Introduction to the Ancient Solar Calendar in Kanayama

A Guide to The Kanayama Megaliths and Archaeoastronomy in Japan

Kanayama Megaliths Research Center
About Kanayama Megaliths Research Center

In 1997, artist Yoshiki Kobayashi discovered *two lines* and *three ovals* engraved into a massive stone in the mountains of Hida. Believing these to be intended man-made symbols, he began an investigation to solve the mystery of their origins, and established *Kanayama Megaliths Research Center* with his fellow researcher, Shiho Tokuda.

Kobayashi and Tokuda have studied the megaliths and their symbols intensively, comparing the arrangement of the megaliths to the position of the sun throughout the year. As a result, and with the help of researchers from Japan and the world, they have successfully shown that the megaliths are in fact built to determine a highly precise calendar. Today, visitors from throughout Japan come to the Megaliths to participate in tours and monthly observational gatherings hosted by the Center. In addition to studying other megaliths within the prefecture, the researchers also give lectures and publish extensively on the megaliths in the hopes that more people may become aware of them.

Kanayama Megaliths Research Center is located along the Hida Highway, a historical road leading from Hida Kanayama Station that still echoes hints of the old Kanayama town. The Center houses a gallery which is open to public, with displays of descriptive panels, photographs, a diorama of the megaliths, and a short video documentary on the megaliths. (Reservations required*)

**Staff**

**Yoshiki Kobayashi**
Director and Chief Researcher of Kanayama Megaliths Research Center, also an artist.
Kobayashi accidentally discovered engraved lines on a massive stone in 1997. Working on the creation of his own systems of linear symbols at the time, he interpreted them to be ancient man-made symbols. His quest to solve the mystery of their meanings and purpose began the study of the Kanayama Megaliths. A member of the Japan Sundial Society and the Japan Association for Calendars and Culture Promotion.

**Shiho Tokuda**
Researcher at Kanayama Megaliths Research Center, and a photographer.
Tokuda joined the research in 1997. She is in charge of recording, and produce research reports on the megaliths. A member of the Japan Sundial Society.

*Tour of the Kanayama Megaliths*
A half day guided tour to the megaliths, which includes a walk through to the old Kanayama town, and lunch at the Restaurant Hizan. Reservations are required in advance.

http://kanayamamegaliths.com
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What are the Kanayama Megaliths?
The Kanayama Megaliths are an ancient archeological site that was built over 5,000 years ago. It is comprised of three groups of megaliths in separate locations, known as Iwaya-Iwakage, Senkoku, and Higashi-no-ya-ma. The discovery of two lines and three oval shapes engraved into a massive stone at Senkoku in 1997, launched the effort to uncover the mystery of why the megaliths were built.

Thanks to years of tireless research, we now know that the megaliths were used to make regular observations of the sun as it rose and set between certain stones at important times during the changing of the seasons, particularly around the summer and winter solstices, and the spring and autumn equinoxes. Careful observations of shadows and sunlight on the stones have shown that the builders of the megaliths were very much aware of the importance of those pivotal days of the year. For instance, it is clear that the builders saw the sky as consisting of four zones through which the sun traveled throughout the year. They also made good use of the natural environment of the site, carefully considering the geography and the surrounding mountains.

In one example of the precise measurement of time using sunlight, a rock formation was found that can be used to measure a deviation in the sun’s position of one day every four years, making it possible to measure the leap year. The solar calendar of Kanayama is more accurate than the one we use today in most countries, known as the Gregorian Calendar. No other ancient calendar has ever been found that is so accurate as the Kanayama Megaliths.
1. Higashi-no-yama

Literally means *East Mountain*. Higashi-no-yama megalithic group is located near the peak of a mountain as seen from Iwaya-Iwakage and Senkoku groups to the east. It is comprised of two megaliths located on the slope of the mountain and can primarily be used for observing the morning sun during the wintertime.

The group was discovered in 1998 based on predictions that there must be a third site for observing the morning sunlight in wintertime, which was not possible at the other two megalithic groups.

**Note:**
The Higashi-no-yama is located on private land. The site may only be accessed as part of the guided tour (fee required).
2. Senkoku

Located approximately 40m to the east of the Iwaya-Iwakage group, Senkoku includes a collection of megaliths ranging in height from 7 to 9m. This is where two lines and three oval shapes were found engraved on one of the stones in 1997, launching the study of the megaliths the following year.

Senkoku is primarily useful for making solar observations around the time of the summer solstice. It allows to observe the passage of the sun and changes in sunlight shining into the site, and to identify the day of the summer solstice.

Senkoku is so far the only megalithic group in Kanayama with surviving symbols. The two long lines represent the sunlight that shines into the two deep crevices parallel to them around the time of the summer solstice, and the three ovals represent the changing shapes of the sunlight spots that shine into the group at around the same time. These symbols are believed to evidence that the ancient people used this site to observe the arrival of summer.

Marked Stone (Stone A)
Consisting of three megaliths stacked against each other ranging from 9 to 10m in height, Iwaya-Iwakage forms a cavern that is as deep as 10m wide and 7m height. It houses the Iwaya Shrine or Myoken Shrine which has long been worshipped by the locals since ancient times. Pottery and flint arrowheads from the Jomon Period (circa 12,000 to 300 BCE) have also been found within the cavern, and the site was designated as a Historic Site by Gifu Prefecture in 1973. Evidence of human occupation covering the 10,000 years of the Jomon Period has been found in the surrounding areas as well.

Iwaya-Iwakage can primarily be used to measure wintertime through solar observation, and provides a system by which the leap year can be identified around the time of the spring and autumn equinoxes by observing sunlight spots inside.
A Solar Calendar of High Precision
Reading the Cycle of 365 days per Year and the Leap Year

Observation of sunlight spots at the Kanayama Megaliths is used to increase the precision of the calendar. Kanayama Megaliths Research Center has identified two formulas using these observations - the ‘1st Law of Numbers’ for reading leap years, and the ‘2nd Law of Numbers’ for reading deviations in the leap year through long term observations.

The rock formations at the Iwaya-Iwakage and Senkoku groups are arranged to form chambers where sunlight enters. For example, a beam of sunlight penetrates into the chamber of Iwaya-Iwakage, much like a spotlight, around the time of the spring and autumn equinoxes. Through careful observation of the patterns and position of this light as it shines on the megaliths inside, it is possible to identify the yearly cycle of approximately 365 days, as well as the 4-year cycle of leap year.

The length of the year is determined by the amount of time required for the sun in the sky to travel around the Earth (365.2422 days). For someone standing on the Earth, this is equivalent to the time for the sun to return to its starting position over the course of the year. At Iwaya-Iwakage, the spot of sunlight will return to almost the same position after 365 days, but each year the point it returns to is off slightly more than the previous year*. Because this offset adds up to one day of sunlight every four years, it is possible to measure the leap year which adds one extra day to the year every four years. The Measuring Stones formation inside the Iwaya-Iwakage cavern are used to make this observation. The spot of light shines on the Measuring Stones in a meaningful way twice per year, splitting the year into two periods, and those measurements enable the observer to calculate that the year is 365 days long by adding the number of days for the two periods. These periods are the 228 days (229 days in a leap year) during which the spot of light enters into the Iwaya-Iwakage cavern, and the 137 days (136 days in a leap year) of the winter period during which the spot of light does not shine in.

![Diagram of the solar cycle of the Kanayama Megaliths and the 1st Law of Numbers]

228-137=91 (Normal Year)  
229-136=93 (Leap Year)

One Year Cycle 91+91+91+91+1=365 days  
Leap Year Cycle 91+91+91+93=366 days [1st Law of Numbers]  
Four Years Cycle 365+365+365+365+1=1461 days

Fig.1 :The solar cycle of the Kanayama Megaliths and the 1st Law of Numbers

(left) A spot of sunlight striking the Measuring Stones on October 14 -normal years  
(right) A spot of sunlight striking the Measuring Stones on October 14 -leap years

The Measuring Stones
If one focuses on the difference in days from the winter period, one discovers a hidden code in the numbers 91 and 93. For three years in a row, the difference is 91, representing a normal year, but the difference is 93 for leap years. The sum of these numbers over four years equals the number of days in a leap year, resulting in a system for reading the four-year cycle of the leap year. This formula is called the 1st Law of Numbers (see Fig. 1) at Kanayama Megaliths Research Center. According to computer simulation, this formula is estimated to have been most accurate as far back as 1000BCE.

Reading the Deviation of 4-year Leap-year Cycle from Extensive Solar Observation
The results of the calculation will eventually be wrong if one continues to use the 1st Law of Numbers mentioned above*. After 128 years (after the 4-year cycle has happened 32nd times), the two periods in the 365-day year defined by the spot of light entering into the megaliths will be 135 and 230 days respectively, and the result of subtracting 135 from 230 is 95, instead of 93 as it is supposed to be for leap years according to the 1st Law of Numbers. This observation can be used to actually correct the calendar by subtracting one leap year every 128 years to get the result of 93. Kanayama Megaliths Research Center calls this correction the 2nd Law of Numbers.
The next time it will be needed in the year 2094 under our current calendar. This has been proven by comparing long term observational data of the solar altitude.

Accuracy and Considerations of Leap Year Observations
Throughout the world today, we use a system called the leap year—a year with 366 days once every four years—to make up for the increasing difference between the calendar and the position of the sun that occurs in the Gregorian calendar. Furthermore, on every leap year that can be divided by 100 but not by 400, that leap year is skipped to adjust for further error, resulting in three leap years skipped every four hundred years.
But even with these adjustments, the position of the sun still drifts compared to the Gregorian calendar when measured over longer periods. In fact, a deviation of a whole day occurs every 3,200 years. The next time this will happen under our current calendar is the year 4900CE. However, this additional deviation is currently ignored, and the calendar continues to be used without any additional adjustment being made for it.
Meanwhile, if one continues observations using the First and the Second Laws of Numbers of the calendar at the Kanayama Megaliths, there will be a period of 128 years during which the deviation is one day, beginning in 4900CE. This will be followed by another period with a deviation of two days. These deviations can be corrected for under the Kanayama calendar by subtracting one day at the start of each period. (See Fig. 2) The Kanayama Megaliths thus allow not only the prediction of the deviation in the Gregorian Calendar, but also the correction of the calendar through extensive solar observations. This means that the ancient people of Hida may have been aware of this system so many centuries ago.

* Deviation in the Solar Cycle
The exact amount of time it takes the sun to travel around the Earth is 365 days, 5 hours, 48 minutes, and 46 seconds. The excess number of hours causes a deviation that must be corrected regularly.
Fig. 2: Comparison between Kanayama and Gregorian Calendars
Basic Solar Observation

The numbering of observation spots in this guidebook refer to the numbers of signposts placed on site.
1. Higashi-no-yama

From Spot ⑦, one can see Higashi-no-yama to the east.

### Winter Solstice

Observations at Spot ⑭ are made by sitting in the space at the end of Stone R. Here, the sun can be seen rising from its southernmost position during the year around the winter solstice at the point indicated in the sky by the ridge of Stone R.

### Winter 120 days

At Spot ⑬, observations are made in alignment with the side of Stone S. Spot ⑬ is designed so that no sunlight enters for the 120 days of winter.

<table>
<thead>
<tr>
<th>Time</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>60 days before Winter Sol.</td>
<td>Sunlight from the sun rising over the mountain no longer reaches Spot ⑬ after the start of winter</td>
</tr>
<tr>
<td>Winter Sol.</td>
<td>Sunlight is blocked because the solar altitude is lower that the mountain slope</td>
</tr>
<tr>
<td>60 days after Winter Sol.</td>
<td>Sunlight enters again when winter ends</td>
</tr>
</tbody>
</table>
2. Senkoku

This megalithic group can primarily be used to make solar observations throughout the four seasons, centered on the summer solstice. Stone A, with the two lines and three ovals carved on it, can be seen to the south of Spot ②.

Observation Spot ⑧

Winter 120 days
Observations are made from the east side of Stone B. For the approximately 120 days surrounding the winter solstice, sunlight shines between Stone B and Stone B' at Spot ⑧ as the sun sets behind the mountain.

| 60 days before Winter Sol. | The sun begins to descend between Stones B and B' at the start of winter | Around 16:00, 10/23 |
| Winter Sol. | The sun reaches its southernmost point of the year as it descends between the megaliths | Around 16:20, 12/22 |
| 60 days after Winter Sol. | The sun disappears from view between the megaliths at the end of winter | Around 16:30, 2/20 |

Observation Spot ③

Summer Solstice
Around 6:00 on the summer solstice, the sun rises from behind the mountain between Stones B and B'.

Around 17:00, the sun sets behind the mountain along the edge of Stone A'.

This page contains a table that summarizes the solar observations at Senkoku for the winter and summer solstices.
Traces of Ancient Solar Observations

According to the two observations above, the symbols found carved into the stone in 1997 (the two lines and three ovals) are traces of observations made of the arrival of the summer solstice in ancient times. The three ovals symbolically represent the shape of the spot of sunlight in summer, while the two lines similarly represent the spot of light that shines through the crevice during the same period.

Observations at Spot ③ are also made from within the cavern.

A spot of sunlight enters when the solar altitude is at its highest point of the year around the summer solstice (11:40 from May 30 until July 14). The oval shape of the spot of light matches the three ovals carved on the stone.

There is a deep crevice carved into Stone A that is 50cm deep and 5m long. Sunlight shines through this crevice around 15:00 on the summer solstice. There are two lines carved above the crevices in parallel to it.
Summer 62 days  from May 21 until July 22, precisely
The observation at Spot ③ is made from within the cavern similarly to the previous observations. It is a highly precise summer observation using a spot of sunlight. The observation is also important in determining the day of the summer solstice.

Around 30 days before and after the summer solstice, a spot of sunlight shines into the cavern around 13:00. When this happens, a dotted line of light appears on the triangular surface of Stone A’ (40 x 30 x 25cm). This occurs for five days on each occasion, starting on May 21 before the summer solstice and ending on July 22 after the summer solstice. The total period of time from when the dotted line first appears until after it appears and disappears again is 62 days, and the day of the summer solstice can be determined from the midpoint of this period.

Summer 120 days
Observations at Spot ③ are made on the Stone Board inside the cavern. Approximately 60 days before and after the summer solstice, an arrow-shaped spot of light appears in the center of the Stone Board when the light from the rising sun shines into the cavern.

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Around 4/22 and 8/20</td>
<td>An arrow shaped spot of light appears in the center of the Stone Board at the beginning of summer</td>
<td>Around 7:55, 4/22</td>
</tr>
<tr>
<td>Summer Sol.</td>
<td>The sunlight at its northernmost point of the year marks the left edge of the Stone Board</td>
<td>Around 7:40, 6/21</td>
</tr>
<tr>
<td>60 days after Summer Sol.</td>
<td>The sunlight marks the center of the Stone Board once again at the end of summer</td>
<td>Around 7:55, 8/20</td>
</tr>
</tbody>
</table>

Observation Spot ④⑥
Summer 120 days
Observations are made from Spot ⑥. For the 120 days of summer, light from the rising sun shines into the cavern at Spot ④.
The start and end of summer can be measured by the position of the shadow of Stone C on Stone A.

<table>
<thead>
<tr>
<th>Time Period</th>
<th>Description</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>60 days before Summer Sol.</td>
<td>Sunlight begins to shine into the cavern at Spot ④ at the beginning of summer</td>
<td>Around 7:15, 4/22</td>
</tr>
<tr>
<td>Summer Sol.</td>
<td>Light from the sun at its northernmost position for the year reaches the back of the cavern from the front</td>
<td>Around 7:40, 6/21</td>
</tr>
<tr>
<td>60 days after Summer Sol.</td>
<td>The light stops shining into the cavern at the end of summer</td>
<td>Around 7:45, 8/20</td>
</tr>
</tbody>
</table>

**Observation Spot ⑤**

**Summer Solstice**

**Spring and Autumn Equinoxes**

Observations are made at Spot ⑤ by entering between the two stones. Observations here are possible during five periods from spring through fall.

<table>
<thead>
<tr>
<th>Event</th>
<th>Description</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spring Eq.</td>
<td>When spring arrives, the sun rises from the corner of Stone C</td>
<td>Around 9:00, 3/21</td>
</tr>
<tr>
<td>60 days before Summer Sol.</td>
<td>When summer begins, the sun rises from the midpoint between the corner and center of Stone C</td>
<td>Around 8:40, 4/22</td>
</tr>
<tr>
<td>Summer Sol.</td>
<td>The Sun rises at its northernmost position for the year from the center of Stone C</td>
<td>Around 8:20, 6/21</td>
</tr>
<tr>
<td>60 days after Summer Sol.</td>
<td>When summer ends, the sun rises from the midpoint between the right corner and center of Stone C</td>
<td>Around 8:50, 8/20</td>
</tr>
<tr>
<td>Autumn Eq.</td>
<td>When autumn arrives, the sun rises from the corner of Stone C again</td>
<td>Around 8:50, 9/23</td>
</tr>
</tbody>
</table>
3. Iwaya-Iwakage

This megalithic group can primarily be used for solar observation in the winter time. Meanwhile, observation of sunlight spots at the spring and autumn equinoxes demonstrates the most advanced system to identify leap years.

**Observation Spot ⑫**

Winter 120 days

For the 120 days of winter, sunlight shines into the center of the megalith formation comprised by Stones E, F, and G.

Winter 119 days from October 23 until February 19, precisely

The observation is made at Spot ⑫ from inside the megalith formation. This is a highly precise winter observation using spots of sunlight. The observation is also important in determining the day of the winter solstice.

Around 60 days before and after the winter solstice, a spot of sunlight shines into the cavern. At this time, a spot of light overlaps the surface of Stone F in the same shape as that surface (178 x 30cm). This occurs for five days on each occasion, starting around 12:50 on October 23 before the winter solstice and ending around 13:20 on February 19 after the winter solstice. The total period of time from when the light first overlaps until after disappears again is 119 days, and the day of the winter solstice can be determined from the midpoint of this period.
Summer Solstice
This observation is made at Stone H (a menhir) just to the south of Stone E. Here, the sun can be seen rising from its northernmost position during the year on the summer solstice, at a point along the line designated by Stone H.

Summer 120 days
This observation is made at Spot ⑫ from inside the megalith formation. For the 120 days of summer, the light from the setting sun does not shine into the megalith formation.

<table>
<thead>
<tr>
<th>60 days before Summer Sol.</th>
<th>The light stops shining into the formation with the beginning of summer</th>
<th>Around 16:05, 4/22</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summer Sol.</td>
<td>The light from the setting sun as it reaches its northernmost point of the year does not enter the formation</td>
<td>Around 6/21</td>
</tr>
<tr>
<td>60 days after Summer Sol.</td>
<td>The sunlight begins to enter the formation again at the end of summer</td>
<td>Around 16:20, 8/20</td>
</tr>
</tbody>
</table>

A Summer Camp for Bats
Every year during the 120 days of summer, when sunlight does not reach inside the stone formation, approximately 60 horseshoe bats gather in the shadows there to give birth and raise their young. As the sunlight reenters the formation at the end of summer, the bats depart and seek shelter elsewhere. The peaceful lives of these bats in their stone house, following the cycle of sunlight, serve as an important message for modern people.
Spring and Autumn Equinoxes
This observation is made at Spot ⑫ from inside the megalith formation. A spot of sunlight enters the megalith formation during the morning hours (from 9:00 until 13:00) at the spring and autumn equinoxes. The trajectory of this spot of light shows greater movement during this period than any other time of the year. It is possible to determine the length of the one-year solar cycle (approximately 365 days) and the four-year (leap year) cycle when the light is observed to move 4cm in a day.

The position of the spot of sunlight that enters the megalith formation returns to almost the same spot after the passage of 365 days, but the new position is just 1cm off from the original. This results in a 4cm deviation after 4 years, requiring an additional day for the spot to return to its original position. This one day is the so-called leap year.

Spring and Autumn Equinoxes
Sunlight enters the gap between Stones E and F just before the sun sets behind the mountain during the spring and autumn equinoxes.
16:50 on the spring equinox, March 21
16:30 on the autumn equinox, September 23

Summertime is when the light of the setting sun is to the right of the gap, while wintertime is when it is to the left.
Star Observation at the Kanayama Megaliths
In addition to their use as a solar observatory, the Kanayama Megaliths were also used for observation of the night sky. It is believed that ancient people read the seasons from the position of North Star and the constellation of the Big Dipper that revolves around it before sunrise and after sunset.

Observation Spot ①⑪

Observations of the North Star and the Big Dipper at Iwaya-Iwakage
Solar observation at the Iwaya-Iwakage are thought to have been most active around the winter solstice. Likewise, around the winter solstice, the Big Dipper is observed rotating around the North Star in the northern sky at Spot ⑪ along the side of Stone F.
Spot ⑪ is located just beyond the cavern leading from the southern front to the back of the megalithic formation.

Computer simulation has demonstrated that the Big Dipper appeared in its entirety in the night sky along the side of Stone F before sunrise on the winter solstice around 500BCE during years the leap year was observed. Today, the Big Dipper describes a wide rotation around Stone F because it is further away from the position of the North Star, now located at Polaris, than it was in 500BCE.
The south face of Stone J is angled towards the north at approximately 35 degrees. At Spot ①, the North Star and the Big Dipper rotating around it, can be observed along the line of sight extending from the south face of Stone J.

The North Star changes according to the cycle of Earth’s precession*, and while the position is currently (as of 2000CE) occupied by Polaris within the Little Dipper, it is estimated to have been Thuban, also known as Alpha Draconis, in the constellation of Draco at the time that Stone J would have been used for observation (around 2500BCE).

* The Earth’s Precession
The Earth’s precession is the cycle by which the Earth’s axial tilt oscillates. Specifically, it refers to the fact that the axis of the Earth is slanted approximately 23.4 degrees from the line vertical to its plane of revolution, and the axis thus describes a circle in the sky over a cycle that lasts approximately 26,000 years. The North Star is the fixed star along the periphery.
Observation Spot ⑨

Observations of the North Star and the Big Dipper from Senkoku

Solar observations are believed to have been most active at Senkoku around the summer solstice. Likewise, on the summer solstice, the stars rotating around the North Star can be seen from Stones A and D at Spot ⑨.

When viewing the north sky from the engraved Stone A via Stone A’, the North Star, Polaris today, can be seen above Stone D by following the line extending from the eastern side of Stone A’.

According to computer simulation, it can be demonstrated that the Big Dipper was aligned vertically with the east side of Stone D roughly one hour after sunset in the sky of the summer solstice around 500 BCE during leap year observation.

Late at night during the same period, several bright stars - Vega in the Lyra constellation and Deneb in the Cygnus constellation - would have been observed when looking up from the channel in the center of Stone D.
Access

From JR Hida-kanayama Station to the Kanayama Megaliths: 16km
From JR Hida-kanayama Station to Kanayama Megaliths Research Center: 1km
From Kanayama Megaliths Research Center to the Kanayama Megaliths: 16km
From Gero Hot spring to the Kanayama Megaliths: 19km

Tour of the Kanayama Megaliths

A half day guided tour to the megaliths, which includes walking trip around the old town of Kanayama and lunch at the Restaurant Hizan. Reservations are required in advance.
Jomon Astronomy
Solar calendar of the Kanayama Megaliths
Harriet H. Natsuyama, USA
Visiting Researcher at Kanayama Megaliths

Five thousand or more years ago, Jomon people constructed three megalithic sites as a living observatory for the sun’s passage in the sky during its yearly cycle. These megaliths are tucked away in the Iwaya mountain valley of Hida Kanayama, a mysterious, ancient, unspoiled land. They are the most sophisticated megalithic astronomical constructions ever recorded in history, anywhere! The enormous megaliths were shaped and ingeniously assembled, creating small apertures through which the sun would shine on certain days of the year at certain times of the day. From these observations, a calendar is determined which incorporates the four-and 128-year leap-year cycles. This calendar is fifteen times more accurate than the current, globally employed, Gregorian calendar. It will take 51,000 years before making an error of one day!

The Kanayama Megaliths are a treasure not only for Japan but for the whole world. Experiencing the Kanayama Megaliths in the natural setting, we believe can eventually lead to a world of happiness and peace.

Complete essay is available at www.japan-insights.jp

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Looking towards the 2020 Olympics and Paralympics and beyond, we hope to contribute to a Japan that offers people from around the world many opportunities for discoveries and memorable encounters.

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