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# Introduction of European Art of Navigation into Japan, sixteenth to eighteenth century

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Preface

Japan which had wars every day in sixteenth century went to be unified at the end of the century. In that period, Portuguese and Spanish reached at Japan, coming around a half of the earth, and also Japanese began to go abroad, learning art of celestial navigation from Iberian people. Japanese of that era who was ambitious enough did not only master the art but also intended to improve it. However, Dutch and English who arrived on Japan after Iberian people slandered Iberians, saying that Catholics had intension to conquer Japan. For fear of it, Japanese rulers closed the country for European people with exception of Dutch trading only in a small artificial island called Dejima. What a way did take the art of navigation born in Iberia and introduced into Japan? Did Japanese learn art of navigation from Dutch?

1. Introduction of Iberian art of navigation to Japan

1) Berth of *Genna-koukaiki* or *Navigation Book of Genna era*

The arrival of Portuguese on Tanegashima Island in 1543 was a beginning of comings of Europeans to Japan for trade and missionary work. Also Japanese went the Southeast Asia and founded Japanese towns in Philippine, Thailand and Vietnam in those days.

At the beginning of the movement of Japanese to go abroad, there was no ship in Japan available to sail ocean and they went on board Chinese junk and ships of Iberian people who were called “nanbanjin” (*1) by Japanese.

In this circumstance one Japanese navigator whose name was Kouun Ikeda learned Iberian navigation art from a nanbanjin pilot, Manoel Gonzal, sailing with him between Japan and Philippines for two years. Basing on knowledge gained from Gonzal and adding his ideas of improvement of the Iberian navigation art, he wrote a book titled *Genna-koukaiki* which means Navigation Book of Genna Era (*2). One manuscript written in 1618 of the book remains in Kyoto University. Because of that many Portuguese words and some sketches coming from Portuguese navigation guide book are found, Manoel Gonzal must have been Portuguese.

2) Practical and ambitious *Genna-koukaiki*

This is the first Japanese book treating European navigation art. This is not an introductory book, but covers almost all items necessary for celestial navigation with intention to be utilized practically. And celestial tables based on the Gregorian calendar given by Manoel Gonzal were transferred to those of the Japanese contemporary calendar by Ikeda’s effort in order to be used directly on board. Furthermore, he offered ideas to improve what he learned, and this fact shows that he had high ambitions. Let have a look at his effort for practicability and new ideas for improvement.

(1) Impressive effort for adaptation of solar declination table to Japanese

*Genna-koukaiki* consists of 155 pages, including 90 pages of a solar declination table for four years (hereinafter called the "solar table") which occupy 58 percent of total pages. For a long time in Japan, origin of the solar table of *Genna-koukaiki* was looked for and at last I founded it in the version of the year of 1588 of *Compendio del Arte de Navegar* of Rodrigo Çamorano, Mayor Pilot of la Casa de la Contratación of Seville. The contents of the *Genna-koukaiki* other than the solar table are different from those of *Compendio del Arte de Navegar*, therefore it can be said that *Genna-koukaiki* is not a translation of it. It must be that Kouun Ikeda took a note of a solar table and other items necessary for navigation in possession of Manoel Gonzal. For example, a picture of so called "Regimento de Legua" is not found in *Compendio del Arte de Navegar* but is shown in *Livro de Marinharia de Gaspar Moreira* (*3) and also in *Códice Bastião Lopes de autor anónimo* (*4)

The most important device of Kouun Ikeda which made the solar table be used directly on board without any calculation was an insertion of a calendar contemporaneously used in Japan into the Gregorian calendar. The Japanese calendar of that era was made by experts of the Court of the Emperor, basing on Chinese luni-solar calendar. However, at that moment the Japanese calendar corresponding to the third and fourth years of the solar table was not accomplished and Ikeda calculated and made the lacking part of the calendar by himself, studying Chinese calendar. Also he added every week days for four years with date to the solar table so as to know luni-solar date directly. Furthermore he started the solar table from February meeting with luni-solar calendar and put Portuguese name of months in phonetically imitated Japanese letters in order to eliminate confusion with the Japanese months.

(2) New ideas for improvement of the Iberian art of navigation

Kouun Ikeda began *Genna-koukaiki* with the following preface:

> "It is an art of pilot, of which teachings I received from a Nanbanjin whose name Manoel Gonzal in the second year of Genna (This was the year of Hei-Sin.). (*5) At that time, we sailed together with to Luzon Island in two years. And that master let me know almost what he knew and trained me to practice it.
>
> Once, I asked him three questions. The first one is a way to measure the sun before and after midday. The second one is a way to know *arutoura* (*arutoura* means in what degree of height we are.) of the Southern Sieve, that is to say *Kuruzeiro* (*Kuruzeiro* is name of constellations. It lines in a form of cross.), when it lies diagonally on a line from right to left, or lies on a line between east and west. The third, considering on the North Stars, even there is a drawing of eight

directions in old teachings, four directions are met in day time. And one direction is out of sight in morning or in evening. Lastly, other three directions are in their positions in night. However, if one cloud covers it at that time, just we lose the time. Are there ways to know these three things at any time, or not? I asked him to look for answers in his deepest and most precise knowledge. The master answered that there were just no teachings about these three. With regard to the first one of measuring the sun, only one pointed time is indicated. It is the time when the Sun is just in the midst of east and west. If we cannot measure it in such a short period, its day is wasted. From old time it is said that, there is no way to measure the sun before and after noon. The second, *Kuruzeiro* is thirty *garaho* (thirty *garaho* is thirty *dan*, or degrees) (*6) away from the South Pole and its *Dai Sei*, or stand of stars of *Kurusu* (that is to say *Juuji*, cross) stand out, therefore, when they are vertically straight, we know it. When they decline slightly, measurement is difficult. Much less, when they are diagonal, we cannot know it. The third, there is no way to guess it, and we can only know it by that old drawing of the Large Dipper. There is no way to know it by accuracy of *minuuto* (*minuuto* is a unit called "*fun*" in Japanese, or minute). Even if we ask pilot of anywhere about these three questions, perhaps there would be no one who says "I know it." For a while I listened to what he said. The pilot was sorry about the way of teachings was limited, and I thought that there were things of old words not yet reached the ultimate solely in reason. Because, I think that ideas do not run out. Reminding thoroughly these words in my mind, I have used them to look for ideas outside of common knowledge. Wanting to control my thinking open-mindedly, I worked out my ideas for some months. In the next year, I accomplished my work by three instruments of measurement. These have shapes and forms, which never have been seen from the ancient time until now. If someone says that these exist from the old time, he will have to cover his virtue. Up to now, pilots of any country say that they do not know these. Therefore, even I am so ignorant, but I cannot stop to want to leave my ambition and ideas for my descendant. Forgetting my nature to stick to old things and no to accept new things, and throwing away my rough character, finally I shall wait correction by someone in a future. At the same time, I hope this book will be a gate to enter this way for Japanese. I am attaching four *dekurinasan* (*dekurinasan* is a daily table of the sun for four years.) (*7), *rejimento* (*rejimento* means order.) and the rest herewith. After examining them, which already existed, and adding what was lacking, I am writing down what I translated to Japanese language as follows.

In a Good Day of August, the 4th year of Genna (this is the year of Jutu-Go, or 1618) (*8)

Living in Nagasaki, Family of Kikuchi in Higo

Edited by Ikeda Yoemon Nyuudou Kouun “

By this preface we know when and how he wrote *Genna-koukaiki* and what purpose he had. He made three questions in order to improve the art of navigation. To the first question, he did not propose any solution. But to the second and the third, he proposed idea of new devices by sketches without any explanation on them.

An answer to the second question, which asks a way to know height of the Southern Sieve, when it lies diagonally on a line from right to left, or lies on a line between east and west, is shown in Fig.1

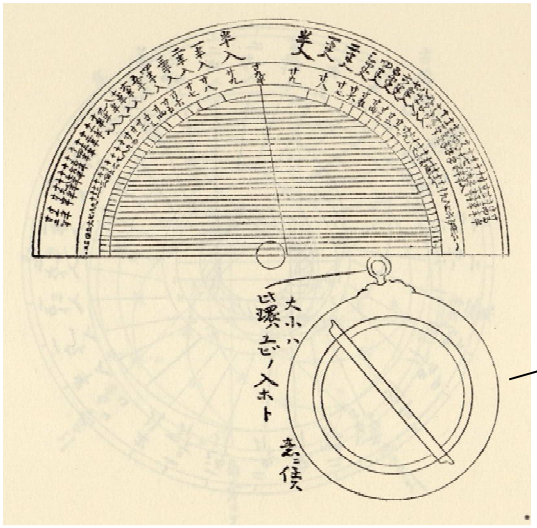

Fig.1

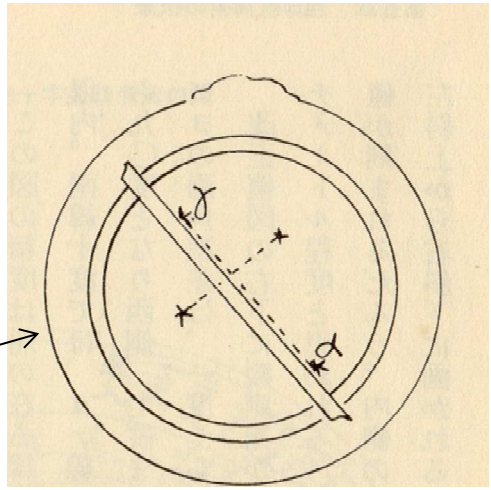

Fig2

In the Fig.1 there is a half circle and at the top of its third band from the outermost band it is written as “29 and half”, and the numbers　29,28,27、・・,2 and 1 are written in turn in black ink from the top of the half circle to the bottom of its both sides. In the second band and above each of these numbers 29 through 7, it is written that “ half iri”, “1 and half iri”,”2 and half iri”, ・ ・ ・”22 and half iri” in vermillion ink, and nothing is written above the number 29 exceptionally. Japanese word “iri” means “to add” in calculation. Although there are no indication of “to subtract” for the black letters, we can assume that black letters mean to be subtracted in calculation as those of the solar table. It is considered that black letters are to be subtracted from observed altitude of the star $\alpha$, if the star comes in north side of a horizontal line of stretched arms of

observer and it is considered that vermillion letters are to be added if the star comes in the south side. In almost all Iberian books of navigation of those days, the star $\alpha$, or "Estrela de Pé" nearest of four stars of the Southern Cross to the South Pole had a polar distance of 30° . As a line made by connecting the star $\alpha$ and the star $\gamma$, or "Estrela de Cabeça" did not pass on the South Pole, Kouun thought that the polar distance of a circle, which this line made turning around the South Pole and touching with, was 0.5° . I assume that Kouun might get the number of 29.5° as a more practicable polar distance, subtracting 0.5° from 30° known commonly as the polar distance. A small circle drawn in the half circle is the circle which has a polar distance of 0.5° , and one line, which touches to this circle extends to the letters of "29 and half". This is a drawing to get number to correct observed altitude by polar distance of the star $\alpha$, which is known by direction of a line connecting the star $\alpha$ and the star $\gamma$. Explanations on "Regimento do Cruzeiro do Sul" made in Iberian books of navigation are all simple, referring only to the polar distance of 30° of the star $\alpha$ as the correction number. The Compendio del Arte de Navegar of 1588 shows only one drawing which indicates four stars of the South Cross putting "A" as a name to the star $\alpha$ and "B" as a name to the star $\gamma$.(*9) Even in *Regimento de Navegación* published in 1606 by Andrés García de Céspedes, whose explanatory description is very detail refers the name of Çamorano and his polar distance of 30° with six directions of correction as follows: 28° 35' (Kouun:29 ° 30') minus in case of the star $\alpha$ is in the north, 19 ° 25'(Kouun:20° )minus in case of the star $\alpha$ is in northwest, 5° 38'(Kouun:7° )plus in case of the star $\alpha$ is in the east, 19° 25' plus in case of the star $\alpha$ is in the southeast, 28° 25' plus in case of the star $\alpha$ is in the south, etc. Although, in *Genna-koukaiki* this drawing is said to be related to the Regimento do Cruzeiro(do Sul), Yoshirou Iida proposed to interpret that this instrument of half circle was invented for the Regimento do Cruzeiro by its circumstance, and Iida proposed a unique idea regarding how to use an instrument resemble to an astrolabe sketched below the half circle instrument. I agree with Iida's interpretation and also with his unique idea regarding to the instrument which looks like an astrolabe (*10).

The answer to the third question, which asks how to know altitude of the North Stars, even there is a drawing of the eight directions in old teachings, if cloud covers these stars, or a way to know the altitude at any time by the North Stars, is shown in Fig.4. Fig.3 is the drawing with eight directions which comes from old time. The North Star does not stay at the due North Pole, and in the sixteen century it turned on the course, which was separated about three degrees and half from the North Pole. The Regimento do Norte has a purpose to assume right position of the North Star by position

of the Ursa Minor, which is observed in different position depending on the time. The Regimento do Norte was used as a supplement to the Regimento do Sol.

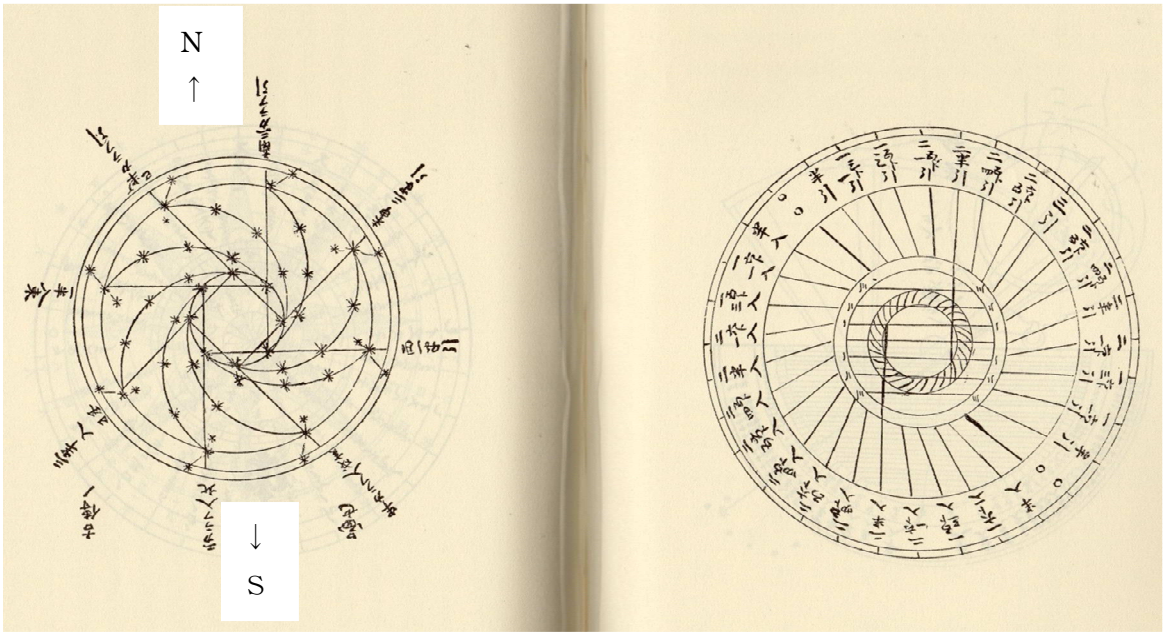


Fig.3 Fig4

The drawing appears in Fig.4 is an improved drawing of “Regiment of North Star” and is an answer of Kouun Ikeda to the third question. Ikeda intended to improve observation in night, increasing drastically observation chances by means of increase of numbers of correction from those given in the eight directions to those given in thirty-two directions. The idea to increase number of directions itself was not original of Kouun, but Pedro de Syria proposed sixteen directions in his *Arte de la Verdadera Navegación* published in 1602(*11)

I have no idea how Kouun got these numbers. It is difficult to think that he got them by observation. Did he calculate them?

I understand well the proposals for improvement made by Ikeda in Fig.1 and Fig.4 theoretically, however, I am not confident that these were practicable on board. Were Direction graduations consisted of so many lines of the instruments for the Regimento do Cruzeiro and the Regimento do Norte shown in Fig.1 and Fig.4 able to be used practically on the ships moved violently? I appreciate the high ambition of Kouun Ikeda stated in the preface of *Genna-koukaiki*, however, I doubt practicability of his ideas. Perhaps his confidence on his ideas must have been not so strong that he left them to judgement of someone in a future.

2. Where had gone the Iberian art of navigation ?

1) Continuing demand for celestial navigation method

After *Genna-koukaiki* was written in 1618, a governmental policy so called "Sakoku" to close the country of Japan was started in 1633, prohibiting Japanese to go abroad without permission and Japanese who lived abroad to return to Japan. In 1639 the government of Tokugawa prohibited Portuguese to enter into Japan by reason of a fear caused by an occurrence of rebellion of Catholics. In 1641 the Sakoku policy was completed and the government gave an exceptional permission to Dutch, who helped the Japanese government in the rebellion, to trade with Japanese only in Dejima Island of Nagasaki.

As Japanese could not go abroad after the Sakoku policy was taken, the necessity of celestial navigation methods introduced from the Nanban was reduced a lot, but was not lost totally. Because, a stable situation of the Tokugawa government demanded a large scale transportation of rice of imposition, especially from Kyushu Island located far from Edo (now Tokyo) the Capital of Japan, which preferred direct sailing by celestial navigation through the Pacific Ocean. And another demand was to go to Ogasawara Islands which were newly found. It was the Ichizaemon Shimaya family who realized these two navigations.

2) Influence of Dutch art of navigation

(1) *Anjin-no-hou* or *Rule of pilot*, memorandum on Dutch art of navigation

A book written on European art of navigation next to *Genna-koukaiki* is *Anjin-no-hou*, or *Rule of pilot*. This book was written by Ichizaemon Teijuu Shimaya and one manuscript is kept in the National Archive of Japan.

This book begins saying "--- at the beginning of the autumn of the 10th year of Kanbun (i.e.1670), one junk arrived at port of Edo in the province of Musashi. Boarding on this ship a person whose name was Ichizaemon Hamada came in. I asked him art of navigation taking an order of my master. Hamada answered ---, and continue many questions and answers between Ichizaemon Teijuu Shimaya and Hamada. Teijuu Shimaya asked Hamada how to know position of a ship, and Hamada answered "As oceans are immense to measure distance of places, so we look up at heaven and to know degree by stars". Upon the question made by Teijuu how to get degree, Hamada explained on quadrant and a way of measurement of degree of Pole Star by using the quadrant and also explained on observation of altitude of the sun by astrolabe. Teijuu was asking so primitive questions and it seems that he might not at all know European navigation art. This fact makes us think that even Teijuu Shimaya, who belonged to one of the most famous family of pilot in Japan at that time, was not accustomed to the

celestial navigation because of lacking chance to practice it 30 years after the Sakoku. Ikeda wrote *Genna-koukaiki*, intending this book to be a text book for new comers. But was not the book handed down to anyone? It seems that the contents of *Anjin-no-hou* told by Hamada shows little influence of *Genna-koukaiki* and another book of navigation written by Shimaya family, which will be presented later, also has no footmark of *Genna-koukaiki*. To the contrary I am going to mention some points which make differences between *Genna-koukaiki* and Shimaya's books.

The obliquity of the ecliptic of *Genna-koukaiki* is 23° 28′ but, it of *Anjin-no-hou* is 23° 30′ , which is a number used in Europe in older days than *Compendio del Arte de Navegar*. The sketches of an astrolabe of these two books do not look like definitely as shown in Fig.5 and Fig.6.

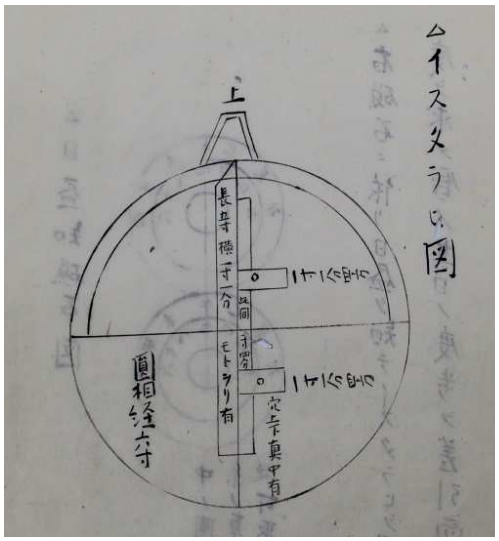

Fig.5 sketch of "Istorahi"(or Astrolabe) of *Anjin-no-hou*

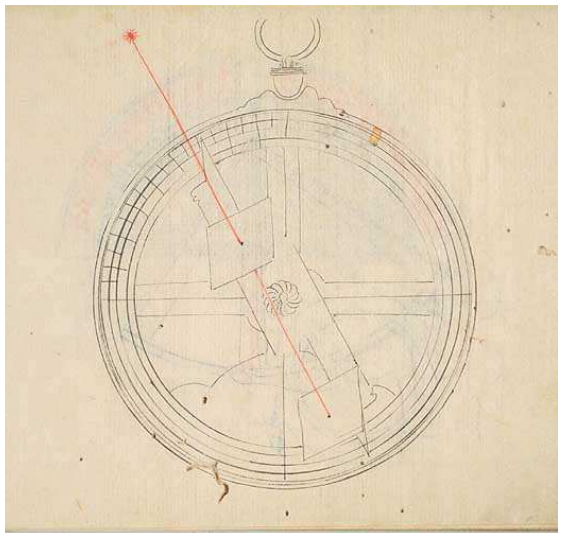

Fig.6 sketch of "Astororabio" (Astrolabe) of *Gennakoukaiki*

*Anjin-no-hou* mentions Dutch denomination of months of calendar and of official class mariners. Regarding Portuguese words appeared in *Anjin-no-hou*, only the names of the months are mentioned. Considering these facts, I think *Anjin-no-hou* received the least influence of *Genna-koukaiki*. *Anjin-no-hou* does not include a declination table of the sun, and nobody could practice celestial navigation without it at that time. *Anjin-no-hou* is not a book for teaching art of navigation, but only a memorandum of Teijuu Shimaya in order to report what he got from Hamada to his master. Though Hamada had a chance to learn Dutch art of navigation, only he must have scratched the surface of it.

(2)Ocean sailings carried out by the Ichizaemon Shimayas

For the purpose of pursuing advantages of transportation of long distance in a short period, the government ordered the Governor of Nagasaki, who was the master of

Shimaya, to construct a large junk in 1670. This junk was completed in May of the same year and sailed to Edo from Nagasaki within only fifteen days. This voyage directed by Ichizaemon Mitate Shimaya was surprisingly short. He was permitted to carry sword like a samurai and rewarded for the success and had an honor of being visited by General Tokugawa on the junk at December. However, there was a researcher who mentioned that when he paid attention on the places which Mitate Shimaya put in, his voyage was almost made along with coast and not a full ocean-going navigation, though its period was very short.

In the same year of 1670 one cargo ship blew away by strong northwest wind in the Pacific Ocean and drifted ashore desert islands which were some one thousand kilometers far from the main island of Japan and was named later as Ogasawara Islands. The mariners of this wrecked ship made a boat with remained timbers of their broken ship and returned to the main island of Japan. By their report the government came to know existence of these desert islands.

In February, 1674 the government ordered Ichizaemon-no-jou Shimaya who was in Edo at that moment to explore this desert archipelago. After he met some difficulties to depart from the main island of Japan, finally May 29, 1675 Ichizaemon-no-jou Shimaya and his son Tarouzaemon departed from the main island and arrived the Ogasawara Islands and left this archipelago on July 27 after exploration. They came back to Edo on August 10.

There are many books which make confusion about members of the Ichizaemon Shimayas. The gravest reason of it is that the same first name of Ichizaemon was succeeded for three continuous generations in the same pilot family of Shimaya. Takejirou Akioka studied on this family in detail in "*Kaiji Shi Kenkyu*,or *Jourtnal of the Japan Society for Nautical Research*—, no.1", 1963. He assumed that:

1st Ichizaemon Mitate Shimaya: Mitate is his nickname after retirement. Father of Ichizaemon-no-jou and grandfather of Teijuu He sailed in the junk from Nagasaki to Edo in 1670.

2nd Ichizaemon-no-jou Shimaya: Son of Mitate and father of Teijuu "Jou" is a respective title for a senior man. He sailed to the Ogasawara Islands in 1675 with his son Tarouzaemon who is brother of Teiijuu.

3rd Ichizaemon Teijuu Shimaya: Grandson of Mitate and son of Ichizaemon-no-jou. Teijuu is his nickname after retirement. He wrote *Anjinnohou*.

(3)Navigation book *Funanori-pirauto* or *Mariner Pilot*

One manuscript named "*Funanori-pirauto,* or *Mariner Pilot* is preserved in Touhoku University. In the last page it said "In August, 1685 I was taught this from the Senior

Mitate Shimaya in Nagasaki". It was not known who got the teachings from Mitate Shimaya and wrote the book. *Funanori-pirauto* is not a memorandum of question and answer like *Anjin-no-hou*, but is a book which has a form of guidebook with itemized description on art of navigation similar to *Genna-koukaiki*. From the style and content of the book, it can be judged that only a person who had knowledge of European navigation methods, even though not as deep one as Kouun Ikeda had, could write this kind of book.

Just after a table of contents at the beginning of the book and a drawing of compass rose with sixteen names written in Japanese, an itinerary of sailing round trip between Japan and Thailand under a title of "Sailing to Siam by Dutch way" and another itinerary of sailing round trip between Japan and Luzon Island of Philippines appear. After these itineraries a sentence saying "The above routes are Dutch sailing itineraries, and one Dutch league corresponds to Japanese 2.5 Ri." was added. Nothing about Iberian league is referred. Two times of commenting "Dutch way" or "Dutch sailing itineraries" are emphasizing the fact that these itineraries had an origin in Dutch navigation.

Next, after listing degrees of some Japanese and foreign places, come the degrees of the Ogasawara Islands explored by Ichizaemon-no-jou Shimaya under a title of "Memory of the Desert Islands".

Now, a declination table of the sun for four years begins with January. The contents of this table are same as those of the 1588 year version of *Compendio del Arte de Navegar* of Rodrigo Çamorano (hereinafter referred as the Original Table). Were they transcribed from *Gennakoukaiki*? No, it is not. There is a definitive evidence to prove that the solar table of *Funanori-pirauto* was not transcribed from *Genna-koukaiki,* but was transcribed from the Original Table. The evidence is that the table of *Funanori-pirauto* does not contain errors of numbers of the degree which Kouun Ikeda made in the transcription from the original table of Çamorano. *Genna-koukaiki* has sixty five such errors in total. I'm showing only such mistaken numbers of the first year in Table 1, comparing the numbers of the Original Table, those of *Funanori-pirauto* and of "*Nanbanryu-tenmon-no-sho* or *Iberian Astronomy Book* which will be described later.

Table 1

| Date of the 1st year | *Compendio del Arte de Navegar* | *Genna-koukaiki* | *Funanori-pirauto* | *Nanbanryu-Tennmon-no-sho* |
|---|---|---|---|---|
| January 5 | −22° 38' | −22° 28' | 22° 38' | 22° 38' |
| February 2 | −16° 52' | −16° 53' | 16° 53' (*) | 16° 52' |

| | | | | |
|---|---|---|---|---|
| March 16 | −1° 52’ | −2° 52’ | 1° 52’ | 1° 52’ |
| April 8 | 7° 6’ | 7° 7’ | 7° 6’ | 7° 6’ |
| April 20 | 11° 25’ | 11° 39’ | 11° 25’ | 11° 25’ |
| May 3 | 15° 35’ | 15° 25’ | 15° 35’ | 15° 35’ |
| May 24 | 20° 43’ | 20° 42’ | 20° 43’ | 20° 43’ |
| May 2 | 20° 54’ | 20° 54’ | 20° 54’ | 20° 54’ |
| July 21 | 20° 33’ | 20° 23’ | 20° 33’ | 20° 33’ |
| July 23 | 20° 10’ | 20° 20’ | 20° 10’ | 20° 10’ |
| July 27 | 19° 18’ | 29° 18’ | 19° 18’ | 19° 18’ |
| October 6 | −5° 2’ | −9° 2’ | 5° 2’ | 5° 2’ |
| October 6 | −5° 48’ | −5° 49’ | 5° 48’ | 5° 48’ |
| November 13 | −17° 58’ | −18° 58’ | 17° 58’ | 17° 58’ |

In *Funanori-pirauto* the same number as the mistaken numbers which appear in *Genna-koukaiki* is only one marked with (*), and in *Nanbanryu-tenmon-no-sho*, there is no one. By this fact it can be assumed that the solar tables of *Funanori-pirauto* and *Nanbanryu-tenmon-no-sho* were not transcribed from *Genna-koukaiki* but from the Original Table which existed independently from the table of *Genna-koukaiki* in Japan. From this fact, it is not deniable the existence of the Original Table in Japan at that time.

With respect to the Original Table, names of months are not written in the table of *Funanori-pirauto*. However, curiously in the table of *Nanbanryu-tenmon-no-sho* these names appear in Portuguese and in Dutch one after the other, of course both are transferred to Japanese letter phonetically. The names of months from January to June of the first year are written by Dutch names and the months from July to December of the first year which come in a next page are written by Portuguese names. And those of months from January to June of the third year are written by Portuguese names and the rest of the third year are written by Dutch names. When we look the table through the four years, the name of each month of a year is written in each language only once. Both books have a same list of names of months in Dutch and Portuguese using Japanese letter phonetically. A reason why the solar table of *Nanbanryu-tenmon-no-sho* was written in Dutch and Portuguese might have come from the difference between of the languages used in the Dutch knowledge of navigation and the Portuguese solar table.

It must be noted that the table of *Nanbanryu-tenmon-no-sho* whose numbers are same as the Original Table has the names of months written in Portuguese and Dutch as mentioned above, even though the names of months of the Original Table published in

Spain are written naturally in Spanish.

A drawing of astrolabe which appears in *Funanori-pirauto* is different from that of *Genna-koukaiki* (see Fig.6). The drawing of *Funanori-pirauto* (see Fig.7) is very realistic and looks like surprisingly a Portuguese astrolabe so called Atocha II which was produced in 1616.(see Fig.8) (*12)

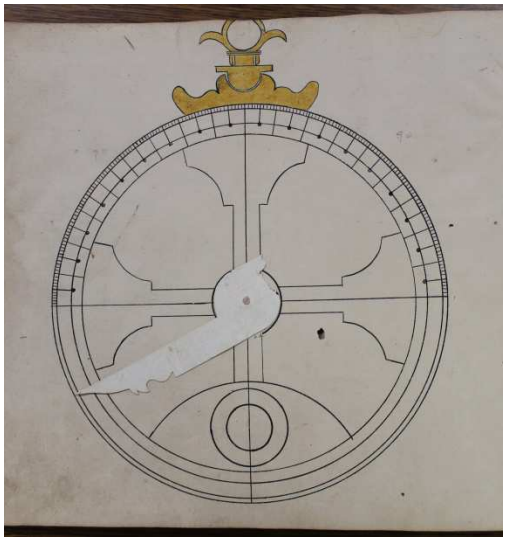

Fig.7 Astrolabe of *Funanori-pirauto*

NMM 58 *Atocha* II astrolabe, 1616.

Fig.8 Atocha II

Finally it is concluded that *Funanori-pirauto* was written under small influence of *Genna-koukaiki*. Ichizaemon Mitate Shimaya who taught an author of *Funanori-pirauto* the contents of this book might have gotten a glimpse of *Genna-koukaiki* in his youth, however, might not have learned it fully. If he studied it, keeping it at his side, the contents of *Funanori-pirauto* ought not to be so different from *Genna-koukaiki*.

At the last part of *Funanori-pirauto* there is an itinerary written in Chinese and with a compass-rose of Chinese directions titled “Drawing of Chinese directions of sailing”. As *Anjin-no-hou* was the report to Shimaya’s master, the Governor of Nagasaki who must have not be interested in detail, adding other data omitted in this report, Teijuu or Ichizaemon-no-jou might have written *Funanori-pirauto* which was a book of navigation for pilots and mariners with contents in a proper order and sequence.

(4) *Nanbanryu-tenmon-no-sho* or *Iberian Astronomy Book* with confusing title

There is a manuscript with a title of *Nanbanryu-tenmon-no-sho* or *Iberian Astronomy Book* in the Library of Miyazaki Prefecture. I already mentioned it when I made a

comparison of some numbers of the solar tables of the first year between *Compendio del Arte de Navegar*, *Genna-koukaiki*, *Funanori-pirauto* and *Nanbanryu-tennmon-no-sho* in the Table 1. The title "*Iberian Astronomy Book*" of this book makes someone mistake to think that this book must treat on Iberian astronomy, but in reality it treats on Dutch art of navigation. At the last page, name of Shigemasa Hidaka appeared with date of October 1848. Shigemasa Hidaka was a samurai of one feudal domain which was a part of Miyazaki Prefecture and he mastered art of surveyor of land and transcribed some books related to this art when he went to Edo. *Nanbanryu-tenmon-no-sho* is one of his transcriptions of these books. It is clear that the transcription was done in October 1848, however, the date of 1673 is acknowledged in the first page. And after this date, brief explanation on what luni-solar year corresponds to each of four years of solar declination table. Same explanation as this is done after the itineraries of *Funanori-pirouto*. As just in this year of 1673, or Kanbun 13 of Japanese calendar, the era of Kanbun terminated and began newly the era of Enpou, it is to say that Kanbun 13 was the last year of Kanbun era. By this reason, it is probable that the original book from which Hidaka made subscription was written before 1673. Let us note that only three years passed from the year of 1670 when *Anjin-no-hou* was written.

Regarding to its solar table, the numbers of the table are basically same as the Original Table. As it is mentioned above that the names of the months are written in Portuguese and in Dutch one after the other. This book has degrees of some places of Japan and abroad as same as that of *Funanori-pirouto*, but there is one important difference between them. *Nanbanryu-tenmon-no-sho* has only degrees of two islands of the Ogasawara Islands. From this fact, we feel a loss of vivid atmosphere of the adventurous sailing of Shimaya after one hundred and eighty years. And after description of the degrees, the Chinese itinerary same as *Funanori-pirouto* comes and some drawings of an astrolabe and others which are totally different from *Funanori-pirouto*. These drawings consist of some movable parts made of round paper.

Judging from what I have mentioned here, we can say that *Funanori-pirouto* and *Nanbanryu-tenmonnosho* were not transcribed from each other. Consequently there must have been a book from which these two books were derived. Between such original book and these two books there might have been other book(s) as intermediary.

There is one book included in *Hiden-chiikizuhou-daizensho, Chiikizuhou* or *Volume of Regional Map Making of The Great Books of the Art of Regional Map Making* written by Koutaku Hosoi who was familiar with art of land survey. The contents of this book are almost same as those of *Nanbanryu-tenmon-no-sho*, only lacking some drawings. This is a book of survey and it is evident that it was transcribed from other book.

(5) *Kanbun-koukaizu* or *Navigation Chart of Kanbun era*

Another similar manuscript as *Funanori-pirauto* and *Nanbanryu-tenmon-no-sho* is preserved in The National Museum of Japanese History under name of *Kanbun-koukaizu*. Its table of contents and some summarized description on important points are include in *Nihon-chizu-sakuseisi*, or *History of map-making in Japan* written by Takejirou Akioka (*13). Akioka compared the tables of contents of *Funanori-pirauto* and *Kanbun-koukaizu* and found the two tables were same. *Nanbanryu-tenmon-no-sho* is not compared in this book. *Kanbun-koukaizu* was in possession of Akioka before he died. It seems he assumed that *Kanbun-koukaizu* might be original of *Funanori-pirauto.* He said "I think that the reason why *Kanbun-koukaizu* has no title nor has it name of author is that this book was written as a memorandum for his family and his pupil mariners, and so it was not necessary to put a name on book. This comment suggests that *Kanbun-koukaizu* would be original of *Funanori-pirauto*. However, differences between these two manuscripts make me think that any one of these is not original of another and there must have existed original one differently.

(6)Echo of *Genna-koukaiki*

The Iberian books of navigation were forgotten day by day after the Sakoku, or the Closure of the country of Japan was executed, and Dutch art of navigation entered Japan indirectly, but it was superficial. Any Dutch declination table of the sun was not introduced to Japan and the table of Çamorano survived. The name of Kouun Ikeda did not appear in the succeeding books. Was forgotten the name of Kouun Ikeda totally? No, it wasn't. Only one book whose title was *Banreki*, or *Iberian calendar* referred to his name. It is regret that this book kept in the Library of Mito was burnt in the World War 2, but we can know this book by one study of Akira Hirayama which indicates "a letter of the Professor Kouun Ikeda, November 15, 1664"was included in *Banreki*, and mentions that *Banreki* had the solar declination table same as the table of *Genna-koukaiki*. (*14), however, Hirayama did not transcribe the solar declination table.

3. Translation of a Dutch Navigation book

1) Blank of one hundred years

The navigation books like *Kanbun-koukaizu and Funanori-pirauto* changed their fashion to books of astronomy and land survey like *Nanbanryu-tenmon-no-sho, Hiden-chiikizuhou -daizensho,* and *Banreki. Genna-koukaiki* embodied the Iberian art of navigation in Japanese style. But with regard to the Dutch art of navigation, it is difficult to say that Japanese book embodied it, lacking especially Dutch celestial tables, and the so-called Dutch art of navigation went out of use.

2) Translation of *Oranda-kaikyosho-wakai,* or *Translation of Dutch Sea-mirror*

In the time of the Sakoku, European knowledge and information brought to Japan through the Dejima Island. As all of them were written in Dutch, person who directly contacted them were Dutch-Japanese translators. The renowned translator Yoshinaga Motoki translated a Dutch navigation book in 1774 by order of the government. The title of the translated Japanese book is *Oranda-kaikyosho-wakai* and his original manuscript is preserved in Tokyo Metropolitan Central Library. *Oranda-kaikyosho -wakai* is not a book composed of what was heard from a pilot, but is an accurate translation of whole of one Dutch book. From its title we can assume that original Dutch book must have been "*Zeespiegel*" of Joan Willem Blaeu. This was not a book of the era of the translation, c.1774, but its first edition was published in 1623 and the last one was published in 1652 in Amsterdam. This means that a book published more than one hundred years ago was used for the translation of Motoki. Takejirou Akioka, asking his friend who visited Het Scheepvaartmuseum in Amsterdum, confirmed that the version of *Zeespiegel* translated by Motoki was a version published in1643.

Why did Motoki use so old book for his translation, even though there were Dutch books which contained more advanced navigation art? If the government had wanted a newest book, it could be supplied by Dutch traders. After all, the government did not necessitate new navigation art under the policy of the Sakoku. The government was gathering only general information. Other than *Oranda-kaikyosho-wakai*, Yoshinaga Motoki translated twelve Dutch books of different categories. Japanese sailed newly to the Ogasawara Islands ninety years after the translation of *Oranda-kaikyosho-wakai*, using the newest navigation technology which they learned in transpacific sailing with Americans.

4. Conclusion

At the beginning of the seventeenth century when Japanese went out abroad, the Iberian art of navigation was introduced to Japan intensively, and Kouun Ikeda wrote *Genna-koukaki* basing on what he learned from a Portuguese in 1618. Ikeda not only made many devices to applyEuropean navigation art to Japanese, but also proposed his own ideas to improve it. Even though, the necessity of western navigation art to sail abroad was lost after Japan closed the country in 1642 and *Genna-koukaki* went to be forgotten, all of necessity did not go away. Because new necessity to improve transportation of rice of imposition to Edo by sailing Pacific Ocean from distant land and secondly to sail to the desert islands newly discovered far from the main land came. Ichizaemon Mitate Shimaya and his son realized these two voyages by the order of the government. Ichizaemon Mitate Shimaya knew *Genna-koukaki,* but was not familiar

with it. After he succeeded sailing of rice of imposition from Kyushu to Edo, his grandson Teijuu heard about Dutch navigation art from Ichizaemon Hamada who came to Edo in a junk and he made a memorandum titled *Anjin-no-hou* in 1670 so as to report what they learned from Hamada to his superior, the Governor of Nagasaki. This memorandum has some echo of Iberian art of navigation using some Portuguese words. Existence of Ichizaemon Hamada is questionable. In 1673 or 1674, one navigation book which has the title of *Kanbun-koukaizu* was made, being based on *Anjin-no-hou*, adding a solar declination table and drawings of celestial observation instrument. The declination table of the sun of *Kanbun-koukaiizu* was same as the Original Table of the 1588 version of *Compendio del arte de navegar* of Çamorano, being different from that of *Genna-koukaki,*. Where did the Original Table remain? Why this old Iberian solar table was used in place of Dutch table fifty five years after *Genna-koukaki* was written? To these questions, answers are not yet given. There are some books similar to *Kanbun-koukaizu*, *Funanori-pirauto a*nd *Nanbanryu- tenmon-no-sho.*

These hybrid navigation books of Iberian origin and Dutch origin did not make any development. The celestial observation method lost its demand in navigation and remained only in books of astronomy and land survey, as *Banreki*, *Hiden-chiikizuhou-daizennsho,* etc.

Approximately one hundred years later, Yoshinaga Motoki translated Dutch book *Zeespiegel* to Japanese and gave name the translated book *Oranda-kaikyousho-wakai*. This *Zeespiegel* was old enough at that time and *Oranda-kaikyousho-wakai* was never used actually, because the motive of translation was a simple curiosity of the government. The second visit to Ogasawara Islands by Japanese was made in 1863 ninety years after the translation of *Oranda-kaikyousho-wakai* by using the newest navigation technology gotten from American.

The end

Note:

(*1) “Nanban” means south barbarian countries. “Nanbanjin” means people of the Nanban and was used to mention Portuguese and Spanish in principle.

(*2) “Genna” is Japanese name of an era from 1615 to 1623 in Gregorian calendar.

(*3) *Livro de Marinharia de Gaspar Moreira* in the possession of Bibliothéque Nationale de Paris, cod.Port.No.58. Léon Bourdon and Luís de Albuquerque, *Le Livro de Marinharia de Gaspar Moreira*,1977,Lisbon.

(*4) *Códice Bastião Lopes de autor anónimo*, with an introduction of Luís de Albuquerque, Imprensa Nacional-Casa da Moeda,Portugal 1987.

(*5) “Hei-Sin*”* is a year of the Chinese calendar system which makes one periodic time

every 60 years. Ten kinds of Chinese letters in order to make one group called “Jukkan"(i.e.10Kan),and other twelve kind of Chinese letters also in order to make another group called “Juunisi” (i.e.12Si), and sixty combinations are gotten as the least common multiple of ten and twelve, combining one letter from each group in turn. These sixty combinations (i.e.60Kan-Si) are allotted to sixty years, and after one cycle of sixty years ends a new cycle of sixty years of the same names as the previous sixty years begins. This calendar system was adopted in about 1400B.C. in China and Japan introduced it. The years of this system do not duplicate in a same cycle of sixty years. A year of Japanese era (for example, the fourth of Genna) is not a year subject to a perpetual calendar, and consequently cannot be corresponded perpetually to a year of Gregorian calendar. However, if we know that the second year of Genna is the year of Hei-Sin of 60Kan-Si we can assume that it is the year of 1616 in the Gregorian calendar.

(*6) *"garaho"* came from Portuguese “grau”, i.e. “degree” in English, and Kouun translated it “dan” in Japanese, but in modern Japanese it is said “do”. The word “minute” is said “*minuuto*” phonetically transferred from Portuguese “minuto”. In another sentence of *Genna-koukaiki*, Kouun explains “The circumference of the world has 360 *garufu*, it is to say 360dan.” And he says “One *garabu* is 17ri and half in a distance of Nanban”. This is just suggesting that one degree of the altitude was generally considered to be 17.5 léguas in Iberian countries. However, this légua is an old légua, which corresponds to four milha same as Italian old milha at that time, and has 5,920 meters in the metric system (according to A. Fontoura da Costa). The modern milha is one 20th of one degree and has 5,560 meters today. Kouun also indicates that 17.5 léguas correspond to 41ri, 31chou, 6tan, 5ken, 3shaku and 5sun in Japanese old measurement system. In this paper I am not going to treat how many kilometers does this old Japanese length mentioned by Kouun correspond to, because there is a contradict description to these numbers in *Genna-koukaiki* and it is making a confusion.

(*7)”Dekirinasan” was transferred phonetically from Portuguese word “declinação”.

(*8)The 4th year of Genna (this is the year of Jutu-Go) corresponds to the year of 1618 in Gregorian calendar.

(*9) “*Kuruzeiro*” is Portuguese “Cruzeiro”, or “Southern Cross” in English. “*Kurusu*” is Portuguese “cruz”, or “cross” in English, and it is said "Juuji" in Japanese. As “dai” means “stand” and *”*šei*”* means “star”, so “Dai Sei” means “Stand Star” and it is the star $\alpha$ of the Southern Cross. In the time of Discovery in Portugal it was called as “Estrela de Pé” ( João de Risboa, “Livro de marinharia”, in the page 37 of the Brito

Rebello edition), Portuguese “pé” has a meaning of leg or stand of an object, so Kouun called this star “Dai Sei ”.

(*10)Yoshirou Iida, *Nihon-Koukaijutushi,*(or *History of Japanese art of navigation*), 1980, Tokyo.

(*11)Pedro de Syria, *Arte de la Verdadera Navegación*, 1602, Valencia, possession of Biblioteca Nacional de Madrid, R.14263.146p.

(*12)Alan Stimson, *THE MARINER'S ASTROLABE*, Utrecht, 1988.

(*13) Takejirou Akioka, *Nihonchizu-sakuseishi,* or *History of the Making of Japanese Maps*, 1971, Tokyo.

(*14) Akira Hirayama, *Banreki*,, or *Iberian calenda*r, 1971, individual publication.