

Cultural Astronomy

A status of archaeoastronomy in a cultural context

Abstract

Cultural astronomy is the set of interdisciplinary fields studying the astronomical systems of current or ancient societies and cultures. The fields include e.g. archaeoastronomy (use of astronomy in prehistoric sites or sites from antiquity or even later e.g. up to medieval), historical astronomy (historic astronomical data), ethnoastronomy (astronomy and its role in contemporary cultures), the history of astronomy and the history of astrology (difference between astronomy and astrology). Sometimes archaeoastronomy is combined with other disciplines as archaeology or archaeotopography, even genetics¹ appear now and then. I just finished my PhD in cultural astronomy and I would like give the background and line up the possibilities by working interdisciplinary in the field of cultural astronomy. The field is rather complex and do not have sharp defined boundaries and is still developing including more and more disciplines. My latest article in Adoranten, 'Neolithic Cosmology?' Adoranten 2014, (Clausen, 2015) is an example of a work in cultural astronomy.

Background

The original main idea of the discipline of archaeoastronomy is to combine the two topics: astronomy and archaeology. In this way archaeoastronomy becomes an interdisciplinary discipline or topic.

The ideal archaeoastronomer would be a person with a MA in both astronomy and archaeology. This is still rare, but a handful of persons fulfill this criterion. If you can master both disciplines, you become familiar with two traditions of scientific method. As an archaeoastronomer you will probably be more aware of typological identical units or formations spread out over a wide area in both distance and timespan² and therefore be equipped to consider possible astronomical or topographical explanations for a phenomenon. The latter term, topography, belongs to the discipline of archaeotopography, where landscape formations play a central role in explaining ancient remains which are to be observed.

Archaeoastronomy today is part of a much more general field known as cultural astronomy, which includes such disciplines

as astronomy, archaeology, anthropology, ethnography, astrology, history, the study of ancient languages, church science and more.

In recent years, it has become more common to work internationally in an interdisciplinary or intercultural fashion in the fields of both scientific and humanistic subjects. This method sometimes gives birth to completely new ways of seeing things and making connections. For example, you can combine astronomy, history, archaeology and genetics³ and in this way reveal the familial relationships between the Egyptian pharaohs, thus most likely providing a new view of factual history. This, of course, is only possible when using written sources. Intercultural cooperation is in a strong phase of development and, unfortunately, Denmark is only weakly represented in the field of cultural astronomy.

Brief history

The first one known to use archaeoastronomical methods to determine the age of

an ancient construction was probably the English astronomer Sir John Frederick William Herschel (1792 -1871). Herschel tried to figure out the age of the Cheops pyramid based on astronomical observations and calculations. The pyramid's entrance corridor points at a spot on the northern hemisphere's night sky, which is very close to the point corresponding to the geographical North Pole. Herschel guessed that the Egyptians had aimed towards the star called Alpha Draconis ("Dragon's Heart") also known as Thuban in Egyptian mythology⁴.

With knowledge of precession (the 26,000 year period of the Earth's rotational axis), it is possible to turn the starry sky backwards in time until the selected star on the precession circle is in the desired position. However, there are always two solutions to the problem; one when the star is approaching the polar center in the sky, and another when the star moves away from that point again⁵. The two solutions found by John Herchel for Alpha Draconis put this star in the desired position in 2160 BCE and in 3400 BCE. The accepted age of the Cheops pyramid today is about 4500 years, that is, it stems from around 2500 BCE.

The English astronomer and astrophysicist Sir Norman Lockyer (1836–1920) became aware during a trip to Greece in 1890 that a number of the classic temples were oriented towards the point where the Sun sets at the horizon. Lockyer is also known for his discovery of the element helium in the solar spectrum and as the founder of the journal, *Nature* (1869).

In 1906 Lockyer published an article in *The Times* which, for the first time, brought the subject of Stonehenge into public discussion⁶. Norman Lockyer was also the first to make large-scale implementation studies of prehistoric stone installations; unfortunately, he was over imaginative with his interpretations, and was therefore not taken seriously by his contemporaries. Thus, the "thread" in Lockyer's work was not taken up until many years later.

In 1963, the English astronomer Gerald Hawkins (1928 - 2003) published an article on Stonehenge in *Nature*, and in the following years he published a series of articles

in various journals dealing with subtopics within archaeoastronomy. The one most mentioned is "Stonehenge Decoded"⁷. Hawkins' notable result in this context was a possible interpretation of the application of Stonehenge. In brief, he had the idea that those who built Stonehenge had mapped the movements of the Sun and the Moon along the horizon so precisely that it was possible to predict lunar eclipses – and perhaps even solar ones.

The English astronomer Sir Fred Hoyle (1915–2001) has also worked with Stonehenge. He treats the subject in an article in *Nature* in 1966⁸. Hoyle's ideas are quite controversial and rather unlikely. In his opinion, the so-called Aubrey circuit with 56 holes that surrounds the stone structure in Stonehenge is a model of the ecliptic. If this is so, it would have been possible for the Stonehenge people to follow both the intersections (nodes) of the Moon as its pitch reached the plane of the ecliptic. Hoyle has therefore stated that "it would be ironic to think that the invisible knot [the one that does not cause an eclipse] has inspired the idea of a hidden god, a hidden god who is the guiding force behind everything, and thus could be the basis for the oneness of God, *monotheism* (who is worshiped in Christianity and by Muslims) to be of astronomical origin." (Free quoted). Hoyle has been heavily criticized for this hypothesis, especially by religious historians⁹.

Other researchers, like Hoyle, have perhaps also moved out onto "deep water" – this includes the English professor and BSc (with a special distinction in Engineering) Alexander Thom, known for the discovery of the "megalithic yard", hereafter "my"¹⁰. The "my" is a length of 83.5 cm, ostensibly used repeatedly in many stone structures from megalithic period (about 5000 BCE to about 2800 BCE) within the Neolithic period, in both the British Isles and on the European mainland. Thom got the idea that people during the megalithic period used the magic of numbers in their culture. In some stone structures in which there are several concentric circles (or ellipses) with growing perimeters, which is always represented by an integer, so that from one

"circle" perimeter to the next perimeter can always be shared with figures from the series of numbers, doubling numbers as : 2.5 ; 5; 10; 20, well-marked if we use the "my" as unit. It appears obvious that a sequence of digits using a doubling of numbers is used in the case of several concentric ellipses, for example in "Woodhenge", just north of Stonehenge, where the ellipses have circumferences with the values: 40 "my", 60 "my", 80 "my", 100 "my", 140 "my" and 160 "my". One finds that an ellipse with the circumference 60 "my" corresponds to the series of numbers 3 (x 20), 6 (x 10), 12 (x 5) and 24 (x 2.5); and that an ellipse with the circumference 160 "my" corresponds to the series of numbers 8, 16, 32 and 64. The approximately 500 stone circles that Thom examined in the British Isles can be divided into classes of different shapes, for example: circles; flattened circles; composite circles; egg-shaped and more. The reason for this could be that the Neolithic people from the megalithic period in the British Isles sought an integer relationship between the circumference of a circle or similar forms (such as ellipses) and their diameters. That is, they were looking for something that corresponds to the circle constant; *pi*. Such thoughts have been strongly criticized by many researchers; thus giving archaeoastronomy a weak and bad reputation for quite a few years.

A breakthrough for the discipline probably stems from the time when organizations that devoted their work to archaeoastronomy were founded. One example is the Center for Archaeoastronomy, a professional research organization founded at the University of Maryland in 1978. The center later helped to establish ISAAC, the International Society for Archaeoastronomy and Astronomy in Culture in 1996, to promote the academic development of archaeoastronomy and ethnoastronomy around the world.

The latter was inspired by SEAC, the European Society for Astronomy in Culture. SEAC does not have a physical seat, and the Executive Committee (EC) represents the Society. The Society was founded in Strasbourg, France, in 1992, under the inspira-

tion of the late Professor Carlos Jaschek, and had its inaugural meeting in Smolyan, Bulgaria, in the summer of 1993.

In the 1990s, comprehensive field work was done in the Mediterranean by the English astronomer Michael Hoskin and the Spanish astronomer Juan Antoni Belmonte. Likewise, the English astronomer and archaeologist Clive Ruggles did comprehensive work in the British Isles. Clive Ruggles is regarded as one of the leading figures in the field of archaeoastronomy.

The work of Hoskin, Belmonte and their colleagues was published in *Archaeoastronomy: The Journal of Astronomy in Culture* and later in the *Journal for the History of Astronomy*. The main conclusion of this work is that most megalithic monuments in Western Europe are oriented towards the Sunrise pointing towards east to southeast and climbing at the southern parts at the horizon. This is known as the Sunrise/Sun-climbing (Sun-culmination) theory, SR/SC¹¹.

In addition to the different organizations and published work in journals, the internet has become more and more important, with different websites dealing with archaeoastronomy and megalithic monuments. Worthy of mention is the Megalithic Portal, a database founded in 1997 and active as a website since 2001.

The discovery of the Nebra sky disk close to Mittelberg some 60 km west of Leipzig, Germany, in 1999 (see Figure 1), dated to the early Bronze age (1600 BCE), was not known by the public until 2001. Great efforts and much money have been used to interpret the meaning of the symbols on the disk. Since the Nebra Sky Disk (also known as the Nebra Sun Disk) emerged into public knowledge, archaeologists and astronomers have put forward their theories about how it worked and what it meant to the ancient society that fabricated it. The general opinion is that the symbols on the disk are related to the Moon, the Sun and Moon, the stars and perhaps the Pleiades and the extreme points of the Sun. But what do we really know? Michael Rappenglück (current president of SEAC) argued in a speech ("Fire from the heavens") at the SEAC 2014 conference for another



Figure 1. The Nebra sky disk. It is possible that the large symbols that the left are Moon/Sun, crescent Moon and the angle between the Sun's extreme points (standstill points) at the eastern horizon. The big symbol at the bottom; the "Sun boat", the smaller symbol; stars, and the cluster of seven smaller symbols close to the center at the top could be the Pleiades, but might it not also be a human (happy, smiling) face? Photo © J. Lipták/LDA Halle

view on the disk. His conclusion is that we in fact do not know what the idea is with the Nebra sky disk. This just emphasizes the fact that we cannot be sure of finding the right interpretation of archaeological artefacts from ancient times. This is a key point in astronomy in culture, in this case, more precisely, in archaeoastronomy.

Present work in the field of cultural astronomy and related disciplines

Today it is common to hold annual conferences, seminars, workshops, etc. in the field of astronomy in culture. Conferences often result in conference proceedings containing about 50 to 80 peer-reviewed papers. The topics cultural astronomy or astronomy in culture are internationally comparable with the topic of cosmology and, as such, are accepted scientific and humanistic disciplines.

Concerning the work with megalithic monuments, new methodologies are being

developed and new statistical methods have emerged (see e.g. González-García, 2009 or González-García and Belmonte, 2010).

Examples of new measuring techniques would include the use of aerial photos (orthophotos) or satellite surveys¹². Google-Earth can be a useful tool in this connection. Magnetic surveys¹³ of the ground can reveal the presence of stone blocks or material with different density in the ground, which can indicate the remains of a megalithic monument (see Figure 2); further, imprints of removed stone blocks can give an idea of the layout of a missing monument.

Also, the development of models which can animate astronomical phenomena at the horizon is in progress. In this way it is, for example, possible to test an imaginary use of the Stonehenge complex.

Megalithic monuments easily lend themselves to statistical testing and research on model hypotheses due to the enormous numbers of units in Western Europe and

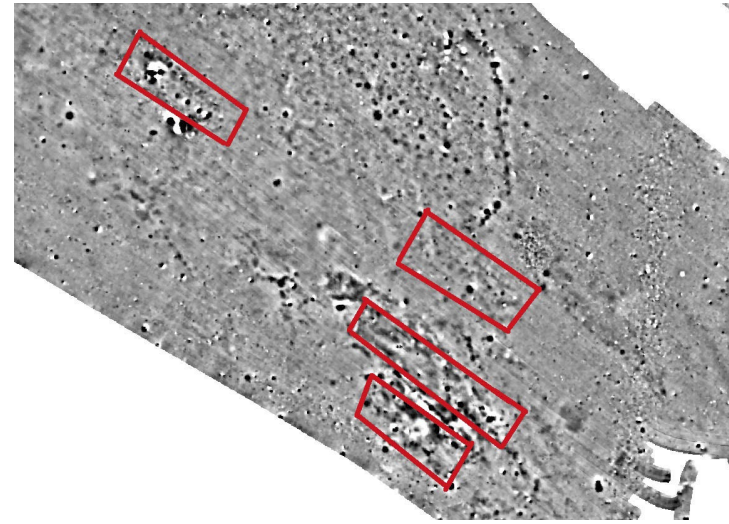
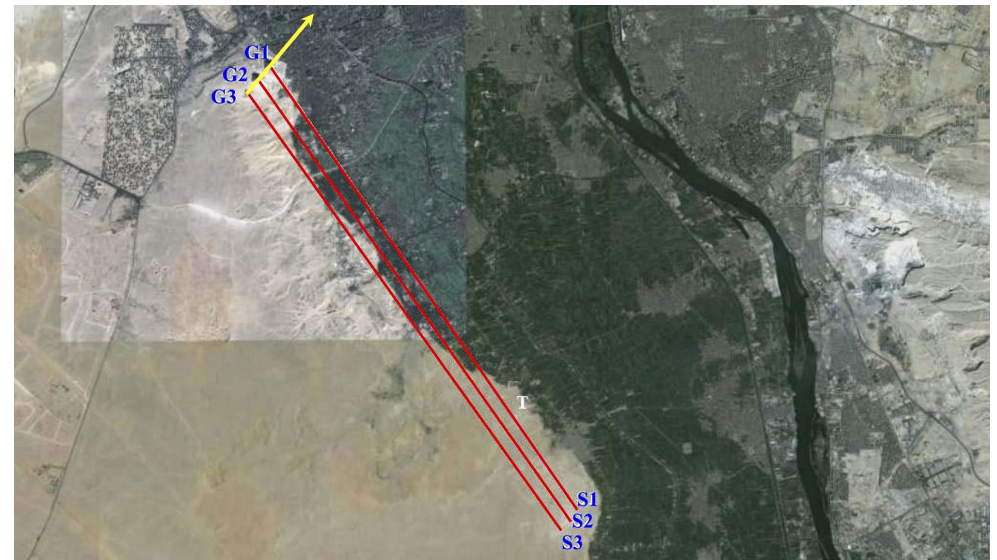


Figure 2. Magnetometer measurement on a field close to the location Snave at the western part of the Danish island Fünen¹. Contours marked with red reveals the features of four long barrows (with dolmens) constructed approximately around 3400 BCE. Figure adopted from (Andersen, 2013) edited by Claus Clausen

neighboring areas. In Denmark alone, around 5000 megalithic monuments are preserved. Of these, about 700 are of the passage grave type.

In recent years more focus has been on the behavior of the Moon, i.e. the full Moon or the crescent Moon, in connection with megalithic monuments – especially in

Figure 3. A satellite image of the Memphite area. Lines connecting the Giza pyramids of Khufu (G1), Khafre (G2) and Menkaure (G3) respectively with the Userkaf (S1), Djoser (S2) and Unas (S3) pyramids in Saqqara are shown with red color. Following the alignment line (yellow arrow) of the three Giza pyramids in the northeastern direction, it crosses the Heliopolis area in today's Cairo, which should be the position of the original ancient Heliopolis. Figure adopted from (Magli, 2010) edited by Claus Clausen.



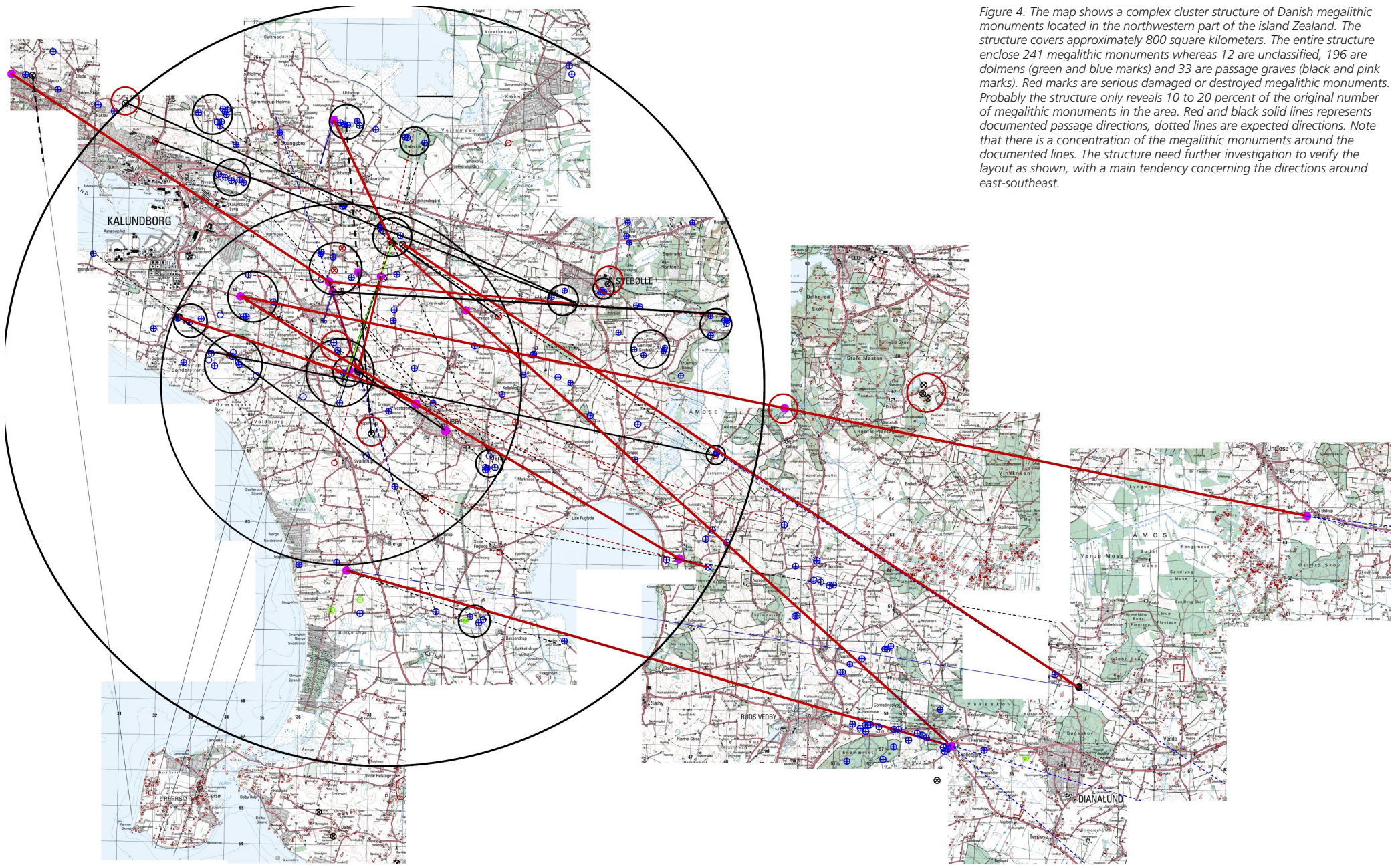


Figure 4. The map shows a complex cluster structure of Danish megalithic monuments located in the northwestern part of the island Zealand. The structure covers approximately 800 square kilometers. The entire structure enclose 241 megalithic monuments whereas 12 are unclassified, 196 are dolmens (green and blue marks) and 33 are passage graves (black and pink marks). Red marks are serious damaged or destroyed megalithic monuments. Probably the structure only reveals 10 to 20 percent of the original number of megalithic monuments in the area. Red and black solid lines represents documented passage directions, dotted lines are expected directions. Note that there is a concentration of the megalithic monuments around the documented lines. The structure need further investigation to verify the layout as shown, with a main tendency concerning the directions around east-southeast.

Europe. Statistical results indicate that a lunar explanation rather than a solar one could be favored in the case of megalithic

monuments. The Moon has a more complex movement at the horizon than the Sun, which could be the reason that the Sun has

been the primary object dealt with in past years. This is probably also because in present times, we find it more logical to turn

to the Sun, for example, for calendar use. The problem, however, is that we have no knowledge whatsoever about what man

in Neolithic times thought about what was logical or illogical.

The new way of working has also revealed that passage tombs (passage graves or dolmens with a passage) and other megalithic monuments from later periods in antiquity, for example the pyramids in Egypt, are linked in linear relationships (Magli, 2010) (see Figure 3). The interpretation is not always astronomical, but rather archaeotopographical. Commonly, tomb orientations towards a local mountain or hill which could have a significant meaning in relation to local belief systems are found (examples: Clausen, 2012; Fabio Silva, 2012; Prendergast, 2005 and 2006).

A general picture seems to be that line relations/sight lines/alignments were very important for prehistoric Neolithic man in Europe and later in antiquity as e.g. for the Egyptians. In details, it is interesting that clusters of passage tombs both in Denmark (Clausen, 2012) (see Figure 4) and in Ireland (Prendergast, 2006 and 2007) are linked together as the group G and S pyramids highlighted on Figure 3.

An interesting work (Belmonte and González-García, 2013) on megalithic structures in ancient Magan on the Arabian Peninsula located in the area today known as Oman, shows that the monuments by time change orientation. The conclusion is that either a new people with different ideas came to the area or the present people changed their belief system. In both cases, the change in orientation shows a change in the culture. Quoted from the conclusion of (Belmonte and González-García, 2013):

“This new custom speaks of a probable change in the builders’ worldview, either by a shift in their religious beliefs or the arrival of a new population. This could be easily checked by a comparative genetic analysis of a statistical significant sample of individuals buried in the two types of graves.”¹⁴

In spite of the great number of megalithic monuments in Denmark, very little research has been done in this field. In recent years, very few works have been published concerning the placement and orientation of Danish megalithic monuments. Worthy of mention are work done by Niels H. An-

dersen (Eriksen and Andersen, 2014) and Claus Nybo, who received an MA in 2009 in the field of Danish passage graves. His MA project report was entitled “Heaven’s Gate”. He measured about 400 passage graves, but unfortunately, he never made his work available to the public by publishing it. Hopefully, my PhD thesis will help to focus more attention on the subject in the near future, so that Denmark can be more strongly represented internationally and in cooperative projects.

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Notes

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² Furholt, M. and Johannes Müller, J., 2011: *The earliest monuments in Europe – architecture and social structures (5000-3000 cal BC)*, p. 20, in: Furholt, M., Lüth, F. and Müller, J., *Megaliths and Identities, Early Monuments and Neolithic Societies from the Atlantic to the Baltic*, 3rd European Megalithic Studies Group Meeting 13th – 15th of May 2010 at Kiel University, ISBN 978-3-7749-3745-1

³ Belmonte, J. A., Instituto de Astrofísica de Canarias, Tenerife, Spain. *The last days of Nefertiti: astronomy, archaeology and genetics in ancient Egypt*. (Belmonte, 2015 SEAC, Public Lectures)

⁴ Rantzau, P., 1972: *Alle tiders tal*, ISBN-13, Politiken 1972, p. 38.

⁵ Clausen, C., 1997: *Astronomi med sten og stænger*, *Aktuel Astronomi* nr. 3 1997, p. 30.

⁶ Lockyer, Norman, 1906: *Stonehenge and other British stone monuments astro-*

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⁷ Hawkins, Gerald S., 1963: *Stonehenge Decoded*, *Nature* 200 (26 October 1963), pp. 306 - 308.

⁸ Hoyle, Fred, 1966: *Stonehenge: an eclipse predictor*, *Nature* 211 (30 July 1966), pp. 454 - 456.

⁹ Nilson, Peter, 1969: *Kring några undersökningar av Stonehenge och andre frönlämningar på de Brittiske öerne*, *Astronomisk Tidsskrift*, nr. 1, (1969), p. 21.

¹⁰ Thom, A., 1971: *Megalithic Sites in Britain*, Oxford at the Clarendon Press [1971], Chapter 5, p. 43.

¹¹ Hoskin, M., Churchill College, Cambridge, and colleagues, 1998: *Studies in Iberian archaeoastronomy: (5) Orientations of megalithic tombs of northern and western Iberia*, *Archaeoastronomy* no. 23 in the *Journal for the History of Astronomy* xxix, p. S86 - S87

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¹² Magli, Giulio, *Archaeoastronomy in the Khmer Heartland*, School of Architecture, Urban Planning and Construction Engineering, Politecnico di Milano, Italy. Fig. 4 and Fig. 5, p. 19 – 20.

¹³ Smekalova, Tatyana N., Voss, Olfert and Smekalov, Sergey L., 2008: *Magnetic Surveying in Archaeology*, More than 10 years of using the Overhauser GSM-19 gradiometer, 2nd revised edition. *Wormanium* 2008 p. 13.

¹⁴ Belmonte, J. A. and González-García, A. C., 2013: *On the Orientation of Early Bronze Age Tombs in Ancient Magan*, *Mediterranean Archaeology and Archaeometry*, Vol. 14, No. 3, pp. 244.

Note (figure 2)

¹ Andersen, Niels H. 4.2.2013, *Magnetometermåling ved Snave*, Foreløbig redegørelse vedrørende magnetometermåling af marker beliggende vest for Snave, p. 2.

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