

A primitive calendar used by prehistoric farmers in Japan

Abstract

This paper examines the problem of calendar in the prehistoric society of Japanese archipelago from the viewpoint of archaeology. The basis of the calendar concept is to recognize the summer solstice and winter solstice, and to recognize the vernal and autumnal equinoxes, and incorporate them into the calendar. Therefore, this paper investigates the relationship between the axial line of burial sites or ritual sites and the orientation of sunrise and sunset.

The head position of burial in the Jomon period is within the range of the direction of sunset in the year. Therefore, it can be understood that they recognized the summer solstice and winter solstice as the north-south limit point of the orientation of sunset.

In terms of the burial heads of royal tombs in the Yayoi period, it was found that the axis of burial was aligned with the direction of sunrise on specific dates in spring and autumn, and the agricultural calendar related to rice cultivation was restored. Furthermore, it can be pointed out that there was a possibility that the lunar calendar started from the winter solstice and the agricultural calendar were adjusted.

In other words, there was the recognition of the summer solstice, winter solstice, spring equinox and autumn equinox in the prehistoric society of the Japanese archipelago, and it reveals that a reasonably well-organized calendar was used even if it was primitive.

Keywords

burial orientation, directions of sunrise and sunset, summer solstice and winter solstice,
sunrise agricultural calendar

1 Introduction

This paper considers prehistoric calendars in the Japanese archipelago from the viewpoint of archaeology. It may be said that it was a reckless attempt to consider the calendar in prehistoric society in Japan, which was without characters.

However, since the origin of the calendar is the movement of the sun and the moon, if we can understand how ancient people recognized the movement of these two planets, it is expected to be a useful clue to consider the calendar, or the idea of time. Therefore, this paper focus on the idea of orientation seen in burial and ritual remnants.

1 natural environment

The Japanese archipelago belongs to the temperate monsoon zone and the change of four seasons is very clear. Based on this environment, it can be pointed out here that prehistoric people had a sense of time to divide a year into four parts.

It is most likely that the change of seasons was understood in connection with the movement of the sun and ancient people were sensitive to various changes in the moon phases and tide levels. Furthermore, they would have understood the sense of time in relation to the movement of the sun and moon.

This paper focuses on whether people of the Japanese archipelago in the prehistoric period were aware of the summer and winter solstices, vernal or autumnal equinox.

2 social environments

Figure 1 shows the chronology of the theme of this paper. The top is earlier, and the bottom is later. This figure shows the correspondence between prehistorical cultures that occurred in the Japanese archipelago and the written records left by the ancient governments of China and the Korean Peninsula. The date is shown on the left side. The prehistoric periods of Japan can be divided into the Paleolithic period, Jomon period, Yayoi period, Kofun period, Asuka and Nara periods.

An important precondition for considering the issue of calendar is that people observed the movement of the sun and moon at regular points. But it is highly likely that this precondition does not suit for the Paleolithic period when people were highly mobile. Therefore, the target periods of the present paper should be after the Jomon period, because ancient people in the Japanese archipelago started their settled life after that period.

Did people in the Jomon period recognize the summer solstice or the winter solstice? For considering this issue, this paper discusses the Shizunai Gotenyama site 静内御殿山遺跡, located in Hokkaido. This site is the burial site in the Jomon period.

In the Yayoi period, rice cultivation was brought into the Japanese archipelago via the Korean Peninsula. Furthermore, the state level society of the Yayoi period began to be partially described in the literature of ancient China, especially in Gishi-wajinden 魏志倭人伝 (literally, an 'Account of the Wa' in "The History of the Wei Dynasty"). The situation in Japan from the second century to the third century is described in detail.

It is worthwhile to note that there is a description that people in the Yayoi period did not know the

correct calendar. However, it is necessary to compare with the situation restored from the archaeological records. As a source for considering this problem, this article takes up Hirabaru No. 1 Tomb 平原 1 号墓, located in Fukuoka Prefecture. This site is very useful to consider the actual calendar used by ancient rice-paddy farmers.

After the Kofun period (tumulus period), an advanced calendar was imported to the Japanese archipelago, and the lunar-solar calendar was also imported via Baekje 百济. This paper focuses on the primitive calendar in the earlier characterless society.

II Orientation of the Jomon burial

1 Fujimoto's Discussion

In 1970, Hideo Fujimoto, a high school teacher in Hokkaido, published an important result of his research on burial positions in the Jomon culture. He excavated 74 burials at the Shizunai Gotenyama site and made a figure of the heads of their graves. It is clear from his analysis that all burial heads face to the west, although they spread out in a fan shape around true west (Fujimoto1971).

Fujimoto assumed that the direction of sunset shifts throughout the year, and he derived the direction of sunset from the summer solstice to the winter solstice by using a simple method and applied it to the figure. As a result, he found that the most of cases fall within the annual sunset range.

In the modern Ainu customs, there is an idea that the soul of the dead follows the setting sun to the underground world. Fujimoto concluded that such an idea goes back to the Jomon period.

This diagram is also important on the calendar issues. It shows that Jomon people knew that the direction of the sun's setting moved throughout the year. In other words, it can also be noted that they knew about the summer and winter solstices as the limit of the direction of sunset in a year.

However, this figure needs to correct. All cases shown in the figure were measured at one excavated site based on the magnetic north. The direction of sunset on the summer and winter solstices were based on the true north direction, and Fujimoto did not consider the change of the angle of ecliptic inclination. As a result of correction, 17 burial heads fall outside the annual sunset range.

2 Correction on the angle

Figure 2 shows the result of my correction on the figures created by Fujimoto. I corrected to the true north basis in accordance with 1970 magnetic deflection angle. The thick line indicates the direction of sunset for the summer and winter solstices in 1500 B.C. The dotted lines show the northern and southern limits of the lunar entry in the high moon mode of this period. Through these adjustments, we can confirm the correctness of Fujimoto's statement. It has to be noted that Jomon

people were quite aware of the summer and winter solstices as well as the northern limit and southern limit of the moonset.

3 Related examples

According to our checking the axis line of the ancient ritual remains, selected from the prehistoric archaeological sites in the Japanese archipelago, 16 sites match the direction of sunrise of summer or winter solstice.

The burial remains among these examples show the clear evidence of aligning their axes with the direction of sunrise on the winter solstice. It can be presumed that people in each period chose the winter solstice as the date of funeral rites.

Figure 3 shows two specific examples of ritual sites. Left figure is a reconstruction of a ritual structure found at the Sannai-Maruyama site 三内丸山遺跡 in Aomori Prefecture. One side of the structure's axis is oriented toward the winter solstice sunset, while the other side is aligned with the full moon's rise from the northern limit, which comes in cycles of 18.6 years. This is one case in the middle Jomon period.

Right figure shows a ceremonial building found at Yoshinogari site 吉野ヶ里遺跡, Saga Prefecture, surrounded by a mysterious shape of moat and earthworks. The axis of this ritual area faces the direction of sunrise on the summer solstice. As a result of more detailed observation, it was revealed that this axis line also coincided with direction of the coming of full moon of the northern limit which appeared near the winter solstice. This is one example of the late Yayoi period.

III A sunrise agricultural calendar restored from a royal tomb

Fukuoka Prefecture, which faced the Korean Peninsula, was the center of Yayoi culture because of a special area where rice farming culture was first brought. In the first century, the political organization in this region tributed to the Later Han Dynasty in China to secure their position as kings. Ito Province is one example, and there is a high possibility that Hirabaru No. 1 Tomb would be the grave of Queen of Ito in the late second century. This tomb was excavated by Dairoku Harada in 1965.

1 Interpretation by Dairoku Harada

Harada's excavation revealed that the central body of the tomb was made of wooden coffin. Furthermore, 40 mirrors including five mirrors with a diameter of 46cm, the largest ones among

bronze mirrors excavated in Japan, and lots of various kinds of beads were found from the tomb. The date goes back to around 150 -180.A.D..

Harada estimated the burial head position and gender of the buried person by the combination of burial goods and their layout in the coffin. The burial head position faces west, and the buried person is assumed to be a woman. In addition, as a result of detailed observation on the axis and direction of the burial, Harada noticed that there was a depression of a mountain called Hinata Pass on the extension line of the foot side. He also confirmed that the day when the sun rises from Hinata Pass is October 20th. As the end of October coincides with the autumn harvest ritual, called Kanname-sai 神嘗祭. Harada estimated that the origin of the current shrine ceremony, goes back to the burial rituals

of the Princess of ancient Ito state.

However, Harada's understanding based on the myth of "photosensitive conception" of pregnancy under the sun in the morning, with actual agricultural rituals, was completely ignored by the academic society at that time.

In 1998, more than 10 years later after Harada's death, a re-excavation was carried out and important discoveries came out around the tomb. The remains of four wooden posts and the remains of Torii 鳥居, the sacred place in which people pray, were also found.

2 Analysis by the author

The east major Pole discovered through re-excavation is located on the line connecting with the central burial of Hirahara No. 1 Tomb and Hinata Pass. In connection with this positional relationship, the first light of the sun rising from the Hinata Pass shines on the east major pole and the shadow extending from the pole overlaps the central burial. It can also be noted that people in the Yayoi period observed a shadow extending to the center of the tomb from the Torii and used it as a sunrise calendar. Based on this hypothesis, the author determined the date when this phenomenon occurred as February 21 and October 22.

Focusing on the evening of both days, the shadow extending from pole 2 just before sunset seems to be overlapped the pillar on the east side of the torii. Such a phenomenon can't be considered an accidental result, it is emphasized that Yayoi people had been intended. When they stand at the Torii, it is also worth noting that they could recognize that the days are close by the direction of the shadow extending from Pole 2 toward the Torii at sunset (Figure 4).

As Harada pointed out, October 22 of the 2 days coincides with the holding period of the Kanname-sai. This specific ritual is held from October 15 to 25. And February 21 is also an

important date because the Sikinen-sai 祈年祭 is held at Ise-jingu Shrine 伊勢神宮 in spring to pray for a good harvest of rice of the year. February 21 coincides with the holding period of this specific ritual. In other words, the Sikinen-sai in spring and the Kanname-sai in autumn are a pair of important rituals, and it is important to note that they are consistent with the sunrise Agricultural Calendar restored from Hirabaru No. 1 Tomb.

A clear correspondence between the sunrise/sunset of the summer solstice and those of the winter solstice should be pointed out on the basis of examining the relationship between the shadows extending from these poles and the main parts of the tomb. Furthermore, it can be pointed out that burial rituals here may have been performed on the winter solstice because the central axis of the burial path located in the southeast coincides with the direction of sunrise on the winter solstice (Hojo 2017, 2020).

3 Comparative analysis with the Chinese history book

There is an important text for estimating the results of these works mentioned above. The Chinese historical document Gishi-wajinden 魏志倭人伝 mentions about the calendar used in Ito state.

The meaning of 「魏略曰 其俗不知正歲四節 但計春耕秋收為紀年」 is as follows: They don't know the summer solstice or winter solstice, nor do they know the correct division of the four seasons. However, they have a one-year calendar made by measuring the cultivation in spring and the harvest in autumn.

The underlined part is very important. The answer to the question of what kind of measuring device it was, can be interpreted as the special relationship of tomb and poles discussed above. In the same way, the correspondence with the dates of the current shrine rituals in Japan can be also understood. Late February and late October are one pair of important terms for agricultural rituals in spring and autumn. It is still valued as the Ise-jingu Shirines' ritual.

4 Possibility that the actual calendar was overlooked

The place where the Chinese envoys stayed, described in the Gishi-wajinden 魏志倭人伝, should be also discussed. The meaning of 「常亭伊都国」 is as follows: The envoys from Wei who visited this land were only allowed to stay in Ito state.

This sentence suggests that envoys from Wei were allowed to walk around freely in Ito, and that they might have actually visited the No. 1 tomb. And it may be possible that they saw a sunrise

farming calendar using shadows from the poles, but those envoys overlooked the fact that Ito people knew both solstices very well.

5 Possibility that the movements of the sun and the moon was taken into consideration

It is also possible that the sunrise calendar was accompanied by the act of observing the waxing and waning of the moon. According to the Julius calendar, the winter solstice in the latter half of the second century is generally December 22. There are 61 nights from December 22 to February 21. The error from the 2 cycles of waxing and waning of the moon is 2 nights. From October 22 to December 22, there are 61 nights in total. On the other hand, the vernal equinox generally occurs on March 20, and from February 21 to March 20, there are 29 nights or 30 nights in total, which roughly corresponds to the time of one cycle of phases of the moon. Therefore, it is most likely that the dates of late February and late October were set by the relationship with lunar movement on basis of the winter solstice.

It may be possible that Yayoi people vaguely considered the plowing in spring and the harvesting in autumn, and that they did not use a simple sunrise calendar, but rather set the reference to the end of second round of the moon phases starting from the winter solstice.

A high level of knowledge of the calendar should be necessary to make sure the vernal and autumnal equinox. Yayoi period people may have understood it by using the phases of the moon. In other words, Yayoi people may have already used a calendar which divides one year into four seasons or six seasons.

Another possibility is that a concentric circle was drawn around the pole to mark the major sunrise shadows such as the summer solstice and winter solstice. Such a concentric circle was not observed in the excavation, but there is a distance of 15m between the wooden coffin and east major pole. If that device had been used, it would have been an advanced sunrise anemometer.

IV Conclusions

As is indicated by analysis, it is worthwhile to note that prehistoric people in the Japanese archipelago recognized not only the Winter Solstice and the Summer Solstice but also the Spring Equinox and Autumn Equinox at early period and understood them as the concept of calendar.

Figure 5 shows the scene of the sunrise at the vernal equinox from the Karako-Kagi site 唐古・鍵遺跡, located at the center of the Nara Basin in the Kinki region. This scene was taken from a large building which assumed to be a rice warehouse built in the third century B.C., the first half of the middle of the Yayoi period, and the sun rises from the north peak of Mt. Ryuo 龍王山. It is

noteworthy that they knew the vernal and autumnal equinoxes by the sun rising from this peak, the summer solstice by the sun rising from Mt. Takahashi in the north, and the winter solstice by the sun rising from Mt. Miwa in the south. The annual sunrise calendar was based on the sunrise from the main eastward ridge.

This site is a settlement of the Yayoi period. 47 early keyhole-shaped burial mounds were built on the mountain shore of Mt. Ryuo in the Kofun period which started later in the latter half of the 3rd century, and it is interesting to note that the central axis line of these burial mounds reconstructed from the layout of them was set at the north peak of Mt. Ryuo and extended to the true west (Hojo 2017).

The north peak has been valued by the local people as a mountain that symbolized the rising sun of the vernal and autumnal equinox since the Yayoi period. It should be understood as a main reason for the decision of the axis.

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