

Astronomical Orientations of the Megalithic Burials of Palippothana⁹

*Thilanka Manoj Siriwardana, Nadeera Harshajith Dissanayake, Indika Ruwan Jayasekara and
D. Thusitha Mendis*

There is a light that shines beyond the world, beyond everything.

Beyond all, beyond the highest heaven....

This is the light that shines in your heart...

- *Chandogya Upanishad*

Introduction

This chapter focuses on the astronomical orientation of megalithic burials at Palippothana, Kahatagasdigiliya. During the field surveys, it was noticed the burials are not randomly constructed but deliberately oriented in a range of angles. The reported angle range is precisely overlapping with the annual lunar path and sun path. This will be the first record reported from Sri Lanka of orienting the megalithic burials with such astronomical patterns; hence, only the findings and basic interpretations will be made. It will need further studies with other burials to strengthen the idea.

While there is copious literature on the megalithic-protohistoric studies in Sri Lanka, the burial orientation has taken into minimal account. The only available records including orientation of the skeletons (Ragupathy, 1987), slab orientation in a single burial (Liyanage, 2006) and mentioning the orientation of bodies in the Indian megalithic burials (Sasitharan, 2012). Overall, however, the orientation of megalithic tombs in Sri Lanka was not subjected to a discussion earlier.

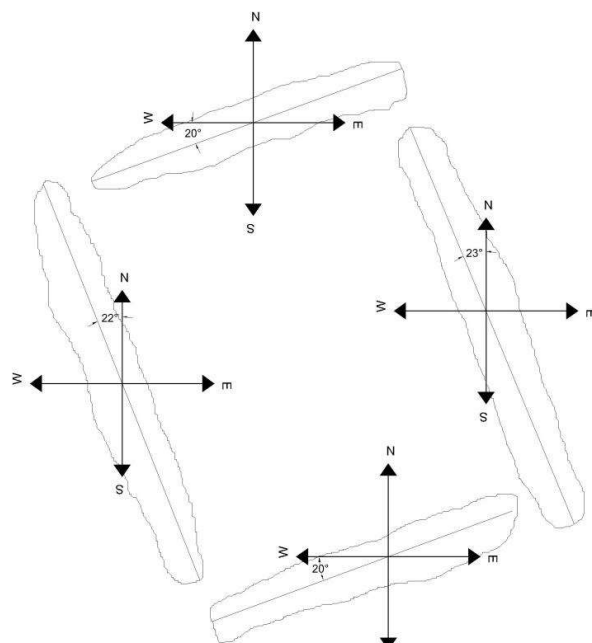
Many megalithic sites around the world reported with their orientation with lunar standstill and sun solstices. A. Thom (1971), CLN Ruggles (2015), Lionel Sims (2016), Frank Prendergast (2016) and many others introduced several theoretical underpinnings to understand this phenomenon in archaeoastronomy and approaches to study the megalithic burials.

Methodology

Only the undisturbed slabs were selected to measure the angles. An orienteering lensatic compass was placed parallel to each slab's edge, and the graduation ring used to measure the positive or negative difference of the angle of each slab relative to North or West

⁹ An extended version of this chapter will be published in the Ancient Ceylon, 2021 volume.

and was measured relative to the edge of a slab. Angles were taken to the nearest round degree. At the end, all the recorded data were converted to azimuth bearings. Recording method illustrated in Plan 6-1.



Plan 6-1 Method used to record the angle of the slabs

The converted tabular data of North-South slabs and East-West slabs were projected separately into a graph with each record's angle. Except for the double orthostat burials, other E.W. projections rotated 90^0 and overlapped with the N.S. records. The final projected graph tested along with the solar and lunar paths. The magnetic North bearings are different from the true north; current magnetic declination at Kahatagasdigiliya was recorded (magnetic-declination.com), which shows a $-1^0 53'$, negative (west) declination. This error was not corrected in the recorded data.

The term 'cist' refers to the burials constructed by using four slabs or have evidence of such a construction and with or without a capstone. The burial chamber can be square or rectangular. The term 'double orthostat' describes burials with two vis-à-vis slabs and other ends open. The schematic visualisation of the results was created by using Autocad software. The graphs are projected to the west of a matrix, and the number of slabs and burials shown in a graph at the edge of the matrix. The length of the line represents the number of slabs or burials. This creates a comparable graph.

Results

Fifty-three burials out of eightyone recorded burials has slabs suitable to take angle readings. There are 149 slabs in the burial, and 113 angles were recorded from slabs (n=109) and capstones (n=4). The angles and azimuth recordings are given in Annexure 01 - Table 6-2. The remaining slabs come from the burials that are either partially destroyed or not in good condition.

The range of the angles is between 0^0 to 40^0 , and none of the burials exceeding the maximum. While most of the burials fall into the range 0^0 to 30^0 (96.5%), only four slabs have 40^0 (two slabs from a single burial and two isolated cases) and no slab reported in the angles between 30^0 - 40^0 . 28 out of 52 burials show the same angle occurrence in all of its recorded slabs, which was reported from burials with two slabs (n=16), burials with three slabs (n=8) and burials with four slabs (n=4). Fifteen burials have a single slab or capstone suitable to record the angle. Nine burials have slabs with differently angled orientations. In such cases, the most well preserved or longest slab was taken into account, and other angles were disregarded. Fifty-four slabs (49%) in 25 burials are aligned into cardinal directions either with exact magnetic North (n=31) or west (n=23). Among others, seven burials face S.W., and 17 burials face N.W., relatively to the western slab of each. Fifty-nine slabs oriented into ordinal directions. There are seven single slab burials, where four are facing west, and three are facing north.

Slabs of four double orthostat burials facing exact north and slabs erected east-west direction, except burial 15, which both slabs facing N.W. by a 15^0 - 20^0 angle. This burial is also unique among the other similar type due to the slab size, elevation from the ground level, and the fineness of slab preparation. A wall-like construction between the two slabs was identified during the excavation of this burial. Burial no. 10 is another double orthostat but has west-facing north-south oriented slabs, and also, the slabs are not vis-à-vis. It is possible to be another burial tradition.

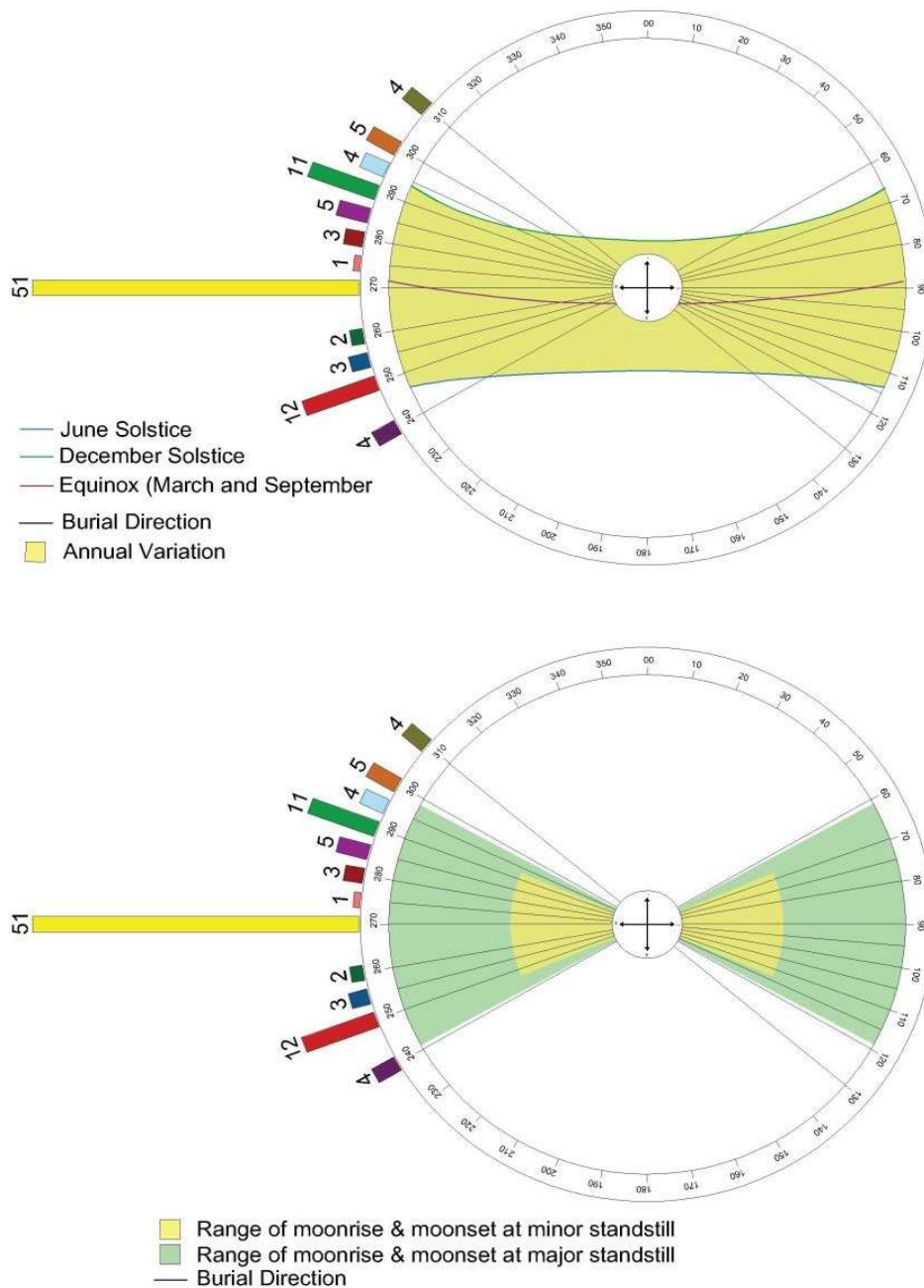


Chart 6-1 Slab orientation of the burials in Palippothana.

Several noteworthy observations were made from the above cases. Burial no. 25 shows a peculiar orientation of its slabs. Three slabs of the burial are angled 20° toward N.E. facing direction. Two separate stone slabs are erected to the west side of the northern section of the burial. One of the slabs is 30° angled toward N.E. facing while the other slabs were erected in exact N.S. alignment. It should also note the burial no. 27, the largest burial in the complex, is oriented north and its cupmarks are also slightly aligned to N.S.

The above-measured angles were projected into X.Y. graph, and then the angles of north-south oriented slabs were rotated 90^0 and aligned with the east-west graph. This step was performed only on the remains identified as a part of cist burials. Double orthostats were examined separately.

Discussion

The above results indicate the Palippothana burial complex contains two types of burials where the cist burials face west or ordinal directions of north-west or south-west in a specific frequency of range and double orthostat burials facing north or north-west. Prendergast (2016, 12) propose ten criteria for assessing megalithic tomb orientation as; random, view, societal, sacred, geographies, water, topographical, focal, skyline and astronomical. It is apparent the burials are not randomly oriented and not evidence of the causative contribution of the societal or sacred factors. Except for the location of rock outcrops impacting the burial clustering, no other evidence is falling into the geographical, topographical or skyline criterion. Four burial clusters are associating with the rock outcrops, and no other meaning could raise. Two burial clusters have several burials which are in a line but has different angled positions. As the 0^0 - 30^0 angled orientation of the burials are higher as 96.5%, it was assumed a repetitively observable event(s) such as an astronomical phenomenon must influence the burial construction. The sun solstices and lunar standstills (lunistics) were examined along with the above data sets, and both patterns are coinciding with each other. The following discussion will draw upon these criteria.

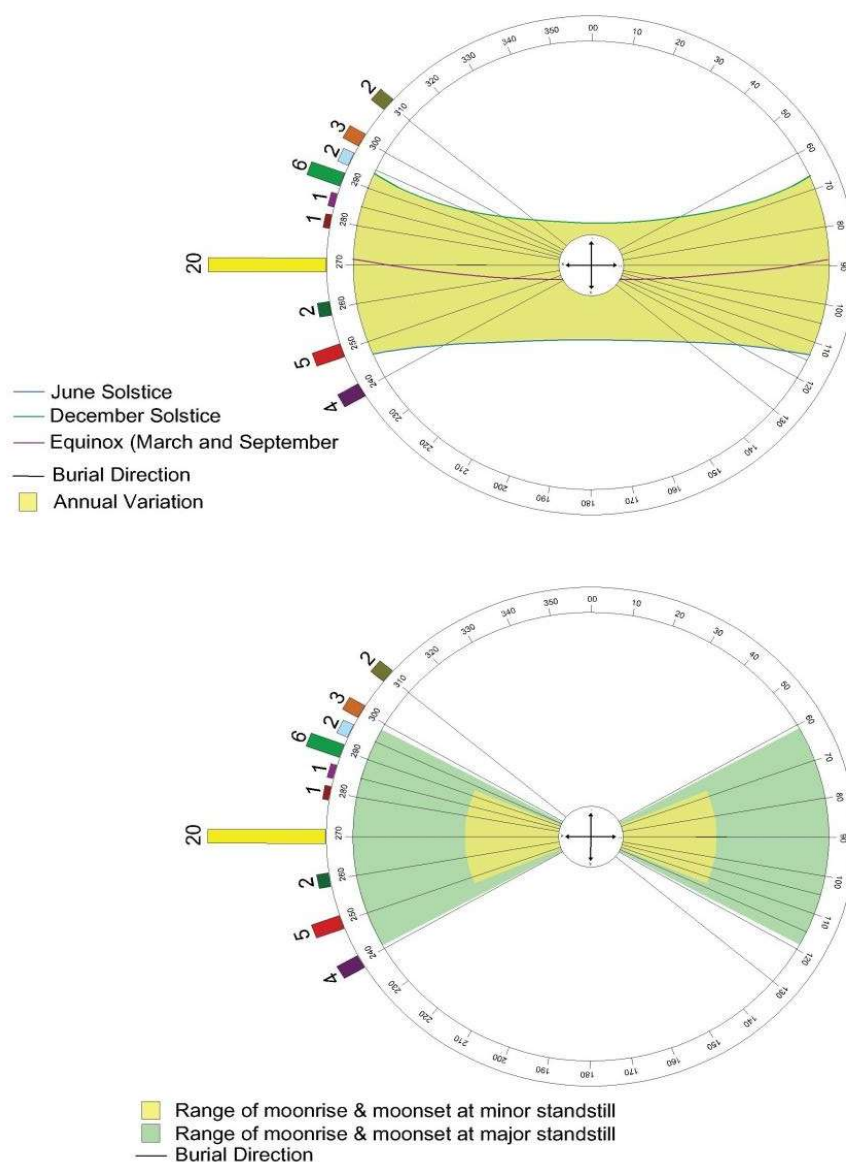


Chart 6-2 Orientation of the burials in Palippothana.

Solar Solstice

The Earth is slightly tilted on its axis; hence, different Earth points receive more or less sunlight during different times of the year. This causes seasonal changes. The two solstices are occurring in June (20 or 21) and December (21 or 22), which on these days, the Sun's path in the sky is at the farthest north or south from the Equator. The equinox happens in March (20 or 21) and September (22 or 23), which on these days, the Sun is exactly above the Equator (Sims, 2016, 467). From Sri Lanka, in 6.9° North latitude, the northern extreme of Sun is 22.4° and the southern extreme is 24.6° (Ratnatunga, n.d).

The Lunar Standstill

The Moon's orbit is inclined 5.1° to Earth's orbit around the Sun, and as a result, the Moon's declination changes rapidly in a lunar month (27 days), and known as minor moon standstill. Moreover, the Moon has a period called the "major lunar standstill period" of 18.6 years, rising and setting at an extreme northern position and extreme southern position. The extremes in the Moon's northern or positive declination ranges from about $+18.2^{\circ}$ to $+28.7^{\circ}$. The extremes of Moon's southern or negative declination ranges from about -18.2° to -28.7° . Moon's declination stops at $+18.20$ at the north or -18.20 at the south in the minor Moon standstill. The declinations are from the lunar path computation from the mooncalc.org for Kahatagasdigiliya for 2025 (major northern standstill) and 2034 (major southern standstill). It should be cautious of using other archaeological references to calculate the moon azimuth as its values depend on latitude.

Solar Path or Lunar Path?

The astronomical declination could be traced from 53 of the 81 burial, where the remaining 28 are ruined or destroyed. The axial azimuths of the burials and slabs are shown in Chart 6-2 and Chart 6-3. These encompass the most incredible possible range of lunar and solar declination. From the tested data set, 37 burials (92 slabs) coincide with the solar path, while 44 burials (101 slabs) coincide with minor and major lunar standstills. There are two outlying burials (4 slabs), which are not overlapping with both patterns, and this case will be discussed separately. Categories and frequencies are summarised in Table 6-1.

Astronomical phenomenon	Solar northern solstice	Solar southern solstice	Solar equinox	Lunar north major*	Lunar south major*	Lunar minor standstill
Number of burials	10	7	20	3	4	37
Number of slabs	24	17	51	5	4	92

Table 6-1 Number of cases reported coinciding with each astronomical phenomenon.

* only coincide with the major lunar standstills without the counts falling into the minor standstill

The Sun and the Moon's horizon movements with their extremes were often noted by the ancient communities from the prehistoric period in many cultures around the globe (Prendergast, 2016). From Palippothana, a greater incidence of lunar alignments is reporting

when comparing with the solar alignments. Also, the equinoctial alignment is higher than any other. There is no significant difference between the number of burials in northern or southern solstices or lunar major events. It can assume the burial builders' observations of both celestial bodies impacted to define the orientation and used both alternatively. The number of burials in the equinox that occurs twice a year is equal to the sum of solstice burials. Comparing with the lunar declinations, the solar changes are more apparent and lasts longer. Lesser number of burials in major lunar standstills occurring every 18 years, indicates the same pattern. It is apparent that they had such a knowledge to trace these objects' movements, but the purpose of expressing it physically is the most challenging part to reveal.

As it was noted from the excavations of burial 12 and 13, north slab aligned to the required direction and then both east and west slabs retained to it. Fourth slab in several burials are shorter and smaller than the rest, and we assumed the intention were to open the burials timely for offering or reuse. As noted from the burial 25, the main burial was oriented toward the northern solstice or lunar path while a small associating slab erected toward the north may represent two different burial events. Also, the excavation of the burial 12 indicate the placement or intentionally broken potteries outside of the western and southern slabs, which can be a sign of a ritual or a traces left by mourners.

We do not believe the orientation of the burials as a direct symbolic expression of a ritual or the use of direction based knowledge at the time was a ground breaking innovation. Alternatively, we suggest it as part of the daily knowledge of early agrarian-husbandary communities who used those skills in many other ventures such as travelling, weather forecasting, etc.

Other Traditions

Two burial sets are showing different characteristics from the above orientation.

a. Double orthostat burials - three out of four double orthostat burials have two vis-à-vis slabs facing north and running east-west. The exceptional case is the burial 15, which also characteristically different from the others and oriented toward north-west and south-east directions (Chart 6-3). However, both the east and west sides of the burials are open. It can assume these burials also serve the same concept of creating a path to a leaving or resurrecting soul.

b. Burials with declination of 40^0 - Four slabs reported from three burials have a declination which is not coinciding with any astronomical pattern. In all these cases, at least

one or two other slabs in the same burial have a declination between 20° - 30° . Therefore, it can assume the outliers can be a result of later alterations of the slabs. However, the possibility of other orientation tradition is not ruling out.

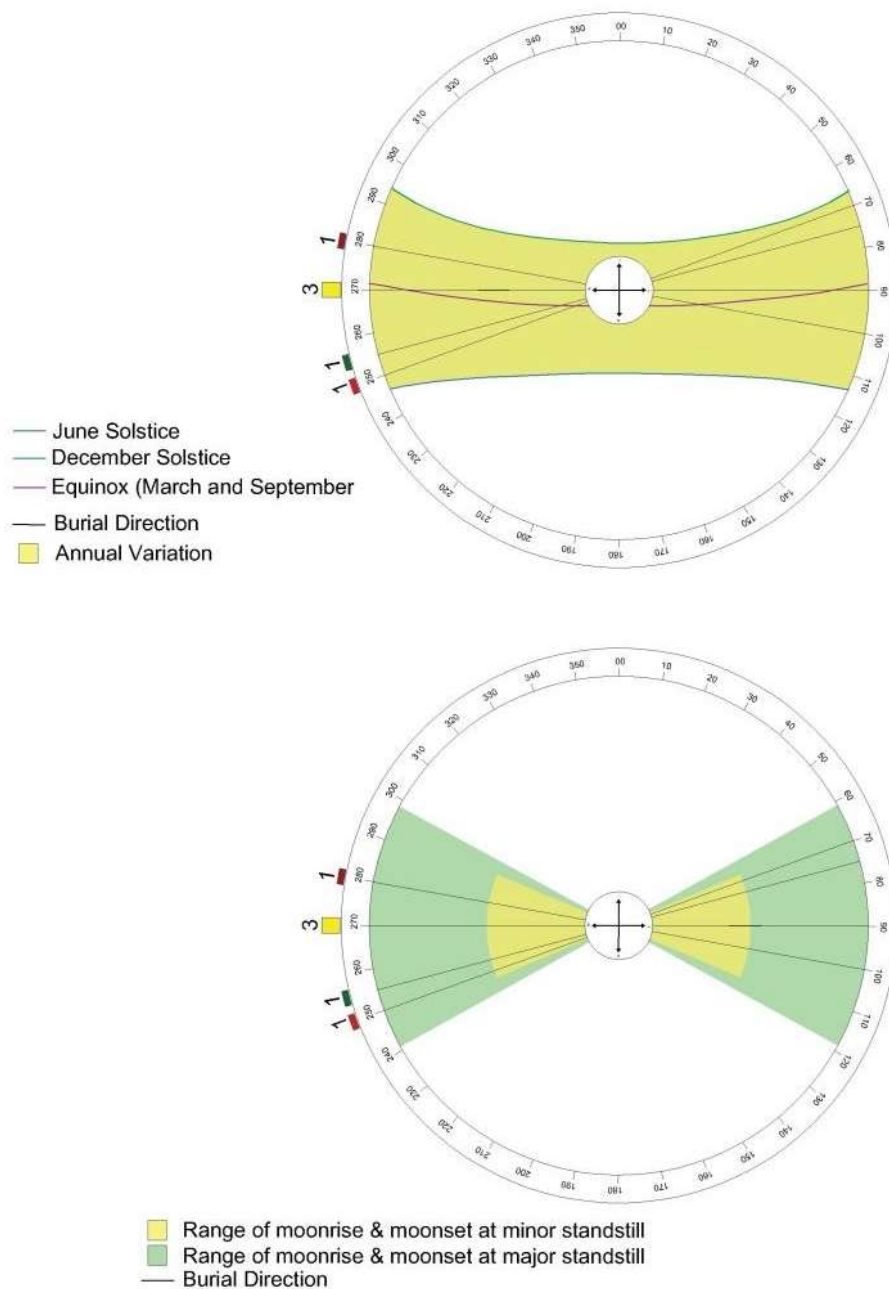


Chart 6-3 Orientation of the double orthostat burials in Palippothana

The analysis of megalithic tomb orientation in the present study is solely based on their directional alignment with the rising/setting celestial targets. As shown above, some of the burials are falling into the annual solar path and all other burials overlap except the burials in 40° with the major and minor lunar standstills.

Concept - native or introduced?

It was commonly believed the Indian invasive colonisation concurrent with the megalithic Iron Age tradition (Kennedy and Deraniyagala, 1989). However, we believe the multiple burial traditions coexisting in the same burial complex with different cosmologies encouraging us to think about the protohistoric transitional period more like the advent of alien cultures to the natives who were curiously started to follow the new social practices along with theirs. There is evidence for both possibilities.

Several burial orientation prototypes were reported from the Indus valley and other Neolithic/chalcolithic cultures in India (Dibyopama et al., 2015, Kennedy, 2000, Aswani and Kumar 2018, Menon and Vahia, 2011, Menon, 2018,) Rao, 1993, Rao et al., 2011 The physical and cultural interactions between the Indian peninsular and Sri Lanka during the Megalithic BRW techno-cultural complex was widely discussed by Sudarshan Seneviratne, based on skeletal and artefactual similarities (Seneviratne, 1984).

On the other hand, the burial records of the Mesolithic culture associating with the Pleistocene-Holocene periods in Sri Lanka are also significant (Kennedy and Deraniyagala, 1989, Kennedy, 2000, 181; Perera, 2010, Deraniyagala, 1958, Somadeva and Ranasinghe, 2006, Kulathilake et al. 2014, Adikari, 1994).

Further, some primary burials are reporting from the megalithic contexts in Sri Lanka has similar cardinal direction oriented flexed position, from Anaikottai - 300 BC-100 AD/ Extended inhumation oriented west to east (Ragupathy, 1987), Cattirantai - Karainagar in the dawn of the Christian period (microlithic flakes may suggest even older date)/ one east to west and one west to east (ibid, 129-130) it is continued toward the historical period as found from Mantai - 160-190 AD (Kennedy, 2000).

The orientation of clay canoe burials is also noticeable. Two north-south and east-west oriented clay canoe burials reported from Kalupahana (Somadeva, 2011) and other five north-south oriented clay canoes reported from Haldummulla. Somadeva proposes the orientation was intentional to avoid the impact of surface runoff water (Somadeva, 2010).

The majority of these inhumations are either headed west or north. Though the motives for the changes of Mesolithic hunter-gatherers' burial rites from mid to late Holocene are not clear, it can assume their cultural norms easily aligned with those of the Indian megalithic cultural influencers and had developed a common ground of funerary

practices. Transformation of the megalithic burial rites into other religious practices noticed since the post-Megalithic period (Seneviratne, 1984).

The Upanishads – another clue

Though we do not have direct references from the Sri Lankan megalithic builders, a trace of their thought can be found from the contemporary religious essays. Upanishad is such a literature which includes the views presented by priests, royals and even Shudras. Therefore, it might be in the popular discourse during the first millennium BC. Significantly, the following extracts from the Prasna Upanishad (composed possibly during the second half of the 1st millennium BC) will show us a path to the present discussion (Prasna Upanishad, 1922).

“The creator... created the pair, Matter and Energy (9)... The Sun is energy and Matter indeed is the Moon (10).... Now when the Sun having risen enters the east, by that, he holds the eastern pranas in his rays. When he illumines the South, the West, the North, the Zenith, the Nadir, the intermediate quarters... he holds all the Pranas in his rays (12)..... The year is verily Prajapati, and two are his paths, the southern and the northern; now those who perform the Ishtapoorta (sacrifices and charitable works) as works of supreme value, attain the world of the Moon and afterwards return there again. Therefore those Rishis who desire offspring go by the Southern path. Matter verily is this path of the manes (14).... But those who have sought the Atman by austerity, abstinence, faith and knowledge, attain the Aditya by the Northern path. This is the source of all the forces.... immortal and free from danger...supreme resort. From there they do not return, it is the end (17).... The month is verily Prajapathi. Its dark fortnight is Matter, and its brighter one is the Prana (energy). Therefore some Rishis perform their sacrifices in the bright fortnight; others in the other half (19)... ”

It was described the Northern path is blocked for the ignorant and persons devoid of the necessary qualities (Sharvananda, 1922, 17). A class of spirits called ‘Pitris’ are widely mentioned in the Brahmanic beliefs and described as spirits of the dead who drink from the Moon the sweet amrita during the dark half of the month. They are not sinners, but fathers of individual families, fathers of tribes and fathers of the race (Seneviratna, 1986).

Further, the Ishavasya Upanishad elaborated *Ishtapoorta* as, *Ishta*; the daily sacrifice of Agnihotra, penance, truthfulness, maintenance of animals, feeding of the guests and feeding the birds and beasts and *Poorta*; sinking wells or excavation of tanks for the public, building temples, giving food to the hungry, laying out public gardens (ibid). We are inviting the readers to compare the King Pandukabhaya section of Mahavamsa with these notes. The fabrication and construction of stone structure for honoured mortuary rites require labour, time, material, and organised commitment; hence it is not for everyone (Kennedy, 2000,

356), and only the honoured people received the recognition. Do these burials indicate the paths the deceased opted to go?

Conclusions

Researchers focusing on the Megalithic or protohistoric period were developed in Sri Lanka since the 1980s, more multidisciplinary approaches such as chemical analysis and GIS applications have been introduced recently. With the present study's outcome, it is possible to link ancient cosmology into the discussion within a landscape where people laid the first seeds of a larger civilisation. Further, the cosmological observations might be linked with two worlds, 'life' and 'death', a cyclic process in most philosophies originated in India, including Hinduism, Buddhism and Jainism. We must consider the fact that ancient people might have a different cosmological sense from ours. Is it encapsulated any symbolism in the architecture, yet we do not know.

The outcome of this chapter potentially allows us to study the protohistoric burial traditions in Sri Lanka more meaningfully, in a broader sense of social belief systems and natural phenomena. Ancient burial orientations can solely depend on the axial alignment of rising, setting celestial targets or non-astronomical factors (Prendergast, 2016). Revealing these will help find minor cultural differences of those communities, level of acculturation, geographical distribution and contribution of each regional community to the emergence of a central governing system, and many such research themes. Even the origin of the cosmological knowledge of ancient societies can be traced back to different sources. Hitherto, the cultural landscape of Sri Lanka was explained through geographical and ecological means. Connecting the attributes such as the horizon, sky, and cyclical celestial phenomena is vital to complete the whole cultural landscape scenario. At least, we have to honour the way how our ancestors saw the limitless sky. They spend it for good.

In Sri Lanka, the megalithic burials show less vibrant than the prototypes of India (Deraniyagala, 1992) can count as evidence of the origination of a local variant adapted by the local tribes after contacting the cultures of Indian seafaring traders. As the level of the grave goods and the burial's spatial distribution is not identical with the Indian burials complexes, it is fair to believe the authors of these burials in the Island were natives who gradually started to follow the cultural traits introduced by the Indian merchants. The protohistoric-historic mortuary studies in Sri Lanka leading to some controversial tensions usually stemming from the concerns of 'identity' and attempts of establishing ethnic

affinities of the ancient communities or linking with the quasi-historical races and tribes hence the romantic trend of finding modern ethnic ties with the ancient communities or diffusionist views should not be encouraged (Kennedy, 1980, 411).

References

1. Adikari,G., 1994. Excavations at the Sigiri-Potana cave complex: A preliminary account, Further studies in the settlement archaeology of the Sigiriya-Dambulla region, PGIAR publication, 65-67.
2. Arjun,R., 2016. Exploring South Indian Iron Age megalithic burial site for its habitational and spatial distribution over the Kaveri landscape at Koppa, Karnataka, India, Current Science, Vol. 110, No. 12.
3. Aswani,O.K., Kumar,A., 2018. Megalithic religion: An archaeological review of beliefs and practices, in Journal of Multidisciplinary Studies in Archaeology, 6: 647-668.
4. Chandimal,K.M., Yasawardene,S.G., Adikari,G., 2011. Morphological and morphometric analysis of prehistoric human skeletal remains from Sigiriya Potana, Sri Lanka, Archaeologia Vol. 1. Pt. II: 32-34.
5. Deraniyagala,P.E.P., 1958. The Pleistocene of Ceylon, Colombo National Museum, Sri Lanka.
6. Deraniyagala,S.U., 1992. Prehistory of Sri Lanka, Vol. II, Department of Archaeological Survey, Sri Lanka.
7. Dibyopama,A., Yong Jun Kim, Chang Seok Oh, Dong Shin and Vasant Shinde, 2015. Human skeletal remains from ancient burial sites in India: With special reference to Harappan civilisation, in Korean Journal of Physical Anthropology, Vol. 28, No. 1: 1-9.
8. Dissanayake,R.B., 2018. Traversing the Megalithic funerary landscapes: The Yan Oya Middle basin archaeological survey, Postgraduate Institute of Archaeology, Colombo.
9. Jayarathna,D.K., 1993. Prag eithihasika yugaye Janawasa ha Susana sankeernayaka asritha parisarika puravidyawa: Ibbankatuwa saha ehi thadasannaye pradeshaya pilibanda adyanayak, Unpublished Master of Science dissertation, Postgraduate Institute of Archaeology, Colombo.

10. Katugampola,M., 2015. Beyond what we seeing: An inter site spatial pattern of Megalithic burial complexes in Yan Oya Middle Basin (YOMB), Sri Lanka, *International Journal of Culture and History*, Vol. 1, No. 2: 129-134.
11. Kennedy,K., Deraniyagala,S.U., 1989. Fossil remains of 28,000year-old Hominids from Sri Lanka, *Current Anthropology*, Vol. 30, No.3: 394-399.
12. Kennedy,K., 1980. Prehistoric Skeletal Record of Man in South Asia, *Annual Review of Anthropology*, Vol. 9: 391-432.
13. Kennedy,K., 2000. *God-apes and fossil men: Paleoanthropology of South Asia*, University of Michigan.
14. Kulatilake,S., Perera,N., Deraniyagala,S., Perera,J., 2014. The Discovery and Excavation of a Human Burial from the Mini-athiliya Shell Midden in Southern Sri Lanka, *Ancient Asia*, No. 5: 3: 1-8.
15. Liyanage,S., 2006. Pinwewa Galsohon Kanatta gaveshanaya saha kanima 1997: puravidyathmaka adyanayak,(In Sinhala) Unpublished Master of Science dissertation, Postgraduate Institute of Archaeology, Colombo.
16. Mendis,T., 2017. Kokebe Megalithica Susana bhumiya ashtrithawa labi athi Carbon 14 kalanirna, in C.Withanachchi and T.Mendis ed. *Madya Yan Oya Nimnaye Janawasa puravidyawa*, (In Sinhala) Rajarata University of Sri Lanka, 176-179.
17. Menon,S., Vahia,M., 2011. Megalithic astronomy in South India, in Nakamura, T and others (ed.), *Mapping the Oriental sky: Proceedings of the seventh international conference on oriental astronomy*, Tokyo.
18. Menon,S., 2018. From megalithic to temples: Astronomy in the lithic records of South India, in W. Orchiston and others (ed.), *Growth and development of astronomy and astrophysics in India and the Asia-Pacific region*, *Proceedings of the 9th international conference of Oriental astronomy*, Mumbai, 241-258.
19. Perera,N., 2010, *Prehistoric Sri Lanka: Late Pleistocene rockshelters and an open-air site*, British Archaeological Reports, England.
20. Prasna-Upanishad., 1922. Swami Sharvananda 2nd edition, The Ramakrishna Math, Madras.

21. Prendergast, F., 2016. Interpreting megalithic tomb orientation and siting within cultural contexts, in *Modern Astronomy: From Material Culture to Cosmology*, 685: 1-25.
22. Ragupathy, P., 1987. Early settlements in Jaffna: an archaeological survey, Published by Thillimalar Ragupathy, Madras.
23. Rao, K., 1993. Astronomical orientations of the megalithic stone circles of Brahmagiri, in *Bulletin of Astronomical Society of India*, 21:67-77.
24. Rao, K., Thakur, P., Mallinathpur, Y., 2011. The astronomical significance of 'Niurallu', the megalithic stone alignment at Murardoddi in Andhra Pradesh, India, in *Journal of Astronomical History and Heritage*. 14(3): 211-220.
25. Ratnatunga, K, n.d., Tips to observe Sunrise behind Sri Pada, viewed by 25th February 2021. < <http://lakdiva.org/sunrise/tips.html>>.
26. Ruggles, C.L.N., 2011. pushing back the frontiers or still running around the same circles? 'Interpretive archaeoastronomy' thirty years on, In C. Ruggles (ed.), *Archaeoastronomy and ethnoastronomy: Building Bridges between cultures*, Cambridge University Press: 1-18.
27. Ruggles, C.L.N, Basic concepts of positional astronomy, in CLN Ruggles (ed.), *Handbook of Archaeastronomy and ethnoastronomy*, Springer Science, New York, pp. 459-472.
28. Sasitharan, Sivasubramaniam, 2012. Mortuary practice of Megalithic cist burial: A special reference to Sri Lanka and Southern India, Unpublished Master of Science dissertation, Postgraduate Institute of Archaeology, Colombo.
29. Science News Letter, 1957. Find skeletons of Stone Age cannibals in Ceylon, Vol. 71 No. 2: 30.
30. Senaviratne, S., 1984. The archaeology of Megalithic- Black and Red Ware complexes in Sri Lanka, *Ancient Ceylon* Vol. 5: 237-307.
31. Seneviratna, A., 1986. Folk beliefs and rituals concerning the dead among the Sinhalese-Buddhists in Sri Lanka, *Ancient Ceylon*, vol. 6: 209-221.
32. Sharvananda, Swami, 1922. *Prasna Upanishad*, 2nd edition, The Ramakrishna Math, Madras.

33. Sims,L., 2016. What is a lunar standstill?, *Documenta Praehistorica*, XLIII:467-478.
34. Somadeva,R., Ranasinghe, S., 2006. An excavation of a shell-midden at Pallemalala in Southern littoral area of Sri Lanka: Some evidence of prehistoric chenier occupation in c. 4th millennium BC, *Ancient Asia* vol. 1: 14-24.
35. Somadeva,R., 2006. Urban origins in Southern Sri Lanka, Uppsala University, Sweeden.
36. Somadeva,R., 2010. Excavation of a protohistoric canoe burial site in Haldummulla, Preliminary report, Postgraduate Institute of Archaeology, Colombo.
37. Somadeva,R., 2011. Site survey and excavations in Haldummulla, Preliminary report, Postgraduate Institute of Archaeology, Colombo.
38. Szucs-Csillik and Comsa, Alexandra, 2017. Solar arch method for the analysis of burial places in Eneolithic, in *Romanian Astronomical Journal*, Vol. 27, no. 03: 211-221.
39. Thom,A. 1971. Megalithic lunar observatories, Clarendon Press, Oxford.

Annexure 1

Table 2: Angles of intact slabs. Azimuth measured from the north to the outside of each slab. Capstone measurements are taken from the most clear edge and angle given accordingly. (West slab align with compass dimensions given as 360, which also equals to 0)									
No	Burial number	Slab	Azimuth angle	Relative to N or W direction	No	Burial number	Slab	Azimuth angle	Relative to N or W direction
1.	1	N	70	20 -	56.	26	E	160	20 -
2.	1	E	160	20 -	57.	26	W	340	20 -
3.	1	S	250	20 -	58.	25 sub 2	W	360	0
4.	1	W	340	20 -	59.	27	E	180	0
5.	2	E	160	20 -	60.	27	W	360	0
6.	2	S	240	30 -	61.	27	Capstone	180	0
7.	2	Cap stone	335	25 -	62.	28	Single slab	190	10 +
8.	3	W	340	20 -	63.	29	Capstone	270	0
9.	4	N	90	0	64.	30	S	270	0
10.	4	E	180	0	65.	30	W	360	0
11.	4	S	255	15 -	66.	31	N	90	0
12.	4	W	360	0	67.	31	E	180	0
13.	5	N	90	0	68.	32	N	90	0
14.	5	E	170	10 -	69.	32	S	275	5 +
15.	5	S	255	15 -	70.	32	W	360	0
16.	5	W	350	10 -	71.	39	Single slab	200	20+
17.	6	Cap stone	360	0	72.	40	E	180	0
18.	7	N	90	0	73.	40	W	360	0
19.	7	E	180	0	74.	41	E	180	0
20.	7	W	360	0	75.	41	S	270	0
21.	8	N	105	15 +	76.	44	N	90	0
22.	8	E	220	40+	77.	44	E	180	0
23.	8	W	30	30 +	78.	44	S	270	0
24.	9	E	195	15 +	79.	44	W	360	0
25.	9	W	15	15 +	80.	45	E	200	20+
26.	10	E	180	0	81.	45	S	295	25+
27.	10	W	360	0	82.	45	W	20	20+
28.	11	N	90	0	83.	52	Single slab	205	25 +
29.	11	E	180	0	84.	65	E	150	30 -
30.	11	S	270	0	85.	67	E	180	0
31.	11	W	360	0	86.	67	W	360	0

32.	13	N	110	20 +	87.	68	N	90	0
33.	13	E	220	40 +	88.	68	E	180	0
34.	13	W	40	40 +	89.	69	E	200	20 +
35.	14	S	250	20 -	90.	69	S	280	10 +
36.	15	N	70	20 -	91.	69	W	15	15 +
37.	15	S	255	15 -	92.	70	N	110	20 +
38.	16	S	300	30 +	93.	70	E	180	0
39.	16	W	40	40 +	94.	71	N	90	0
40.	17	N	90	0	95.	71	W	360	0
41.	17	S	270	0	96.	72	Single slab	150	30-
42.	18	N	90	0	97.	73	E	180	0
43.	18	S	270	0	98.	73	S	270	0
44.	19	N	70	20 -	99.	74	N	120	30 +
45.	20	E	180	0	100.	74	E	205	25 +
46.	20	W	360	0	101.	74	W	25	25 +
47.	21	E	150	30 -	102.	75	N	90	0
48.	23	E	200	20 +	103.	75	S	280	10+
49.	23	W	20	20 +	104.	76	E	180	0
50.	24	N	90	0	105.	76	W	360	0
51.	25	N	105	15 +	106.	78	Single slab	90	0
52.	25	E	200	20 +	107.	79	Single slab	90	0
53.	25	W	20	20 +	108.	80	N	110	20 +
54.	25 sub 1	W	30	30 +	109.	80	E	210	30 +
55.	26	N	110	20 -					

Table 6-2 angles of intact slabs