Astronomy in the Edo (Tokugawa) Period, A Way of Natural History

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1. Introduction

Western astronomy which was introduced by Jesuit missionary was also transported to Japan in the Edo (Tokugawa) Period(1600-1867). The purpose for Japanese scholars to learn it was to make precise calendar. But Japanese telescopes made in this period were used not only for such practical purpose but also used for intellectual's observation and amusement. This situation indicates that the use of astronomical telescopes in Tokugawa Japan had an aspect of natural history which aims to know curious and amazing natural things.

2. Western astronomy in China

It is well known that Western astronomy was introduced by Jesuit missionary. Jesuit scholars promoted study of mathematics and astronomy in Europe. Matteo Ricci (Chinese name: Li Madou, 1552-1610) was a student of the most famous Jesuit scholar Clavius and sent to China.

(Clavius's) books went to China in the hands of Jesuit missionaries like Matteo Ricci and Johann Adam Schall, who were very effective in impressing the Chinese aristocratic classes with Western learning. [1]

His intention is clear in the following writing.

We should change the Chinese calendar, this would enhance our reputation, the doors of china would be even more open to us, our position there would be more stable and we would be freer.[2]

Ricci and his colleagues introduced Ptolemy's geocentric model because to study the heliocentric model of Copernicus was prohibited by Catholic church in 1616. But there were no decisive evidence which indicated which of these model is right, so some astronomers like Tycho Brahe tried to `improve' the heliocentric model to geocentric one. Even Galileo's so-called decisive proof for the movement of the Earth, the tidal motion of the water in the oceans, is false from our point of view. Traditionally geometric models had been regarded as the means for astronomical and astrological calculation.

According to the progress of astronomy in Europe, Adam Schall von Bell (Chinese name: Tang Ruowang, 1592-1666) and Giacomo Rho (Chinese name: Luo Yang, 1592-1638), with a Chinese mandarin Xu Guangqi 徐光啓(1562-1633), compiled and translated Western mathematical and astronomical books and completed *Chongzhen lishu*『崇禎暦書』. They accepted the observational result of Galileo and introduced the geocentric model of Brahe. In this model, the planets go around the sun, and the sun and the moon go around the earth. After the change from the Ming dynasty (1386-1644) to the Qing (Manchu) dynasty(1644-1911), it was again issued as *Xinfa lishu*『新法暦書』in 1646, and next *Lixiang kaocheng*『暦象考成』was issued in 1742.

But to predict eclips exactly Ignatius Koegler (Chinese name: Dai Jinxian, 1680-1746), who was the director of the Imperial Observatory in Peking, and others revised *Lixiang kaocheng* as *Lixiang kaocheng houbian*『暦象考成後編』in 1742. It is still based on the geocentric model, but the orbits of the sun and the moon are ellipse as Kepler adopted in his heliocentric model.These literatures are imported to Japan and Japanese astronomers were affected.

3. Astronomical studies in Japan

Previously it was prohibited to import Western books by the seclusion(sakoku) by the Tokugawa regime, but the 8th Syogun(samurai ruler) Yoshimune 吉宗 was interested in astronomy, celestial observation, and the accuracy of calendar. He relieved the seclusion and allowed the import of Western scientific and technical books except those with religious content in 1720. After that, Japanese scholars gradually learned the Western science, and some Western books were translated into Japanese. Today this situation is described as follows:

Tokugawa society did not support the pursuit of knowledge for its own sake, nor did Japanese scientists think that they should contribute to universal knowledge. Most commentators believed that the goal of knowledge was its application, which could be a search for better surgical procedures and medical therapies, correction of discrepancies in the calendar, more accurate maps of the Japanese coastline, or a variety of other use. Nearly all the

translation of European and Chinese technical works that engaged so many scientists had a practical motivation.[3]

In the case of astronomy, Asada Goryu 麻田剛立 (1734-1799) is a famous figure in this period. Asada was a doctor of Kituki-han 杵築藩(local Samurai regime) in Kyushu. But he was too busy to make celestial observation, so he escaped from Kyushu to Osaka in 1772, changed own name, and began to study astronomy. He became famous because he made the precise prediction of a solar eclipse (1762-63) which was missed by the astronomical bureau and observatory (Tenmongata 天文方).

So in order to reform calendar in Kansei era(1787-93), Tenmonkata appointed Asada's two students, Takahashi Yoshitoki 高橋至時(1764-1804) and Hazama Shigetomi 間重富(1756-1816). This was an extraordinary appointment because Takahashi was a lower class samurai and Hazama was a pawnbroker. But the former had theoretical and mathematical capability and the latter was good at making scientific and observational instruments. So they accomplished the reformation of calendar in Kansei era(1796-7).

Asada and Takahasi studied Western astronomy by technical books translated in Chinese. Firstly they consulted *Lixiang kaocheng*『暦象考成』、but next they got a copy of *Lixiang kaocheng houbian*『暦象考成後編』and studied Kepler's mathematical model. So they did not read Dutch.

However, the most important development was arrival (in 1803) of a book in Dutch by the French astronomer J.J.F.de Lakande. Lalamde was a preeminent figure in eighteenth-century science, and his work was the first ``advanced treatment on contemporary Western astronomy'' to make its way to Japan.[4]

Takahashi began to study Dutch and translate it into Japanese, but he died a year later. The draft is *Lalande rekisho kanken*『ラランデ暦書管見』, (A personal view of Lalande's astronomy).

Ino Tadataka 伊能忠敬(1745-1818) is one of the most famous figures in this era because he made the exact maps of Japanese islands. He had been a rich merchant, and after retirement became a student of Takahashi and Hazama. He was interested in astronomy, but he measured almost all over Japanese coast because he had the skill of using observational instruments.
Yamagata Banto 山片蟠桃(1748-1821), another rich merchant, is also regarded as a member of the Asada school. He is known as an atheist, a materialist, and claimed plurality of worlds which is resembles to that of Fontenelle.

Therefore it is argued that

Tokugawa astronomy focused almost exclusively on producing better calendars, and for much of the period depended mainly on the acquisition (in some cases recovery) of information from China.[5]

But if we change our view a bit and focus on telescopes which were used by scholars at that time, we can see another aspect of astronomy in the Edo (Tokugawa) period.

4. Telescopes in the Edo (Tokugawa) Period

In Europe from the end of the 16 Century to the beginning of the 17 century telescopes appeared and spread. Galileo made a telescope and firstly observed celestial bodies in 1609.

The first Japanese who had a telescope was the first shogun Tokugawa Ieyasu 徳川家康. He received it by an Englishman in 1613. It is supposed that in the early 17 century some Japanese craftsmen produced telescopes at Nagasaki where foreigners were allowed to come. There are some documents which records Hamada Yahei 濱田弥兵衛 and Mori Jinzaemon 森仁左衛門 as makers, but we don't know them in detail.

After the late 17 century we find some pictures which describes people using telescopes for amusement. For example, such a picture is on the book written by Ihara Saikaku 井原西鶴 in 1682.

By 1800 Japanese astronomers were regularly producing telescopes and even grinding lenses. Using telescopes of his own devising, Kunitomo Tobei observed sunspots in 1835 and published a drawing of the surface of the moon; other astronomers began to do systematic observations of the planets.[6]

Kunitomo Tobei 國友藤兵衛 (also called Ikkansai 一貫斎) was a member of the craft in Kunitomo village where guns were manufactured. He made some reflection telescopes from 1834 on.
But before him there was another famous telescope-maker. He was Iwahashi Zenbei 岩橋善兵衛(1756-1811) from Kaizuka, Izumi country south of Osaka. He began to make and sell lens for glasses, but we don't know the reason why

he started to make telescopes or was interested in astronomy. In 1793 he went to Kyoto with his telescope to visit Tachibana Nankei 橘南谿(1753-1805) who was a famous doctor. They observed the sun, the moon and the planets with twelve intellectuals. Iwahashi also went to Osaka to visit Kimura Kenkado 木村蒹葭堂(1736-1802) who was a liquor brewer but known as a botanist and a scholar of natural history.

Iwahashi's telescopes were settled at the astronomical bureau and observatory (Tenmongata), used by members of Asada school. Takahashi and Hazama also mediated Iwahashi's selling telescopes. The mapmaker Inou also used one. A witness wrote that when Iwahashi Zenbei was middle age, he became crazy about astronomical theories by Copernics and Newton, made telescopes, got money but each time wasted it at once. Several telescopes including Inou's have survived until now and we can see them. Also exist some documents concerning his life and work, including an introductory book on astronomy written by Zenbei.

5. Conclusion

As we have seen, some Japanese people in the Edo (Tokugawa) Period were interested in astronomy and observed the heavenly bodies with telescope. In this sense, we can say that they had desire to study natural history which collects and investigates curious or strange things and phenomena.

But, in contrast with Western scholars, Japanese scholars did not have the paradigm to make theories or mathematical models. In the Western world, it had passed four centuries since the translation of Ptolemy's *Almagest* into Latin and the import of such paradigm. After the Meiji Restoration (1868), Japanese scholars got the paradigm of modern exact natural science.

Notes

1. Lattis, p.31
2. Quoted in J.Martzloff, p.21
3. J.R.Bartholomew, p.10
4. J.R.Bartholomew, p.17
5. J.R.Bartholomew, p.15
6. J.R.Bartholomew, p.17

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