# Cultural Transfer into the Future : Time Measurement with Incense in East Asia

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## Introduction

In today's modern age of technology, few people think about the path humanity has travelled in terms of the process of understanding the concept of time and ways of measuring it. In fact, this topic unites two seemingly distant ideas such as incense and time measurement. Today, not many can even begin to guess how something like the burning of incense in antiquity and the early Middle Ages was adapted to aid and make astronomical calculations and technical inventions possible.

Awareness of the importance of the category of time at court, among philosophers, scientists and officials, gradually spread to the life habits of the common people. It has long been noted that folk ways of measuring time were related to daily habits and needs, when it was important to determine the time required to drink a cup of hot tea, eat a bowl of rice, overcome a certain distance, or burn one incense stick. The expression "burning time of one incense stick" that is often found in Chinese literature, specifically reflects this idea.

At the same time, while the use of incense was limited mainly to religious or cult practices in the West, the countries of East Asia found many areas for its practical application. For the function of measuring time alone, incense was widely used in palaces, government offices, Buddhist temples and during science study.

## Time measurement in traditional China

Since ancient times, time measurement in China was carried out in several ways–with the help of sundials, clepsydras, and later hourglasses. While the sundial (圭表 *guibiao*) as the most ancient device for measuring time was already well established in China in the 7th century BC, the use of the water clock (clepsydra) in China most likely began at the beginning of the Chunqiu era (8th–7th centuries BC)[1] and was known as 漏壶 lou hu (meaning "a jug that passes [water]") or 刻漏 *ke lou* (meaning "clepsydra"). During the time of the Han Dynasty, the design of the water clock was based on the principle of measuring the level of water dripping into the lower vessel, from the one above. The imperial palace even had a designated official whose duties included looking after the water clock (Spiritual culture of China, 2009. Vol. 5. P. 114–115; Startsev, 1978. P. 275).

The hourglass, the mechanism of which was based on sand falling evenly onto a wheel with cups, was invented by Zhan Xiyuan in 1360. This wheel was connected through a gear transmission system with an arrow hand indicating the time on the dial, which was subdivided into 12 two-hour periods, which were divided into even smaller intervals.

[1] Presumably, such a way of telling time was not a Chinese invention. Clepsydras first appeared in Egypt and Mesopotamia, from where they could have been borrowed by the inhabitants of East Asia (Bedini, 2005. p. 10).

These methods of measuring time had some disadvantages. Clepsydras lost all functionality at air temperatures below zero, sundials–in cloudy weather, and hourglasses–in high humidity. They were therefore subsequently supplemented (and in some cases replaced) with one more way of keeping time: with the help of incense (sticks and aromatic powder). Incense sticks were the easiest to adapt for time measurement: they had indicators or notches which would correspond to specific time intervals (Voytishek at al., 2020. P.98).

**Incense sticks as a way to measure time**

Time counting required particular accuracy and precision, which is why aromatic raw materials were produced according to strictly defined recipes, making sure that the rate of burning remained fixed and uniform. Sandalwood or agarwood was usually used as the base for aromatic raw materials, to which other ingredients were added to regulate the burning rate. For example, clay slowed down the burning rate, while components containing resin, on the contrary, accelerated it. In addition, powdered aromatic components were also added, such as labdanum, patchouli, cloves, camphor and many others. A small amount of water or wine was added to the ingredients, everything was mixed into a paste–like substance, and then pushed through round holes using a press. The resulting long strands were dried and then cut into sticks of the desired lengthy.

The areas of use of incense sticks as an instrument for measuring time varied widely. They were most commonly used in temples to determine the timing of certain daily rituals, as well as in more complex cases, when fragments of sutra texts or specific Buddhist symbols were laid out with the help of aromatic powder on a special tray.

Incense sticks were also widely used to calculate the duration of court ceremonies. For example, during the coronation of the emperor (to measure the pace of the procession from the palace to the temple where the ceremony took place) or during wedding rituals.

In addition, there have been recorded cases of the use of sticks and more complex aromatic clocks in engineering and marine affairs. For example, the aromatic seals 香印 *xiangyin*, which can be construed as a specific type of incense burner, were quite fitting for use in navigation. They are not affected by rocking caused by sea waves, and you can apply interval signs on their surface, indicating the unit of the time interval, so that the time is clear at a glance. Lastly, the duration of burning of an aromatic seal reaches 12 Chinese 時 *shi* hours (equal to one day), so such a seal is almost an ideal tool at sea for determining the time of day. On Chinese ships, the aromatic clock, like the compass, was placed in a small windproof cabin to avoid any wind interference. Until the middle of the 20$^{th}$ century, Chinese miners, before descending underground, would light a three–hour stick, which allowed them to count their shifts.

Undeniably, many unusual technical inventions in China are associated with incense. During the Yuan Dynasty, the famous court astronomer and mathematician Guo Shoujing (1231–1316) invented the 'aromatic clock with a screen' (屏风香漏 *pingfeng xianglou*), as well as the 'aromatic clock in a locker' (柜香漏 *gui xianglou*). The design of these two types of clocks was similar: they both featured a kind of container in which an incense stick was placed in order to minimize external factors (wind, humidity) on the nature and time of its burning. For the task of counting longer time

intervals (7 days, 30 days, etc.), incense in the form of spirals is still used in Chinese temples (as a rule, only during memorial services).

In addition to aromatic clocks, the Chinese invented several types of 'aromatic alarm clocks' (火闹钟 *huo naozhong*, meaning 'a timer making a noise due to fire'). These were large incense spirals, suspended on a special table mount, the base of which was a metal plate. A small suspension on a thin thread was placed at the desired indicator on the spiral so that when the fire reached this mark, the thread would burn, and the weight would fall onto a metal plate, making a loud sound.

Various modifications of such items were known, including those that used traditional motifs and images of Chinese art–for example, aromatic clocks in the form of dragon boats (龙舟香漏 *long zhou xianglou*). This design was associated with the traditional Chinese Dragon Boat Festival (端午节 *duanwu jie*), which is essentially a series of competitions held on full-sized boats in the form of dragons. Today, it is quite rare to find craftsmen who can restore aromatic clocks and other ancient devices from the Song, Yuan, and Ming dynasties.

**Aromatic seals as a tool for measuring time**

A more unique way of measuring time is using aromatic seals 香印 *xiangyin*. Characters or geometric patterns pertaining to certain time periods were skillfully applied to the flat surface of the vessel, with the help of a combustible aromatic powder. The time was determined depending on how the fire moved along the winding, narrow 'aromatic path'.

A thousand years ago during the Song era, which was a time when the culture of aromas flourished in China, a special device was invented for measuring time using special incense burners in the form of aromatic seals. It was called the 'Hundred Graduations Incense Seal' 百刻香印 *baike xiangyin* (meaning 'the aromatic deal of one hundred *ke*"), where *baike* ("one hundred *ke*") meant a time interval, equal to day and night. Such a seal burned for exactly one day, which meant that factors such as careful selection of the components of the aromatic powder, the ratio of depth, width, length of the 'track' and the rate of burning of the aromatic raw materials, acquired paramount importance.

In the Song era, the aromatic 'Five Watch Incense Seal'(五更印刻 *wugeng yinke*) was used to measure night time intervals (更 *geng*)[2]. During the process of manufacturing of these seals, the changing length of the night depending on the season was taken into account as a factor. Along with different durations of night time intervals, the size of the seals changed accordingly. All 'Five Watch Incense Seals' were divided into five equal segments: when one segment burned out, it meant that one interval had passed. Obviously, such devices could only be used by carefully checking calendar calculations, which could only be done by special attendants with extensive knowledge and special skills (Voytishek, Shmakova, 2021. P. 114).

Detailed information on the use of the 'Hundred Graduations Incense Seal' and the 'Five Watch Incense Seal' (including a detailed description of the 13 seals used at night hours throughout the year, complex calendar calculations and recipes for aromatic mixtures) can be found in written sources of the Ming–Qing epochs (15$^{th}$–19$^{th}$ centuries).

[2] Night time intervals–a unit for measuring time at night, equal to two modern-day hours (120 minutes)

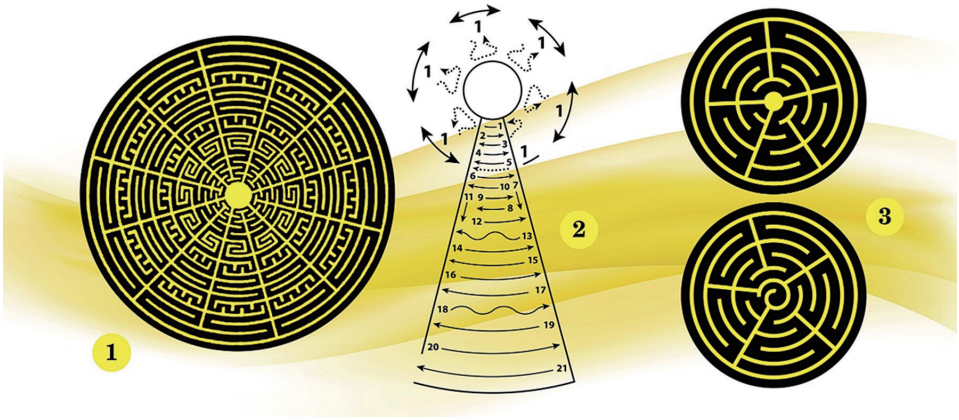


Fig. 1 Chinese Incense seals (collage by I. A. Axenov)

1. Chinese Hundred Graduations Incense seal (By Bedini, 2010. Fig. 43).
2. Scheme of burning of aromatic powder in one segment of the Hundred Graduations Incense seal. Corresponds to two astronomical hours (120 min.) (By Bedini, 2010. Fig. 44).
3. Chinese "Five Watch Incense Seals" (The Five Watch Aromatic Notch Timekeepers) with a closed and open spiral in the center (By Zhou Jiazhou, 2014. P. 447–453).

Gradually, the use of such seals gained wide popularity–in the works of the writers of the Tang era, it is possible to find many metaphors and vivid images associated with the visual of the aromatic seal burning out by morning, indicating their use for counting the night hours. By the time of the Song era, with the 11th century invention of the 'Hundred Graduations Incense Seal' and special devices for counting night time intervals, the use of seals based on the principle of burning fragrant powder per unit of time gradually began to gain popularity among aristocrats, officials, scientists and representatives of the artistic intelligentsia.

Within scientific treatises, catalogs, literary essays, works of aesthetic thought written in the 17th–18th centuries, descriptions of the various types of incense burners and aromatic seals used for timekeeping can be often encountered, with an analysis of their artistic features and functions.

Special catalogs of 'incense burners [in the form of] aromatic seals' (印香炉图谱 *Yinxianglu tupu*), were created, which are a valuable source about the history of the development of aromatic culture not only in China, but also in the entire East Asian region. The catalogs contain over one hundred different types and forms of incense seals, reflecting the attachment of Chinese masters to the images and subjects of traditional art (mythological animals and birds, plants, various benevolent symbols). Among such inscriptions one can find Buddhist and Taoist concepts – for example, 'a universal truth', 'to reach enlightenment' (道悟 *dao wu*); the widely used symbols 'double joy' (雙喜 *shouang xi*) and 'double longevity' (雙壽 *shuang shou*); sententions, as if addressed to a person of culture 文人 *wenren*, for example 'to have been educated' (meaning 'to have the spirit of books and scrolls', 有書卷氣 *you shu juan qi*) [3].

[3] Catalog of incense burners in the form of aromatic seals.URL: https://books.google.ru/books?id=FIEpAAAAYAAJ&printsec=frontcover&hl=ru#v=onepage&q&f=false (accessed 05.01.2021).

Today, scent seals in China are no longer associated with instruments for measuring time. They have remained only a valuable artifact in the development of a culture of fragrances and serve primarily for aesthetic pleasure and exquisite entertainment. The function of measuring time is performed only by incense sticks or spirals of different sizes, and the scope of their use is limited to religious and ritual activities. At present, rare craftsmen work in China, who restore outlandish aromatic clocks from the Song, Yuan, Ming dynasties[4].

**Incense timers in Korea**

In Korea, there are very few reliable sources on this topic, which can be explained by the poor preservation of historical material and the difficulties of its interpretation. Only written sources of the 18th–19th centuries contain information about how the population of the Korean Peninsula has long used aromatic clocks similar to those in China. At the same time, it is difficult to say whether they were of local production or were once brought from China. Perhaps some of them were made by local craftsmen.

For example, the "Treatise on Devices for Measuring [Time]" (儀器輯說 *Uigi Chipsol*) by the official Nam Byeongchol (南秉哲), published in two volumes in 1859, records that the inhabitants of the State of Silla used aromatic substances to measure time from the 6th century. The author of the treatise also points out that in the periods of Goryeo (935–1392) and Joseon (1392–1910), aristocratic timers were very popular in the homes of aristocrats[5].

According to the materials of the chronicles "Historical Records of the Three States" (三國史記 *Samguk sagi*, 1145) and "Remaining information about the Three States" (三國遺事 *Samguk yusa*, 1285), from the very beginning of the Goguryeo state's existence (37 BC–668 AD), Koreans, along with the adoption of Chinese writing and Buddhism, gradually began to master the use of aromatic agents for religious and everyday purposes (Kim Busik, 1995; Iryeon, 2018).

This was also facilitated by the rich experience of the Korean population in studying the properties of aromatic plants and substances, in the manufacture of vessels for their incense. The pinnacle of the development of the aromatic culture of ancient Korea can be considered the famous gilded bronze incense burner of the state of Baekje (百済金銅大香爐) – a unique product created at the turn of the 6th–7th centuries, symbolically reflecting a whole range of religious and philosophical ideas, including Taoist-Buddhist ideas, local cults, local variants of palace ceremonies and everyday practices of the population (Voytishek, 2019).

An insufficient source base does not allow us to accurately trace how the tradition of using incense developed and improved on the Korean Peninsula-in particular, when measuring time. Nevertheless, some of the major museums in Korea have rare exhibits of such items. For example, the Chondongjin Museum of Time presents a late replica of a Chinese aromatic timer in the form of a dragon boat[6].

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[4] Information on contemporary Chinese watchmakers from Suzhou. See URL: http://m-news.artron.net (accessed 31.08.2020).

[5] A treatise on devices for measuring [time]. *Uigi Chipsol*.
URL: https://terms.naver.com/entry.nhn?docId=540851&cid=46637&categoryId=46637 (accessed 12.01.2021).

[6] See materials at the Chondongjin Museum of Time, Republic of Korea (Gangwon-do).
URL: www.http://timemuseum.org (accessed 27.12.2020).

**Incense timers in Japan**

In Japan, where people were also introduced to the properties of aromatic plants quite early on, incense was also adapted for measuring time. There is evidence that such technical devices came to Japan even before the Nara period (710–794) and were used for religious and practical purposes[7].

Thus, the aromatic clock 香 (盤) 時計 *ko:* (*ban*) *dokei* (lit. "clock (on a stand) with incense") was borrowed from China during the Nara era. These were massive lacquered wooden cubic bowls with a box at the bottom, where utensils were stored (stands and containers for incense, a roller, levelling sticks and boards, powder spoons, etc.). When carrying out religious rituals, clocks were installed in front of statues in Buddhist temples and images of bodhisattvas; they were especially appreciated for the safety and constant speed of burning out the fragrant powder. In four sectors, at the corners of the stand, using special wooden frames with slits in the form of zigzags, a fine aromatic powder was applied to the compacted layer of ash, which was then set on fire. Along the entire length of the zigzag track, special marks were installed at regular intervals. The time was determined by the rate of burning of the lane of powder[8].

One example of such aromatic timers was kept in the imperial treasury Shousouin (正倉院). Since it is engraved with signs in Sanskrit, it is assumed that these devices came to Japan through China from India. During the Asuka–Heian periods (7th–12th centuries), such timers were used at a special Department of Rituals (陰陽寮 *Onyouryou*), which controls calendar and astronomical calculations, fortune-telling, and various festivals at the imperial court. By this timer, the sound of the bell was tuned, announcing the time of certain events to ordinary people. In addition to the administration of various religious and cult events (meditations, temple services, burial rituals), such a timer was then used to control the time of water supply to flooded rice fields, as well as other practical purposes[9].

The aromatic timer 線香時計 *senkou-tokei* (lit. "timer with incense sticks") was a wooden box with a tray for storing sticks and other utensils. In the deepened upper part of the box, filled with ash, metal holders of incense sticks were installed in clear rows, where the sticks were inserted just before the start of any event. Such devices were used in private schools 寺子屋 *terakoya* during the Edo period (1603–1868) and during the Meiji period (from 1868 until the beginning of the 20th century), measuring the time of lessons. In addition, they also served as a kind of busy timer for *geisha* when receiving guests (the cost of service was calculated by the number of incense sticks burned–one stick burned for about 30 minutes)[10].

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[7] In O:mi-jingu: shrine in the city of Otsu, associated with the veneration of the 38th Japanese emperor Tenji-tenno: (626–671), according to legend, the inventor of Japan's first water clepsydra, an aromatic clock was installed 香時計 ("Ancient fire clock" 古代火時計 *kodai hi-tokei*), made according to the Chinese model in the form of a dragon boat. See 近江神宮 Omi Jingu Shrine. URL: www.youtube.com (accessed 07.01.2021).

[8] Currently, such clocks can be seen in art galleries (for example, Shoyeido company (松栄堂) in Kyoto, see URL: www.shoyeido.co.jp), museums, they are exhibited in online stores specializing in antiques and home furnishings (see URL: www.auctions.yahoo.co.jp). The items are richly decorated with floral ornaments and Buddhist symbols, many of them made in the Edo period (17–19 centuries), are highly valued (from 16,000 to 66,000 yen). Various types of them are presented in the Museum of the Seiko watch company in Tokyo (The Seiko Museum Ginza). URL: www.museum.seiko.co.jp (accessed 06.01.2020).

[9] Field research materials by E. Voytishek on the Awaji island in 2018; website of the art gallery of incense company Baikundo in Awaji (淡路市梅薫堂). URL: www.baikundo.co.jp (accessed 06.01.2020).

[10] Museum of the Seiko watch company in Tokyo (The Seiko Museum Ginza). URL: www.museum.seiko.co.jp (accessed 06.01.2020).


Fig. 2 Korean and Japanese Incense timers (collage by I. A. Axenov)

1. Korean dragon boat timer (Chinese counterpart). Chondongjin Museum of Time, Republic of Korea (Kangwon Province).
2. Incense timer on a stand (香時計 *kou dokei*) with additional accessories The Seiko Museum Ginza in Tokyo (URL: www.museum.seiko.co.jp).
3. Japanese incense timer 線香時計 *senko: tokei* (lit. "timer with incense sticks"). Iwano Fine Arts Corporation (URL: www.Iwano.biz).

Currently, such devices are not used, but are sometimes showcased in the Japanese incense art clubs 香道 *koudou*. In modern Japan and in this area, the strength of tradition is great: along with the development of aroma culture, a unique business solution was recently found. The largest watch companies and incense manufacturers, together with chemical technologists, have combined their efforts to produce new types of products. It is all about the same concept–the "aromatic timer" (香時計 *kou dokei*), but reinterpreted in the current realities.

Japanese manufacturers offer consumers various types of wrist and table aromatic clocks, skillfully incorporating an "anti-stress" effect to balance out the vigorous activity of residents of modern cities. The watch case, as well as the bracelets exuding pleasant aromas, are made in different colours, with spectacular design options for different categories of buyers[11]. New types of incense burners and censers are equipped with special time stamps, which makes it possible to follow the passage of time, enjoying both exquisite aromas and an elegant design.

As for the aromatic seals 香印 *xiangyin*, which are still popular in Chinese culture, they have not particularly taken off in Korea, but in Japan they continue to be widely used (in a different capacity however) in the art of incense. To enjoy the aromas, small coloured pressed seals with scented ingredients (Jap. 印香 *inkou*) are placed on hot ash in incense burners. In order to measure time, aromatic seals are now practically hardly ever used–even in Buddhist temples, for the most part, only incense sticks, spirals and mixtures of finely ground fragrant wood are burned.

[11] See the websites of manufacturers of aromatic watches and incense burners. For example, the Rakuten fragrance watch company offers its customers a KAORU watch ("Aroma") with the smell of camellia, sakura, hinoki tree, jinkou tree, kyara, etc. (URL: www.product.rakuten.co.jp). Incense packages often provide information about the burning time of sticks or spirals.

**Conclusion**

Over the past hundreds and thousands of years of the development of aromatic culture in the countries of East Asia, vast experience has been accumulated in the use of incense, including in the field of calendar calculations and time measurement.

Analysis of artifacts, objects of religious worship and everyday life indicates a great variability in the use of incense: in addition to lighting sticks, spirals and cones, daily aromatic seals, alarm clocks, as well as clocks that measure night time in strict dependence on the calendar season, were invented. Various types of aromatic clocks were distinguished by their great functionality, finding application in many fields–in navigation, engineering, court and religious ceremonies, in the studies of scientists, in monastic and private schools, tea houses, they even served as an object of admiration for poets, artists and calligraphers.

This once again confirms that the experience of using incense in the countries of East Asia needs careful study, which should be based on an analysis of a whole range of sources–written (treatises, technical manuals, catalogs, poetic heritage), artistic (arts and crafts, art tools incense), as well as ethnographic and anthropological materials. At the same time, it should be noted that, in comparison with a large number of Chinese and Japanese sources, the cultural heritage of the Korean Peninsula is distinguished by significant gaps, which significantly complicates the interpretation of the material.

The use of incense burners, aromatic raw materials and other instruments for measuring time constitutes an amazing phenomenon in East Asian culture, testifying to the high adaptability of symbols and images of traditional culture, ritual and magical practices not only to daily household needs, but also to various achievements of science and technology.

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