. 342-348) showed that the Hyades were related to the narratives of the mythical king of Athens, Erechtheus, but also connected with religious festivals during the visibility of this cluster above the Acropolis, involving young girls of 7-11 years.

in signis)[13], in its section dated 1192 AD, there is mention of the constellation of the Hyades using their native name, before Christianization: *Ulf's Keptr* (wolf's jaw).

The detail of the wolf's jaw is fundamental in the narrative of Ragnarok (*Gylfaginning* 51): "*Fenrisúlfr ferr meðgapandi munn, ok er inn Nedri kjöftr við Jordu, en in Efri við himin. Gapa Myndi hann meira, ef tilværi rumen. Eldar brenna or augum hans ok nosu* ("Fenrir the wolf runs with his mouth open, his upper jaw reaches to heaven and under the earth; it would you even if there was room fire out of their eyes and nostrils"[14]).

Figure 5. Constellation of Wolf´s jaw (Hyades) according to German researcher Otto Reuter (original illustration in German, 1934), situated between the Pleiades (Seven Stars) and Orion (Roca Frigg).

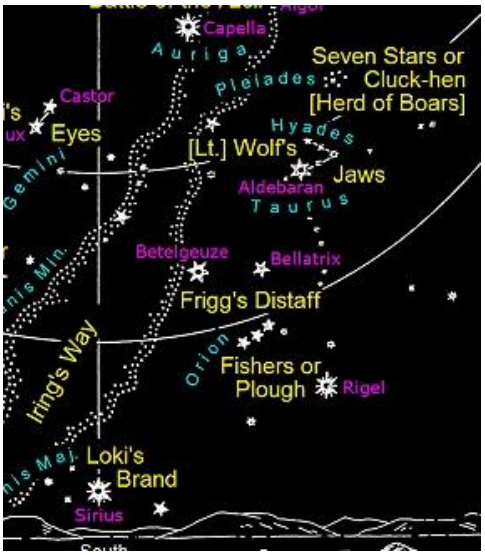


Figure 6. Constellation of Wolf´s jaw (Hyades). Colorful illustration in English based on the original Otto Reuter, 1934 (Wolf's Jaws, (Reuter, 1982)). The interpretation of the constellation of Orion as the Roca Frigg is based on Nordic folklore and also considered as correct.

[13] Available in: https://handrit.is/en/manuscript/imaging/is/GKS04-1812#page/3v++(8+of+77)/mode/2up (last accessed on 31 January 2018).
[14]Translation by Johnni Langer based on the edition of Anthony Faulkes (Sturluson, 2012).

As we are going to see below, there is evidence of astronomical involvement of Hyades with comets and eclipses, which added to the iconography of the wolf´s jaw in Northern Europe of the Early Middle Ages, make this hypothesis a highly compelling one.

Table 1. Astronomical phenomena of the Early Middle Ages[15]

Dating	**Type of phenomenon**	**Description**	**Viewing area of the phenomenon**
03/01/713 AD	Total solar eclipse	Sun, *Hyades*, Castor and Pollux	Scandinavia
01/24/734 AD	Total lunar eclipse	Moon, *Hyades*, Jupiter, Castor and Pollux	England and Scandinavia
11/23/755 AD	Total lunar eclipse	Moon, *Hyades*, Castor and Pollux	Scandinavia
04/12/758 AD	Total solar eclipse	Sun, *Hyades*, Jupiter, Venus, Mercury, Castor and Pollux	Denmark and German
05/04/813 AD	Total solar eclipse	Sun, *Hyades*, Jupiter, Mars, Venus, Mercury, Castor and Pollux	Scandinavia and Northern Europe
12/25/828 AD	Total lunar eclipse	Moon, *Hyades*, Jupiter, Mars, Saturn, Castor and Pollux	Scandinavia
04/18/837 AD	Halley comet	Halley, *Hyades*, Mercury, Venus	Northern Europe and Mediterranean
05/05/840 AD	Total solar eclipse	Sun, *Hyades*, Jupiter, Venus, Mars, Mercury, Castor and Pollux	German and Central Europe
06/16/885 AD	Total solar eclipse	Sun, *Hyades*, Jupiter, Venus, Saturn, Mercury, Castor and Pollux	Scandinavia and Northern Europe
04/04/891 AD	The great comet of 891	891 comet, *Hyades*, Mercury, Venus and Mars	Scandinavia and Europe
08/08/891 AD	Partial solar eclipse	Sun	Scandinavia and Northern Europe
06/07/894 AD	Total solar eclipse	Sun, *Hyades*, Venus, Mars, Mercury, Castor and Pollux	Scandinavia
07/03/912 AD	Halley comet	Halley, *Hyades*, Saturn	Scandinavia and Europe

Comets and Hyades in the Viking Age

Comets are among the most formidable shows that Heaven gives to man since the dawn of time. No matter what period, comets have always aroused great interest of crops, creating the most diverse interpretations of this celestial object. More specifically in Northern Europe during the Viking Age (793-1066 AD), the passage of some comets occurred. What would the perceptions of Scandinavian about these phenomenon be? In the primary sources, in both *Eddas* and the Icelandic sagas, as well as in the historical chronicles previous to the 9th century, it is not

[15]The data for total solar eclipses (date and visibility of all areas, including geographic breakdown with maps) were obtained from the NASA website (http://eclipse.gsfc.nasa.gov/solar.html (last accessed on 31 January 2018). For regional reconstruction of the eclipses of the moon and passages of comets also employ planetary open computer code: *Redshift 7 Launcher* and *Stellarium* 0.11.3. The constant references to astronomical phenomena in Early Middle Ages sources (dates and types of phenomena) were obtained from: (Brazeul, 1984, pp. 56-57; Mardon, Mardon, 1991, pp. 385-393; McCarthy, 1997, pp. 1-23). For a detailed list of astronomical, meteorological and climatological phenomena of the Middle Ages, with secondary bibliographic reference (Chatfield, 2013).

found any direct allusion to them, but we can use the comparative methodology of the Cultural Astronomy to suggest some interpretative hypotheses.

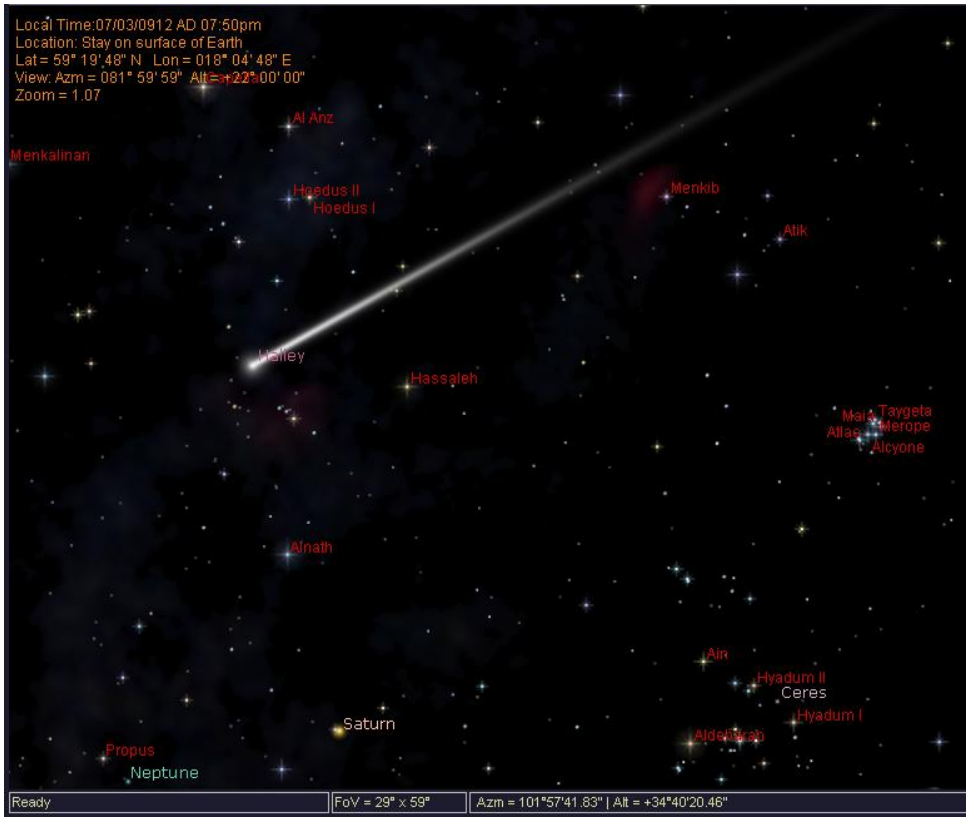


Figure 7. Simulation of the comet 1P/Halley, seen in Stockholm on July 03, 912 AD. On the right, there are perceived clusters Pleiades and below, the Hyades (the constellation Taurus), which we consider as the Wolf´s jaw to the Norse world. Reconstitution according to Redshift 7 Launcher program. Remember that unlike meteors/meteorites, comets are not fast phenomena, being glimpsed at rest relative to the stars around, changing its position and size/brightness with the passing days. Therefore they have a major impact in the ancient peoples´ minds.

The greatest comets recorded in the Viking Age were the passages of 1P/Halley in 837, 912 and 1066 and the Great Comet of 891 AD - observed in England, France and Germany - which leads us to believe they were also accompanied in Scandinavia (Fig. 7). Most sources of the Norsemen (all already Christianized) associate these celestial objects with the death of kings, following a centuries-old tradition of considering comets negative omens or signs of bringing calamities and disasters to men (Gomes, Navarro, 1985, pp. 158-165; Mourão, 1985, p. 375), or the example of the *Anglo-Saxon Chronicle*, associating with famines. The famous record of 1P/Halley in the Bayeux Tapestry in 1066 (see Fig. 8) is an example of this imagery[16].

Recorded in the Bayeux Tapestry (supposedly made in 1070 AD) - to the imagination of the time, the comet was associated with the fall of Harold II (who was defeated by William II of Normandy at the Battle of Hastings in October 1066 AD). On the image, King Harold consulting an astrologer about the star, who explains to him that it would be a bad omen (Fig. 8).

[16]For an analysis of Anglo Saxon and Irish records of comets and meteors during the Early Middle Ages (Brazell, 1984, pp. 56-57; Mardon, Mardon, 1991, pp. 385-393; McCarthy and Breen, 1997, pp. 1-23).

Figure 8. The passage of Comet 1P/Halley between April and June 1066 AD[17].

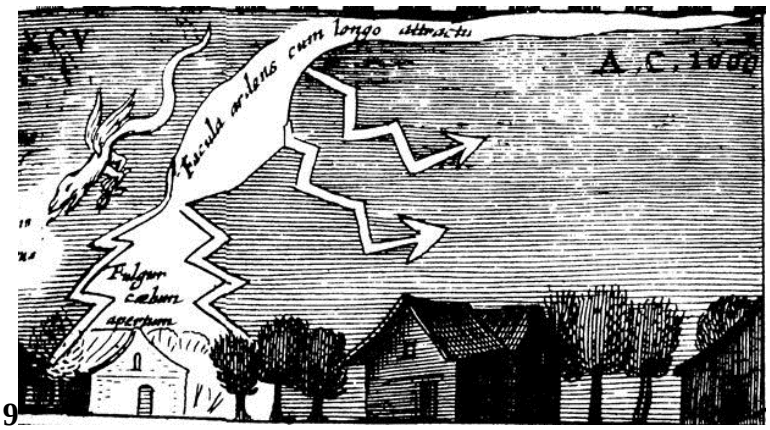
In regards to royalty we cannot perform any direct evidence on the Old Norse world in the case of comets. The basic idea of *cosmic disorder* may have been presentin the Scandinavian society in Viking Age. In most cultures of the world comets sowed terror, like total eclipses, following an ancient tradition of fear and anguish that have not disappeared even in modern times (Verdet, 1987, pp. 77-91). Most researchers did not develop studies in Old Norse Astronomy on the subject of comets. Even so, they occur sporadically in some amateur work, as Ignatius Donnelly, the famous theorist of Atlantis. In a study published in the nineteenth century, he defended the idea that a large comet collided with Earth about 12.000 years ago, producing much of the known myths, and among them, the snake in the world of Norse myths (Donnelly, 1883, pp. 144-145). The theory of cosmic impact on history came back in vogue with Immanuel Velikovsky in 1950´s and more recently with groups of geologists and astronomers who have also endorsed the assumption that the impact of comets or meteors may have originated largely the mythology - including the Scandinavian (Carlson, 1986, p. 71; Hense, 2012). For our part, though we consider the study of the relationship among celestial catastrophes and history an extremely promising prospect, we believe that it has been exaggerated in some points. It is not always possible to explain the origin of myths by mere contact of natural phenomena, considering they have other social, political and even religious motivations. This relationship, much more than causal or deterministic, is *dynamic*. Some myths were created by observing nature, but also many myths are designed in nature, and in the case of the heavenly firmament[18].

Thus, we consider that although the ideas of Donnelly are very fanciful, lacking major physical and astronomical evidence and without more contextual and academic analysis of the *Eddas*, even so its basis remains essentially correct in that the Viking Age comets were interpreted as manifestations of the snake in the world (*Jörmungand*). In many other cultures close to Scandinavia, such as the medieval and modern Baltic, there is an occurrence of ancient

[17] https://en.wikipedia.org/wiki/Comet#/media/File:Bayeux_Tapestry_scene32_Halley_comet.jpg (last accessed on 31 January 2018).

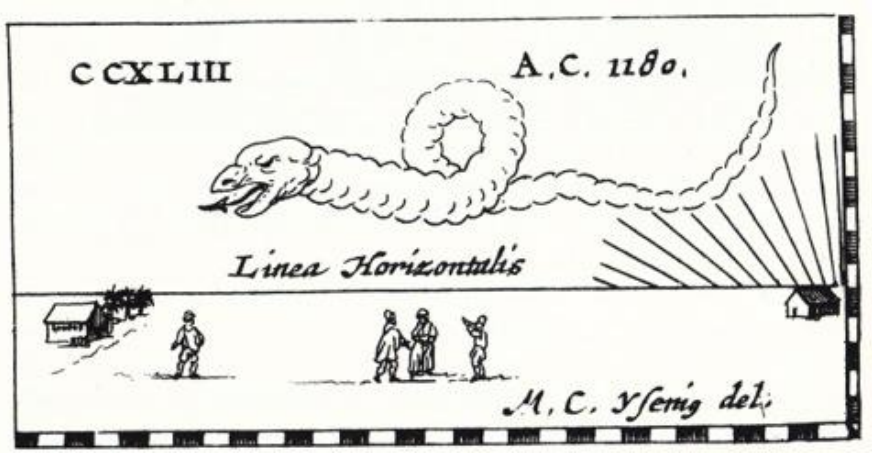
[18]The archeoastronomer Clive Ruggles (Ruggles, 2005, pp. 72-74, pp. 110-112) stated the current debate on the question of catastrophic astronomical events in human history, separating the sighting of comets and meteors and their impact on social and political order of society as an element of cosmic disorder, and on the other hand, the physical impact of meteorites on the planet (with devastating geographical, climatological and physical consequences of disasters on communities).

folklore associating meteors and comets with flying serpents (Avilin, 2007, p. 113) (Fig. 9 and 10).



9 **10**

Figures 9. Comets in the year 1000 AD associated with dragons in the medieval European imagination (Lubienietz, 1668, p. 172).



Figures 10. Comets in the year 1180 AD with flying serpents in the medieval European imagination (Lubienietz, 1668, p. 172).

In the Middle Age, besides these two phenomena, auroras were also seen as flying dragons of fire, usually by people with pestilence and famine, as recorded in the *Anglo-Saxon Chronicle*, in the *Irish Annals* (Mc Carthy, 1997, p. 7; Brazell, 1984, p. 57) and in dozens of other manuscripts (Dall' Uomo, 1980, p. 13, p. 21). Some reports have medieval and renaissance characterization of comets as great serpents spitting poison or fire on heaven (Delumeau, 2009, p. 111, see Fig. 9 and 10).

In Ragnarök, the destruction of the world and the gods is associated with the release of two monsters, the snake of the world - coming out of the ocean - and the Fenrir Wolf - who escapes from his prison in the underworld and opens his jaw covering the Earth and the sky. The sun and the moon are children devoured by the wolf Fenrir, the stars fall and then soon after emerge from a slit in the sky, Muspell and the sons of the giant Surt riding across the sky engulfed in fire - being his sword brighter than the sun (*Gylfaginning* 51). In other words, before the battle on the field of Vigrid, destruction comes mainly from the heavenly firmament. If we think that the Scandinavians had a great knowledge of Astronomy, essentially preserved in mythology (Sigurðsson, 2009, pp. 851-861), so the seasonality of celestial phenomena reflected a divine-cosmic organization that was broken by the appearance of comets, eclipses, meteors, and auroras - chaos revealed, it was an object of fear and evil omens announced. Everything points to a

negative conception of comets by the Norse, and especially when it comes to the appearance of 1P/Halley in 837 AD (estimated with a magnitude of -3, extremely bright) or the great comet of 891 AD, both possibly reached a large size in their tails and consequently of their visibilities (see table 1). Probably the Scandinavian interpreted these big celestial objects to be snakes or celestial dragons, and perhaps associating these with Jörmungand and the dawn of Ragnarök.

Total eclipses and Hyades in the Early Middle Ages

By analyzing the occurrence of ten solar and lunar eclipses during the Early Middle Ages (which were at that time visible in Scandinavia), we have found that nine of these phenomena occurred between 713 and 894 AD, and happened close to the Hyades cluster (interpreted by us as the constellation of Wolf´s jaw to the Norse people). In the case of total eclipses of the sun, which took place in a day for nearly ten minutes, the cluster was visible (at the time of totality, when the whole sky got dark), and in the case of eclipses of the moon, it was visible throughout most of the night . Moreover, also the passages of large comets (like Halley in 837 and 912 AD) were also close to the asterism of Wolf´s jaw. Total eclipses of the sun 755, 840 and 885 AD and the total eclipses of the moon 734 and 755 AD were recorded in English and German chronicles. In particular, the total eclipse of the moon in 828 AD occurred during the winter solstice (25 December).

Recently, archaeologist Mike Parker Pearson (Pearson, 2004, pp. 86-91) compared several Iron Age sites in areas that have pan-Germanic alignments facing total eclipses of the moon during the winter solstice, demonstrating that in addition to observations, these phenomena were astronomically registered. Also, the astronomer Göran Henriksson (Henriksson, 1996, pp. 475-485) examined several petroglyphs of Sweden Bronze Age, concluding that some of those images can be records of the comet Encke near the cluster of the Pleiades (constellation Taurus), during a total eclipse of the Sun occurred in 1595 BC, which would confirm the interest and the record for this type of astronomical phenomenon in Scandinavia long before the Viking Age.

The glimpse of eclipses and comets passing are the two most impressive astronomical phenomena in a social and historical perspective, and certainly they had a significant impact on Old Norse society. We do not defend here that the observation of nature originated the myths, but that the myths were reinforced by it, as they already existed in the imagination. Transferred to the celestial vault, myths take on a new meaning and a new dynamism.

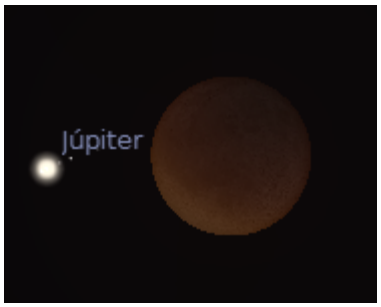


Figure 11. Expanded simulation of the total lunar eclipse of November 23, 755 AD, as the city of Copenhagen (Denmark), Stellarium 0.11.3 Program. Fig. 11 corresponds to the moment of totality, which occurred 17h.

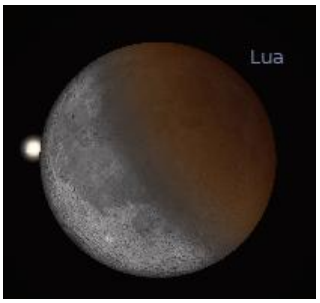


Figure 12. Soon after, 17h: 46m - already with the lunar disc with half of obscuration, Jupiter began to be obscured by the Moon. The planet was seen by observers in England as a star, hidden after the eclipse, documentary later recorded by the chronicler Simeon of Durham.

Thus, the occurrence of major ephemerides traditionally interpreted by cultures around the world to cause chaos and disorder, reinforced the apocalyptic symbolism in the Scandinavian imagery during the eighth and ninth centuries, culminating with the explosion of literary and visual references from the 10th century. This would explain the rare visual representations of Ragnarök in pre-Christian Scandinavia and its sudden emergence from the years 930-1000 AD.

In the mythical tale, the first cosmic event that precedes the battle field Vigrid is the time when wolves swallow the Sun and the Moon (*Gylfaginning* 51), a clear reference to eclipses of both celestial corps. At the moment of totality of the moon's disk, it usually receives crimson tones, creating the imaginary idea of a "moon of blood" (idea contained in *Völuspa* 41 and *Gylfaginning* 12). After Jörmungandr (also called "sea dog" in some poems) arose out of the sea and into the earth, Fenrir runs with its mouth open and its jaw protruding from earth to heaven. This is a crucial detail in the story, because soon after Odin is killed by the wolf, and then his son Vidar steps with his foot in Fenrir's jaw and then divides it with his hands, killing the beast (*Gylfaginning* 51). Earlier, during Fenrir's imprisonment, the gods have inserted a sword in his mouth (*Gylfaginning* 34). All these details converge to a strong symbolism of the wolf´s jaw (bracteates visually present in the migration period and carved cross in Gosforth in England, Fig. 1, 2, 3 and 4), further evidence of the asterism of Wolf´s jaw.

The personification of the moon (Máni) and the sun (Sun) in Norse mythology, unlike most of the world's narratives, presents the moon as a masculine being inhabiting the Old Norse world, a fact which is also observated in Irish (Ealhada), Lithuanian (Mēness) and Slavic (Jarilo) mythologies. The sun, on the contrary, (sun, Sunna) was seen as a feminine being, like in Slavic (Solntse), Lithuanian (Saule) and Finnish (Beiwe) myths. In the eddic poem *Vafthrúdinismál* 22-23, Odin asks the wise giant Vaftrúdinir why do the sun and the moon traverse the sky above men and the answer is that both are children of Mundilfeari (the one that moves according to the weather), making this path through the sky each day and measuring the years. In *Gylfaginning* 11, Snorri gives another version of these stars: Mundilfari is the father of two very beautiful children called Máni and Sun. They remain guiding two carriages which carries the disks of the Sun and the Moon until the time of the Ragnarök when both will be devoured by wolves Skoll and Hati. However, this is only explained in Snorri's material, especially in the case of the Moon - a wolf named Managarm (hog Máni) will feed the life of all humans and will stain the sky with the blood of the Moon and the Sun which will lose their luster (*Gylfaginning* 12). Surely, this is an allusion to the total eclipse of the Moon, which is denominated in various European cultures as the Blood Moon - a phenomenon caused by the refraction of sunlight by the atmosphere during the total cover-up of the lunar disc. The eddic poem *Grímnismál* 37-38 reinforces some elements presented by Snorri, as it mentions the horses Arvakand and Alsvid pulling the wagons

of the brothers, but describes the shell detail Svalin, which protects the mountains and seas of solar heat.

The pagan apocalypse, in this way, is centered on the emergence of monsters, especially lupines, giving the name of this moment to Vargöld (Wolf-Age, *Völuspa* 45), this is, the moment of cosmic chaos. Considering this, the figure of Fenrir becomes prevalent in Scandinavian imagery due to its status as a predatory animal whose consuming power is transferred to the Wolf´s jaw constellation. And in turn, the Christian imagery readily fit all this symbolism to their own apocalyptic references, as reflected in animal transgressive monstrosity of human dominion over nature, as evidenced by Aleksander Pluskowski (Pluskowski, 2005, pp. 141-160).

Some British sculptures preserved the image of wolves chasing a cosmic disk: the hogback of Ovingham 1C, where a canid attacks a hard disk; in the hogback of Tyningham are also two canids remaining part of a circle and touching it with their paws. These two monuments were performed by the pagan Danes in England during the years 900-950 AD and demonstrate the idea that cosmic chaos was a pre-Christian imagery that was eventually adapted to the eschatology of Christianity's theme. Thus, the Norse wolf is also found in crosses of Andreas and Gosforth and Lidberg runestone, dated from 10th to 11th century: in all of them one canid attacks the god Odin. In these cases, the death of the Norse god also serves as an ideological tool for the conversion, and the wolf figure means a reconciliation between the new and old religion, in view of Aleksander Pluskowski (Pluskowski, 2003, pp. 155-176; 2001, pp. 113-131).

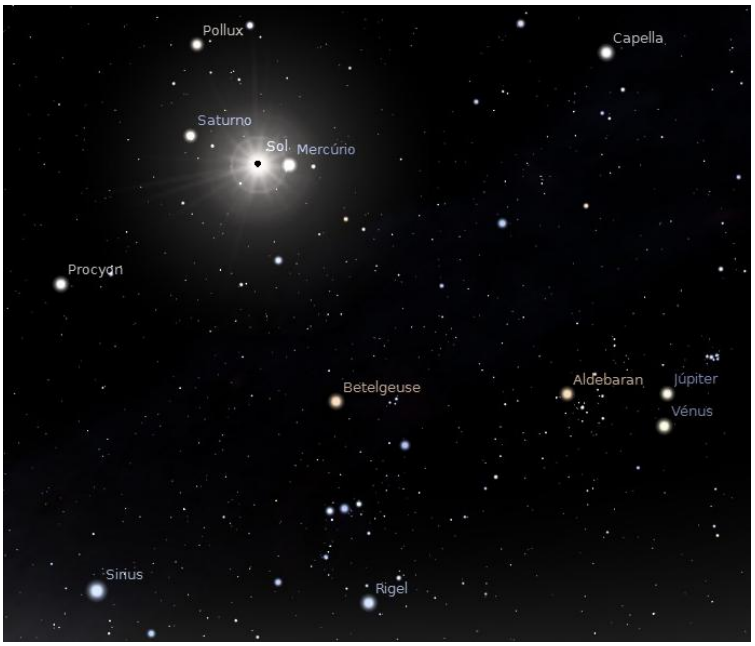


Figure 13. Simulation of a total solar eclipse seen in the Swedish town of Sundsvall on June 15, 885 AD. (Stellarium 0.11.3).

The constellation of Wolf´s jaw (the Hyades) is next to the planets Jupiter and Venus (Fig. 13). More to the side, there is the constellation of Orion with its bright stars Betelgeuse and Rigel, besides the famous Three Marys in its belt. On the far left, the brightest star in the sky, Sirius, in the constellation Canis Major. Above the disk of the sun eclipsed, located the Saturn and Mercury. Overhead, the stars Castor and Pollux (Gemini constellation), identified by us as the Norse constellation of Eye of Tiazi.

Conclusion: Heaven, myth and Science

Studies of astronomical knowledge and social reception of celestial phenomena in ancient and medieval world is still an area filled with problems, questions, but also full of various investigative possibilities. There are many reports, chronicles, iconographic sources and eyewitness accounts of phenomena considered known (such as comets, eclipses and meteor showers) and unknown (fire dragons in the sky, gleaming swords, crowns of fire - which can be auroras, parhelia /"sun dog", Sun and Moon halos and other celestial, meteorological and geo-climatic events). Known historical figures such as Charlemagne and Harald Godwinson, and some anonymous chroniclers, issued some objective opinions on these events. Other facts may have been interpreted within specific symbolism of the imagery, adding up to mythological and religious narratives, or even causing new myths.

Various astronomical and meteorological phenomena were recorded in Ireland, England (especially in the *Anglo-Saxon Chronicle*) and in early medieval Germany, as aurora borealis (765 AD), The sun and moon halos (773, 806 AD), tornadoes (793 AD), intense solar flares (807 AD), meteors (810, 823 AD), extremely cold winters in Europe (with icing up until Egypt, 829 AD), double disc of the sun (909 AD). Did they have anything to do with the eschatological outbreak in Northern Europe in the 10th century? How have these phenomena been interpreted in Old Norse imagery? These and many other questions are arising in the study of Cultural Astronomy applied to Antiquity and the Middle Ages. Even the Vikings may have been interpreted by other people within the astronomical reference (during the first Norse attacks on England in 793 AD, the *Anglo-Saxon Chronicle* listed the same with signs of fire dragons in the skies and lightning, possibly aurora borealis, also recorded in Ireland on that date[19]).

We hope to have given some thoughts that may help future researchers on this topic. There are many questions, but also many sources and documents to be analyzed by historians and scholars interested in the study of myth, religion and the social imaginary. The trail is open.

Acknowledgments

To professors Gísli Sigurðsson (University of Iceland), Neil Price (Uppsalla Universitet), Aleksander Pluskowski (University of Reading), Thomas DuBois (University of Wisconsin–Madison), Christian Etheridge (University of Southern Denmark) by sending bibliography. Victor Hugo Sampaio (PPGCR-UFPB) and Alexandre Amorim (NEOA-JBS) for revised this paper; Pablo Gomes de Miranda (PPGCR-UFPB) for his help in translations.

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[19]Being the Anglo-Saxons have christened, but still interpreting these phenomena within the mythological reference, as was the reaction of the Vikings to the same events? They must also have been visible throughout Scandinavia.

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