

A Primitive Calendar Used by Prehistoric Farmers in Japan

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This paper examines the problem of the calendar in the prehistoric society of the Japanese archipelago from the perspective of archaeology. The fundamental basis of the calendar concept is to recognize the summer solstice and winter solstice and to consequentially recognize the vernal and autumnal equinoxes, and then 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 found within the range of the direction of sunset over the year. Therefore, it can be understood that prehistoric peoples acknowledged 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 established that the axis of burial was aligned with the direction of sunrise on specific dates in the spring and autumn, and the agricultural calendar related to rice cultivation was restored. Furthermore, it can be argued that there was a possibility that the lunar calendar originated with the winter solstice and the agricultural calendar was accordingly adjusted.

In other words, there was 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 in use even if it would be considered somewhat primitive to modern sensibilities.

Keywords

Burial Orientation, Directions of Sunrise and Sunset, Summer Solstice and Winter Solstice, Sunrise Agricultural Calendar

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I Introduction

This paper considers prehistoric calendars in the Japanese archipelago from the perspective 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 lies in 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 provide a useful clue to considering the meaning of the calendar or the very idea of time itself. Therefore, this paper focuses on the idea of orientation seen in extant burial and ritual remnants.

1 Natural environment

The Japanese archipelago belongs to the temperate monsoon zone and the changes in the four seasons are

very clear-cut. Based on this environment, it can be pointed out here that prehistoric people had the sense of time required to divide a year into four parts.

It is most likely that the change of seasons was comprehended in connection with the movement of the sun and ancient peoples were sensitive to various changes in the moon phases and tide levels and furthermore, they would have understood a 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 and the vernal or autumnal equinoxes.

2 Social environments

Figure 1 shows the chronology of the theme of this paper. The top is earlier historically, and the bottom is later on in terms of time. This figure shows the corre-

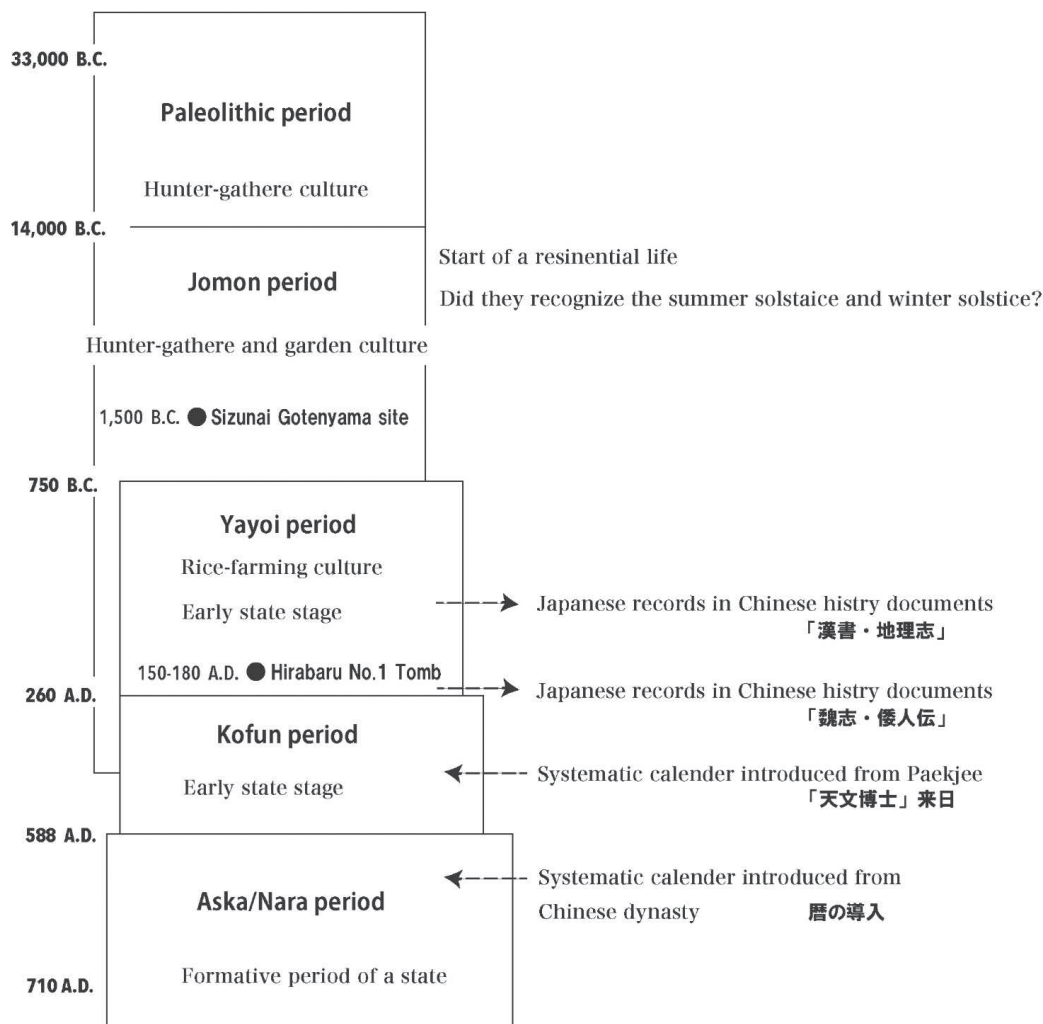


Figure 1 Prehistoric Chronology of the Japanese Archipelago

spondence between the prehistoric cultures of 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-hand side. The prehistoric periods of Japan can be divided into the Paleolithic period, the Jomon period, the Yayoi period, the Kofun period, and the Asuka and Nara periods.

An important precondition for considering the issue of the calendar is that people observed the movement of the sun and moon at regular intervals. However, likely, this precondition does not work in the Paleolithic period when people were highly mobile. Therefore, the target periods of the present paper will be after the Jomon period, since ancient peoples 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? To consider this issue, this paper discusses the Shizunai Gotenyama site 静内御殿山遺跡, located in Hokkaido, which was a 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 worth noting that there is a description stating that people in the Yayoi period did not comprehend the correct calendar. However, it is necessary to compare this observation with the situation retrieved from the archaeological records. As a source for considering this problem, this article analyses the Hirabaru No. 1 Tomb 平原 1 号墓, located in the Fukuoka Prefecture. This site is very useful in considering the actual calendar used by rice-paddy farmers in ancient times.

After the Kofun period (tumulus period), an advanced calendar was imported to the Japanese archipelago, and the lunar–solar calendar was imported via Baekje 百濟. 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 burial sites at the Shizunai Gotenyama site and drew a plan of the heads of their graves. It is clear from his analysis that all burial heads face west, although they are spread out in a fan shape around the true west (Fujimoto 1971).

Fujimoto assumed that the direction of sunset shifts throughout the year, and he derived the direction of the 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 most cases fall within the annual sunset range.

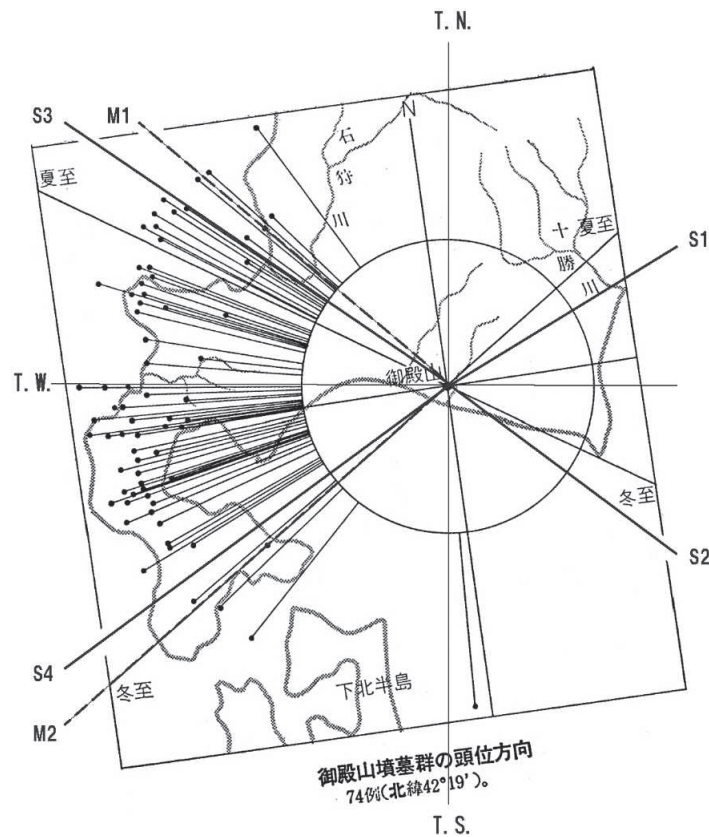
In modern Ainu customs, there is an idea that the souls of the dead follow the setting sun back into the underground world. Fujimoto concluded that such an idea goes back to the Jomon period.

This diagram is also important in terms of 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 be corrected. All instances shown in the figure were measured at one excavated site based on magnetic north. The direction of sunset on the summer and winter solstices was based on the true north direction, and Fujimoto did not consider the change of the angle of ecliptic inclination. Because of this required correction, the position 17 burial heads fall outside the annual sunset range.

2 Correction of the angle

Figure 2 shows the result of my correction of the figures created by Fujimoto. I corrected to the true north basis following the 1970 magnetic deflection angle. The thick line indicates the direction of the 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



Geomagnetic deflection angle at 1970 in southern Hokkaido: N8° W
 Astronomical movements were set in the 1,500 B.C.

S3:sunset direction of the summer solstice
 S4:sunset direction of the winter solstice

M1:northern limit of the entering direction of the moon
 M2:southern limit of the entering direction of the moon

Figure 2 Bulial orientation at the Sizenai-Gotenyama site

Note: modified from Fujimoto 1971: 157

these adjustments, we can affirm the correctness of Fujimoto's statement. It should be noted that the Jomon people were quite aware of the summer and winter solstices as well as the northern and southern limits of the moonset.

3 Related examples

According to our checking of 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 the summer or winter solstice.

The burial remains among these examples show 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.

The left figure is a reconstruction of a ritual structure found at the Sannai-Maruyama site 三内丸山遺跡 in the 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 occurs in cycles of 18.6 years. This is one case in the middle Jomon period.

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

Middle Jomon period



Sannai-Maruyama site in Aomori Pref.

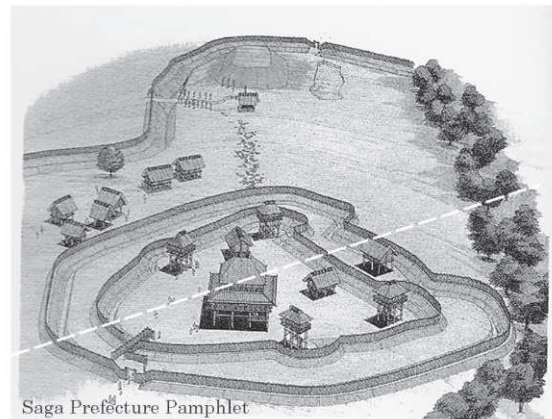


appearance of the north limit full moon
opposite side: sunset direction of winter solstice

Late Yayoi period



Yoshinogari site in Saga Pref.



Saga Prefecture Pamphlet

direction of full moon rising at the northern limit.

Figure 3 An instance in which the axis of the ritual site in the prehistoric period of the Japanese archipelago coincides with the direction of the appearance of the full moon at the northern end of the winter solstice

III A sunrise agricultural calendar restored from a royal tomb

The Fukuoka Prefecture, which faced the Korean Peninsula, was the center of Yayoi culture because rice farming culture was first developed in this special area. In the first century, the political organization in this region gave tributes to the Later Han Dynasty in China to secure their position as kings. The Ito Province is one example, and there is a strong possibility that the Hirabaru Tomb No. 1 would be the grave of a Queen of Ito from 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 consisted of a wooden coffin. Furthermore, there were 40 mirrors, including five mirrors with a

diameter of 46 cm, the largest ones among bronze mirrors excavated in Japan, and many and various beads were found in the tomb, dating 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 positioning in the coffin. The burial head position faced west, and the buried person is assumed a woman. In addition, because of detailed observation of the axis and direction of the burial, Harada noticed that there was a depression on 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 could be adjudged to go back to the burial rituals of the Princess of the 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 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 were made 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 site of Hirahara No. 1 Tomb and the Hinata Pass. Regarding 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 site. 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 dates 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 overlap the pillar on the east side of the Torii. Such a phenomenon cannot be considered simply an accidental result; it is emphasized that the Yayoi people had intended it. 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, and this specific ritual is held from October 15 to 25. February 21 is also an important date because the Sikinen-sai 祈年祭 is held at the 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 period when this specific ritual was held. 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 retrieved from the Hirabaru Tomb No. 1.

A clear correspondence between the sunrise/sunset of the summer solstice and those of the winter solstice

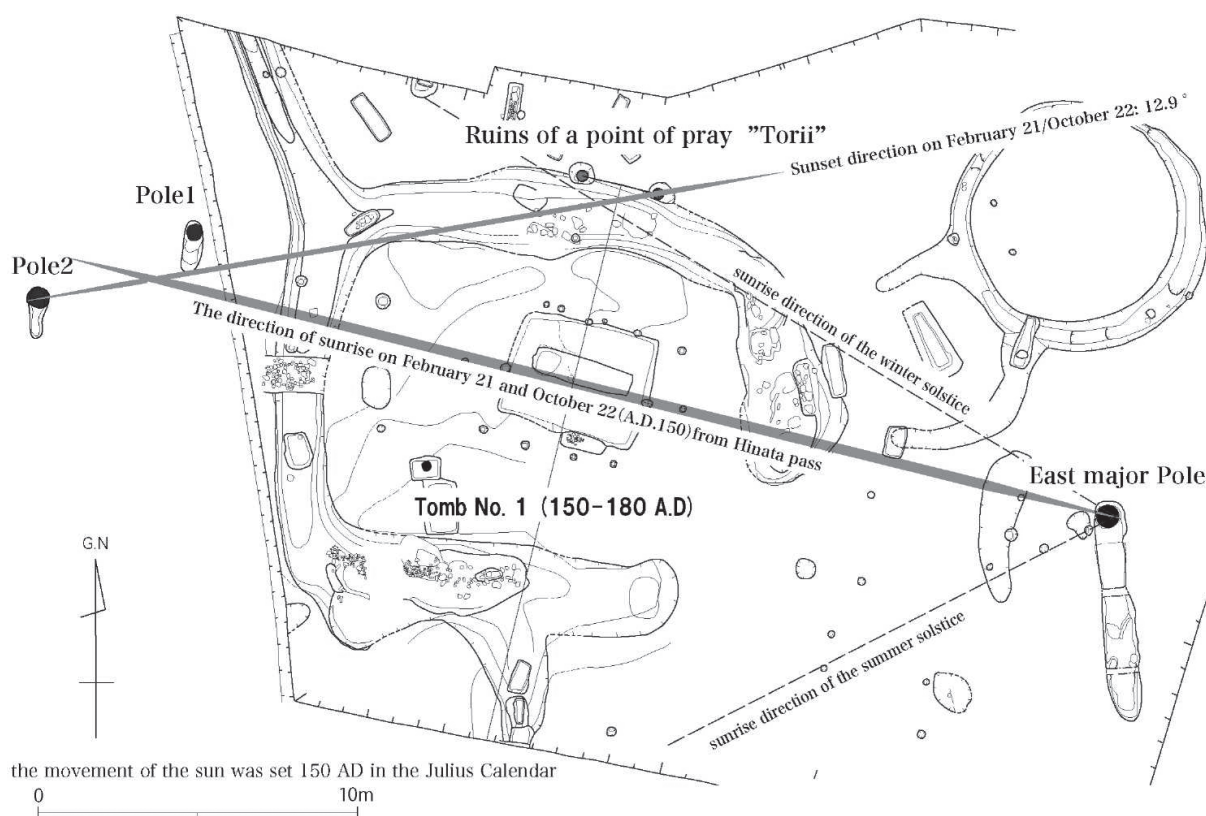


Figure 4 Sunrise Agricultural Calendar Reconstructed from Hirabaru Tomb No. 1

should be pointed out based on examining the relationship between the shadows extending from these poles and the main sections of the tomb. Furthermore, it can be pointed out that burial rituals here may have been performed at the winter solstice, because the central axis of the burial path located in the southeast coincides with the direction of the sunrise on the winter solstice (Hojō 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 the calendar used in the 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 do not 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 already 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 Shrines' ritual.

4 The 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 tomb. No. 1. It may also be possible that they saw a sunrise farming calendar using shadows from the poles, but those envoys overlooked the fact that the Ito people knew both solstices very well.

5 The possibility that the movements of the sun and the moon were 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 Julian calendar, the winter solstice in the latter half of the second century was 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 the second round of the moon phases starting from the winter solstice.

A high level of knowledge of the calendar should be necessary to determine the vernal and autumnal equinoxes. 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 that divides one year into four seasons or six seasons.

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

IV Conclusions

As is indicated by the analysis, it is worth noting 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 an early point and understood them as the concept of a calendar.

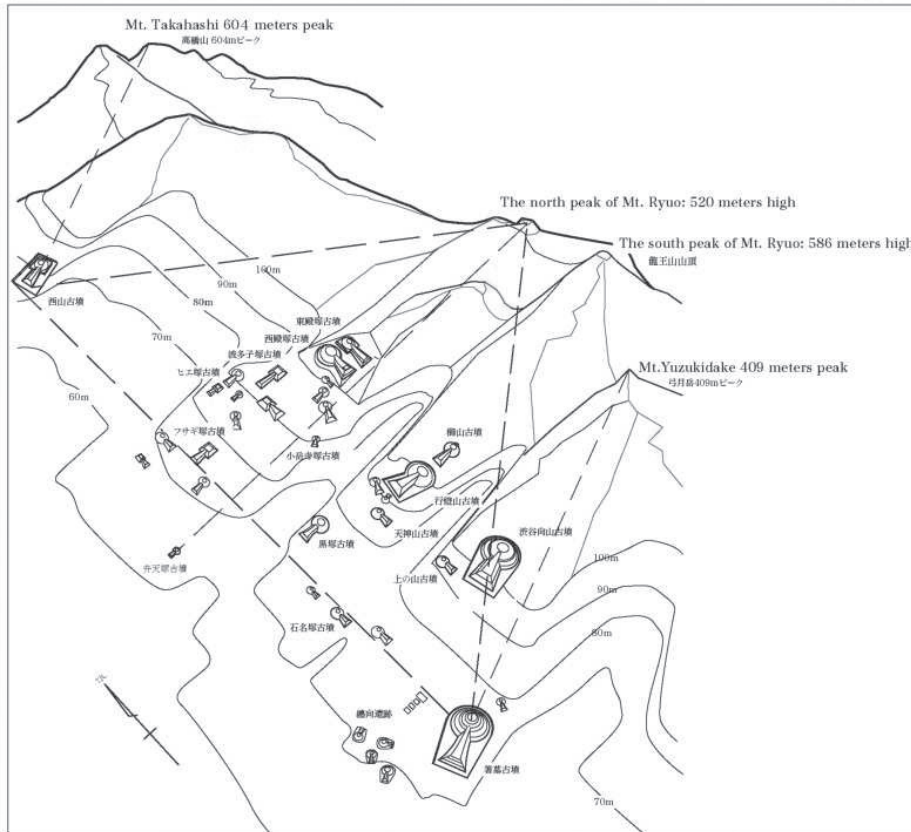


Figure 5 The peak of the sunrise at the vernal equinox seen from the Karako-Kagi site and the early Kofun clusters with the mountain peak at the top of the picture

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 was 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 recognized 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. Forty-

seven 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 third century, and it is interesting to note that the central axis line of these burial mounds reconstructed from their layout 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 equinoxes since the Yayoi period. It should be understood as the main reason for the decision for the axis placement.

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