Paper for:
International Committee for the History of Nautical Science
XVI International Reunion Bremerhaven
3 – 6 October, 2012

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Japanese Book of the Art of Navigation "Gennakoukaiki" (1618) By Kouun Ikeda

Contents

1. Background of the era

When Japan formed a country, culture and Buddhism introduced from China played important roles. Since that time Japan mainly traded with China until the second half of sixteenth century, accordingly Japan did not require large ship or art of navigation to cross over immense ocean.

Spanish sailed to west of the Atlantic Ocean and reached America, questing for gold country "Jipang" by leadership of Christopher Columbus. On the other hand, Portuguse developed route of the Cape of Good Hope and reached India, taking aim at spices with little interest in Japan. The first Portuguese who told about Japan was Tome Pires. He mentioned that "Jampon" was arrived from Lequeo (i.e. Ryukyu, today Okinawa-ken of Japan) sailing seven or eight days in his "Suma Oriental" written in 1514. He said that in Jampon there were few types of merchandise to trade with foreign country and that Jampon seldom traded with China. It was far from China and people of Jampon had no navigable ship like Junco (i.e. Junk) and they were not seagoing people. Portuguese adventurers began to appear in waters of the Far East of Asia in those days. The first record of encounter of Japanese and Portuguese is found in a Japanese book titled "Teppou-ki" or " Book of Harquebus " *[1] which reports that two or three Portuguese came to Tanegashima island with Chinese and introduced harquebus to Japanese. Information about Japan was widespread in Portugal, and Jesuit

Francisco Xavier, who got it from Fernão Mendes Pinto*[2], arrived in Japan and propagation of Catholicism was initiated. Once Macao was ceded to Portugal in 1557, Portugal utilized it as a center of commerce in the Far East, and began to trade with Japan regularly. At first Portuguese ships entered into the port of Hirado which had good location to access and also into the port of Bungo which was located in the domain of Ootomo-shi, a daimyo, or feudal lord, who protected the Catholicism. At this period Nobunaga Oda was the most powerful daimyo, and he hated expanding armed Buddhist priests and their followers and protected Catholicism. Hideyoshi Toyotomi succeeded Nobunaga Oda who was killed in 1582, and unified Japan. Being anxious about expansion of Catholics by reason of attitude of disobedience to him taken by a Catholic daimyo, Hideyoshi Toyotomi gave orders to deport Catholic priests in 1587, however, encouraged trade with nanbanjin, or Iberian people. After the death of Hideyoshi Toyotomi, Ieyasu Tokugawa governed Japan as Shougun*,* or General and inherited the policy of encouraging trade, but strengthened to oppress Catholicism.

Spain found a way to the Spice Islands of Moluccas crossing the Pacific Ocean thanks to the result of the circumnavigation by Ferdinand Magellan. But they gave up the spices of Moluccas by stiff resistance from Portuguese and concentrated their effort to colonization of Philippines (Ordnance of The King Philippe Second to the Viceroy of New Spain). Before long they became aware of making a business pay between American silver and Chinese silk, and began an annual trade known as "Manila Galleon" in 1573 establishing Manila as a transferring base. Spain annexed Portugal in 1580.

Not only European people, like as Portuguese, Spanish, Dutch and English, came to Japan but also Japanese merchants went to Ruson, Macao, Cambodia, Vietnam, and Siam with Shuinjou, or Vermilion Sealed Licenses issued by Ieyasu Tokugawa since approximately 1600, boarding on ocean going ships like junk and "*Misutuisu*"*[3] type ship. The latter was a ship constructed basing on junk and adopting advantageous parts of European ship. Many Japanese colonials were made in Manila, Siam, Vietnam and other places.

To eliminate Portuguese monopolization of the trade of Chinese silk with Japan, Dutch and English slandered repeatedly Portuguese to the Government of Tokugawa that Catholics committed themselves to invasion upon other countries. The successors of Ieyasu Tokugawa, Hidetada Tokugawa and his son Iemitu Tokugawa severely prohibited Christianity and persecuted Catholics and resulted to set a limit to passage of Japanese to foreign countries in 1633, and to limit trade with Portuguese only in a small reclaimed island called "Dejima" annexed to Nagasaki City in 1634. After the exile of Portuguese from Japan in 1639, Dejima was taken over by Dutch in 1641, and "Sakoku", or Isolation of Japan was completed.

Japan continued the Sakoku for about two hundred years until the conclusion of friendship treaties with U.S.A., Britain and Russia in 1854, and Japan did not sailed to anywhere more distant from China. And construction of large oceangoing ship was prohibited.

2. Composition and Preface of Gennakoukaiki

This manuscript is composed of eighty Japanese papers 26.5 cm in width and 19 cm in length and is written in black ink and vermilion ink, included a cover, an internal cover and a back cover. There is a title of "Gennakoukaiki" in the cover and also there is a title of "Gennakoukaisho" in the internal cover (underlined by Yamada) and both titles are considered that they did not exist originally but were added afterward. The words "ki" and "sho" have the same meaning of "book" and the both titles are used to mention this Book (hereafter called the "Book"). "Genna" is a name of the era of Japan when the Book was written and "koukai" means "navigation".

The Book fell in hands of The Library of Kyoto University in 1903 [*4,] and was published in 1928 for the first time.

In this paper, with regard to words and person's names which came from languages other than Japanese and were written in Chinese letter or Japanese letter only to imitate original pronunciation, I am going to transfer those words and names to phonetic notation in alphabet commonly used in Japan, if it is thought helpful.

1) Composition of Gennakoukaiki

As the Book has no table of contents and pagination, I put the first page to the cover, the second page to the internal cover, the third to the first page of 157 pages of texts and the page 158 to the back cover. Using this tentative pagination, I summarize contents of the Book as follows:

(1) A preface is written from the page 3 through the page 6 under a title of Preface (hereafter called the "Preface") and at the end of the Preface it is written that "August of the 4th year of Genna" and "Edited by Ikeda Yoemon Nyuudou Kouun,

resident of Nagasaki". "Ikeda"is the author's family name and "Yoemon" is the first name. In Japan for a name of individual, family name comes before first name. "Nyuudou" means Yoemon Ikeda, the author of the Book became a Buddhist priest before he wrote the Book. "Kouun" is the author's name as a priest. As is usual in Japan, I am going to indicate the author's name as "Kouun Ikeda". The 4th year of Genna corresponds to the year of 1618 of Gregorian calendar.

(2) After the Preface, the texts continue from the page 7 through the page 104. At the beginning of the page 7, a solar declination table for four years starts abruptly and lasts in ninety pages to the page 96. Ninety pages occupy about fifty seven percent of the total pages of the Book.

(3) In the page 97 necessary matters to use the solar declination table are described in itemized form under the title of "Yottsu no *dekirinasan*" or "Four declinations". At first, one year is divided into four periods between the vernal equinox, the summer solstice, the autumnal equinox and the winter solstice, and it is indicated to which sign of the zodiac the sun is going at the beginning of each period.

(4) In the pages from the page 98 to middle of the page 100, under the title of "*Garabu* no tsumori" or "Calculation of degree", it is explained that the circumference of the Earth consists of 360 degrees, and one degree corresponds to seventeen léguas (Portuguese league) and half in Nanbam, and corresponding lengths in Japanese measurement system are given.

(5) One page from middle of the page 100 to middle of the next page has a title of "Hi wo toru koto", or "To get the Sun". Kouun Ikeda says that I translate "Toma sol" said in Nanban to "Hi wo toru koto" in Japanese and he explains how to calculate latitude of a place where an observer is by using the solar declination table. This is to say the Latitude method by calculated observed solar meridian altitude in the modern navigational term.

(6) Tow pages from the page 100 to the page 103 have a title of "Nichirin shoutoku no mawari wa nishi yori higashi he mawaru koto" or "Natural round of the Sun is a round from west to east", and explain history of adoption of Gregorian calendar and how to correct this calendar. At the end of this explanation Kouun Ikeda writes his name once more.

(7) One page from the page 103 to the page 104 has a title of "Tate naname yoko ni yotte michi no nori wo hakaru koto" or "To calculate how long advanced by measuring vertical, diagonal and horizontal ways". Here it is shown a way of traverse navigation, which is called "Regimento de Légua" or "Regiment of League" by Fontoura da Costa.*[5] And in the page 105 one drawing of a compass

rose with thirty-two points which shows how many léguas, or Portuguese league does a ship need to advance when someone wants to sail one degree of latitude from 11.25th degree to 90th degree.

(8) In the page 106 a compass rose with thirty-two points is shown and Portuguese names of point (i.e. direction) are indicated at every point, and corresponding Japanese names are given at mayor sixteen points.

(9) In the page 107 there is a drawing titled "Koden no zu" or "Drawing comes from old time". This was used for correcting altitude of "the Seven Stars of the North" or "the Large Dipper" in order to apply to the Latitude method by calculated observed North Star meridian altitude in the modern navigation term which Fontoura da Costa called "Regimento do Norte" or "Regiment of North". *6

(10) The page 108 shows a drawing which may suggest an improvement proposed by Kouun Ikeda on the "Koden no zu"

(11) In the page 109 there are two drawings, and one of them is a half circle and another is a sketch of an instrument which looks like an astrolabe, however, there is no explanation how to use them. On the half circle twenty-eight parallel lines are drawn, and at both outer ends of every line, pairs of numbers are written which make always 29.5 when every pair is added. I have never seen this kind of instrument in any Iberian guidebook of navigation of 16th and 17th centuries.

(12) In a sketch appeared in the page 110, a man with a large quadrant is observing altitude of the Large Deeper.

(13) In the page 111 there is a sketch of an astrolabe for navigation. From the page 112 through the page 116 a table of days of full moon and new moon of the year from 1615 through 1690 together with Epact and Golden Number is shown.

(14) Pages from the page 117 through the page 134 are given to a router from Nagasaki to Macao and to Annan. In the page 119 a sketch of a lead and line to measure depth is shown with an explanation on it.

(15) Pages from the page 135 through the page 147 are allocated for useful knowledge for mariners in itemized form, how to outlook weather and Japanese teachings handed down from old time.

(16) In pages from the page 148 to the last page, some useful knowledge for navigation, such as relation between degree and minute, relation between latitude and distance, and the size of the Earth.

2) Preface

The Preface is important by two reasons. The first reason is that in the Preface Kouun Ikeda reveals when, how and why he wrote the Book. The other is that he emphasizes on originality of his improvement of methods of art of navigation and invention of new instrument based on what he learned from the European art of navigation. He did not only show simply ideas just occurred to him, but also asked his Nanbanjin teacher, *Manoerugonsaro* if his ideas had novelty. After getting his answer that he had never heard these ideas from any pilot, Kouun Ikeda proposed his ideas and asked someone to comment on these.

We can feel a high-minded intention of Kouun Ikeda in the Preface.

I am going to translate entire the Preface in English as follows:

It is an art of pilot, of which teachings I received from a Nanbanjin whose name was *Manoerugonsaru**7 in the second year of Genna (This was the year of Hei-Sin.) *8. At that time, we sailed together with to *Ruson**9 during two years. And that master let me know almost what he knew and trained me to practice it.

Once, I asked him three things. The first one is a way to measure the Sun before and after midday. The second one is a way to know *arutoura* (*arutoura* *10 means in what degree of height we are.) of the Southern Sieve, that is to say *Kuruzeiro* *11 (Name of constellation is *Kuruzeiro*. It lines in a form of cross.), when it lies diagonally on the line from right to left, or lies on the line between the East and the West. The third, considering on the North Stars, even there is a drawing of the eight directions in old teachings, four directions are met in day time. And one direction is out of sight as in morning or in evening. Lastly, the 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 the East and the West. If we cannot measure it in such a short period, its day is wasted. From old time it is said as this, there is no way to measure the Sun before and after noon. The second, *Kuruzeiro* is thirty *garaho* (thirty *garaho* is thirty *dan*) *11 away from the South Pole and its Dai Sei of *Kurusu* (that is to say Juuji) 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".*[12]). Even if we ask pilot of anywhere about these three things, 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 the future. At the same time, I hope this will be a way for Japanese to enter the gate of this way. I am attaching four *dekurinasan* (*dekurinasan* is a daily table of the Sun for four years.) *[13], *rejimento* (*rejimento* means order.) *[14] 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) *[15]
Living in Nagasaki (Family of Kikuchi in Higo) *[16]
Edited by Ikeda Yoemon Nyuudou Kouun *[17]

At the beginning of the Preface Kouun Ikeda describes briefly when, how and for what purpose he intended to write this Book. He mentioned "the second year of Genna" as the year when he sailed to Ruson Island and also mentioned "August, the fourth year of Genna" when he wrote up the Book. "Genna "is Japanese name of an era of which the first year corresponded to 1615 in European calendar. The Japanese era has not a system of calendar. In Japan at that time, the calendar introduced from China in the year 859 of European calendar, and in order to maintain relation with this Chinese calendar, which was not a solar calendar but a luni-solar calendar, the second year of Genna of Japanese year was written as "year of Hei-Sin". As the Iberian art of navigation used the Gregorian calendar, which was a solar calendar, Kouun explained about this European calendar and he offered various ideas to have correspondence between years of Gregorian solar calendar and years of the luni-solar calendar, which Japanese used in common. (See pages 101 to 103, and 148 to 153 of the Book)

It is most probable that *Manoerugonsaru* who taught Kouun Ikeda the art of navigation was a Portuguese. I have looked for names Manuel (or Manoel) Gonçal, Manuel Gonzal, or even Manuel (or Manoel) Gonçalo, or Manuel (or Manoel) Gonzalo in Portuguese and Spanish books related to this period, however I have never met any case which can convince me.*[18] Some Japanese researchers intended to find *Manoerugonsaru (ro)* in the names of Nanbanjin who were granted Shuinjou, or Vermilion Sealed License to trade with foreign countries, however there is no agreeable case clearly. Identification of *Manoerugonsaru (ro)* remains a question for the future.

Another important point of the Preface is that Kouun Ikeda was offering ideas to improve the art of navigation introduced from Nanban in it. In the meantime he was practicing the art of navigation; he asked *Manoerugonsaro* three questions of which solution or on which improvement would offer additional conveniences for the art of navigation. As his master replied that he did not know any pilot who could answer to the questions in the world, Kouun thought out answers by himself. I would like to refer to this matter in detail later on by two reasons. The first reason is that for the audience present here, after knowing what is written in Gennakoukaiki and what level has the content of the Book, they may understand better on the three questions and the answers for them by Kouun. The second reason is that Kouun presented answers only in sketches of instrument of astronomical observation, not in a writing. And even though the sketches show his originality, but there is a room for interpretation of their usage because of lack of explanation.

3. Solar declination table for four years (the Solar Table)

After the Preface, in ninety pages from the page 7 through the page 96, a solar declination table for four years is written (hereafter called the "Solar Table"). I am going to translate the first ten days of the first year in English as follows:

Numbers written in parenthesis are numbers of declination of the Sun indicated in the solar declination table of "Compendio de la Arte de Navegar" of Rodorigo Çamorano published in 1588 (the third edition) *19 (Annex 1)

		black letter is to be taken,	vermillion letter is to be added							
Febereiro	1st day	17 9 (17 09)	Thu.	Tue.	Sun.	Fri.	Wed.	Mon.	Sat.
	2nd day	16 53 (16 52)	Fri.	Wed.	Mon.	Sat.	Thu.	Tue.	Sun.
	3rd day	16 35 (16 35)	Sat.	Thu.	Tue.	Sun.	Fri.	Wed.	Mon.
	4th day	16 17 (16 17)	Sun.	Fri.	Wed.	Mon.	Sat.	Thu.	Tue.
	5th day	15 59 (15 59)	Mon.	Sat.	Thu.	Tue.	Sun.	Fri.	Wed.
Risshun	6th day	15 41 (15 41)	Tue.	Sun.	Fri.	Wed.	Mon.	Sat.	Thu.
	7th day	15 22 (15 22)	Wed.	Mon.	Sat.	Thu.	Tue.	Sun.	Fri.
	8th day	15 3 (15 3)	Thu.	Tue.	Sun.	Fri.	Wed.	Mon.	Sat.
	9th day	14 44 (14 44)	Fri.	Wed.	Mon.	Sat.	Thu.	Tue.	Sun.
				Year of *Ki-Yu* Shougatu-shou: Kou-Go					
	10th day	14 25 (14 25)	Sat.	Thu.	Tue.	Sun.	Fri.	Wed.	Mon.
						Year of Sin-Si Shougatu-dai: Tei-Chuu			

1) Note on the Solar Table

(1) February is the starting month of the Solar Table and January comes last in a year, because Japan adopted Chinese luni-solar calendar at that time, and the first month of this luni-solar calendar corresponded to February of Gregorian calendar.

In order to eliminate confusion, Kouun intentionally put names of months phonetically transferred from Portuguese. There are numbers of solar declination for four years of which last year is a leap year.

(2) The sentence "black letter is to be taken" means to subtract number of declination written by black letter in the Solar Table from number of altitude of the Sun which is observed at noon of a day, and the number remained after being subtracted indicates the latitude of where the observer's ship is. And "vermillion letter is to be added" means to add number of declination of the Solar Table if it is written by vermillion letter to observed altitude of the Sun. The Book is a manuscript written mainly by black letters and sometimes by vermillion letters when having comment as this. For example, the letters of numbers of the days from 1 February to 20

March and from 24 September to 31 January are written by black letters and the numbers of the days from 21 March to 23 September in the first year are written by vermillion letters. There are some Portuguese and Spanish solar declination tables written or printed by the two colors of black and red, however, major printed Iberian tables were indicating “add or subtract” by marks ”+” and ”－“ or indicating to add or to subtract by means of directions of observers’ shadow (to the North or to the South). Gennakoukaiki explains how to calculate the latitude in the pages 100 and 101.

(3) The everyday of the week is indicated without omission. As the first day of February is Thursday and the last day of January of the fourth year is Monday, consequently the first day of February of the year of the second cycle is Tuesday. These cycles are repeated and the Solar Table makes a perpetual calendar of the week as result. Kouun wrote all the seven days of the week for everyday of the four years, and made this repetition seven times, and so totally twenty eight times. It must be considered that his enthusiasm came from his desire to have Japanese mariners use the solar declination table basing on the solar calendar easily because of impracticability of knowing a day of the oriental luni-solar calendar corresponded to the western solar calendar everyday calculating it on board. Kouun added comments besides the days of the week. For example in the part of the Solar Table translated above, it was commented “Year of Ki-Yu, Small First Month: Kou-Go” besides the day of 9 February of the second time (this day is Thursday), and besides the day of 10 February of the fourth time (this day is Sunday) “Year of Sin-Si, Large First Month: Tei-Chuu”. These comments show correspondent years of the luni-solar calendar. (See Note *8)

(4) There various comments related to the luni-solar calendar are put in detail. Because the seasons of the lunar (or luni-solar) calendar have difficulty to maintain their seasonal significance (especially relation to agriculture) in the solar calendar as one year of the lunar calendar is shorter approximately eleven days than the solar calendar. To relieve this difficulty, the all days of the solar calendar were divided into twenty-four, and the first day of these days of a year was named as “Risshun”, or “Setting-in Spring”.

The “Ki-Yu” and the “Sin-Si” is respectively one year of sixty years of the luni-solar calendar, which consists of sixty-year cycles (See Note *8). ‘Shougatu-shou*”* means ”small first month” and “Shougatu-dai” means ”large first month”, because there are two kinds of months, one of which is consisting of twenty-nine days and another is consisting of thirty days, in the lunar calendar by reason of the lunar revolution and the small first month is the first month which consists of twenty-nine days of the year and the large first month is the first month which consists of thirty days of the year.

2) Where did the Solar Table come from?

(1) Studies on Gennakoukaiki began 1930s, and approximately twenty years later Moritune Uchiyama*[20] and Itraru Imai*[21] made extensive studies on the Solar Table by approaching it from point of view of the calendar and the astronomy since 1955. Imai compared the Solar Table with some old western solar declination tables getting from facsimile editions of books of navigation of William Bourne, Lucas Waghenaer, Willem J. Blaeu and also "Obras" of Pedro Nunes*[22], but he could not find any same declination table as the Solar Table of Gennakoukaiki. The obliquity of the ecliptic is 23° 28' in the Book. This was proposed by Germans, Georg Peuerbach and Johannes Müller, whose Roman name is Regiomontanus and this number was known in Portugal in the days of Columbus. The first published solar declination table with this number appeared in "Regimento de Navegação" of João Baptista Lavanha*[23]. In the guide books of navigation with which Imai consulted, although the books of William Bourne and Lucas Waghenaer have 23° 28' of the obliquity of the ecliptic as same as it of Gennakoukaiki, but the numbers of the solar declination tables of these books are very different from those of Gennakoukaiki. Uchiyama paid attention to "Livro de Marinharia de Gaspar Moreira", a manuscript written in Portuguese language in the possession of Bibliothéque National de Paris, of which the obliquity of ecliptic is 23° 28' and which has a drawing of the Regimento de Légua in a style of compass rose looked like very much that of Gennakoukaiki (See Annex 5), however this book uses the solar declination table of João Baptista Lavanha. The fact that Imai and Uchiyama did not or could not access to Iberian books of navigation was one of the reasons which caused delay to find out natural relation between Gennakoukaiki with books of the Iberian art of navigation, even in the 1930's Japanese scholars talked with C.R.Boxer in an occasion he visited Japan on the origin of Gennakoukaiki and this erudite scholar suggested that it might be one of Portuguese books of the late sixteenth century, exemplifying Manuel de Figueiredo.

(2) I lived in Brazil for six years from 1983 and had a chance to get some old Portuguese books of navigation, art of navigation, cartography and also modern books of A. Fontoura da Costa, Luis de Albuquerque, etc. and started to look for origin of Gennakoukaiki. As I could not succeed it for some years, at the same time

I began to make calculations by myself to assume how could get the solar declination table of the Book by personal computer and software of calculation of position of the Sun which appeared on the stage as new weapons for researchers. I calculated solar declination from positions of the sun on the ecliptic by applying the formula $\sin\delta = \sin\lambda \sin\varepsilon$ as same way as astrology in old time. δ is the solar declination to be gotten, λ is the ecliptic longitude of the noon of the day and ε is the obliquity of the ecliptic of 23° 28'. I got results that the solar declination of four years from 1548 was most near to the Table of the Book. Kazuo Urakawa, who was a member of the Japan Society for Nautical Research asked the Japan Coast Guard to do similar calculation which was almost same as mine. *[24] Internet developed soon and helped me greatly to access easily to the libraries of Europe, namely Biblioteca Nacional de España and Biblioteca Nacional de Portugal. I got copies of many original books of navigation from the both libraries, and at last in 2004 I succeeded in finding the same solar declination table of Gennakoukaiki in the edition published in 1588 of "Compendio de la Arte de Navegar" written by Rodorigo Çamorano of which the cover and the beginning of the first year of the Solar Table is shown in Annex 2. I reported it in "Kaiji Shi Kenkyu" , the Journal of the Japan Society for Nautical Research,no.62, November, 2005 and also in the same Journal, no.63, November, 2006.*[25] There are only sixty five days in which exist difference between the Solar Table of the Book and the table of Çamorano, comparing everyday of 1461days of four years. And almost all such differences come from mistakes occurred in copywriting numbers. I am going to show all differences of the first year in the following Table A:

Table A

day & month	Çamorano(1588)	Gennakoukaiki
5 January	−22° 38′	−22° 28′
2 February	−16° 52′	−16° 53′
16 March	−1° 52′	−2° 52′
8 April	7° 6′	7° 7′
20 April	11° 25′	11° 39′
3 May	15° 35′	15° 25′
24 May	20° 43′	20° 42′
25 May	20° 54′	20° 57′
21 July	20° 33′	20° 23′
23 July	20° 10′	20° 20′
27 July	19° 18′	29° 18′

6 October	$-5°\ 2'$	$-9°\ 2'$
8 October	$-5°\ 48'$	$-5°\ 49'$
13 November	$-17°\ 58'$	$-18°\ 58'$

The first edition of "Compendio de la Arte de Navegar "published in 1581 had another solar declination table than the third edition published in 1588, and it is said that there are more other editions published in 1582,1586 and 1591 *26, which I have not yet researched.

3) For which years was the Solar Table prepared for?

There is no mention for which years the Solar Table was prepared in the table for the first year transcribed above, but at the beginnings of the tables for the second year, third year and the fourth year, years for which the tables were prepared were mentioned in Gregorian calendar years and also luni-solar calendar years of sixty years cycle, and Japanese years were added only besides of every first year of these three years. I am going to translate that of the second year for example. The third year and the fourth year have same mentions as this respectively. These mentions of the years for which the table of each year was prepared were written on small pieces of paper and these pieces were stuck on principal papers by paste, and before the beginning of the first year there is a space appropriate to be stuck a same piece of paper. Consequently we can assume that such piece of paper was not stuck on the first year by some reason. (See Annex 2)

Second year mainly Chuu,Go,Jutu You *27

1600

30	34	38	42	46	50	54
Kou-Go	Kou-Jutu	Bo-In	Jin-Go	Hei-Jutu	Kou-In	Kou-Go
7th of Kan-ei,						
58	62	66	70	74	78	82
Bo-Jutu	Jin-Chuu	Hei-Go	Kou-Jutu	Kou-Chuu	Bo-Go	Jin-Jutu
86						
Hei-Chuu						

The years for which the Solar Table of the second year was prepared were 1630, 1634,・・・・and 1686, getting these number by adding to 1600 with numbers 30,34,38,・・・86. Although the first year has not this description, the years of 1629, 1633, 1637, ・・・1685 can be assumed. Kou-Go, Kou-Jutu, Bo-In,・・・Hei-Chuu in the second line show years of 60Kan-Si of the luni-solar calendar (See Note *8) in order to correspond to calendars of Japan and China, "7th of Kan-ei" written beside 1630 is Japanese year, and the period of Kan-ei came as the next period of Genna which continued until 1623, and so the first year of Kan-ei corresponded to 1624. The solar declination table of the Compendio de la Arte de Navegar of 1588 of Çamorano had no indication for which year was prepared its table, however, it was said that 1584 was a leap year in an example of calculation of latitude made just after the table. Consequently the year of 1632 in the table of Çamorano had to be a leap year, and this fact harmonized with the fact that the fourth year which came out at the first in the Solar Table of Gennakoukaiki was a leap year. In the Solar Table of the Book, Kouun put the luni-solar calendar corresponding to Gregorian calendar of solar calendar in order to facilitate use of the Solar Table of the Book for Japanese mariners who were not accustomed to the solar calendar. The luni-solar calendar which was used in Japan was Senmei-Reki introduced to Japan in the year of 859 of western solar calendar from China (the Tang dynasty) and used without revision for about eight hundred years. In Japan official preparation of calendar was done by contemporary government. In a paper "Gennakoukaiki no sakujitu-hyou ni tuite", or "About the new moon days in the declination table of Gennakoukaiki" *19 Uchiyama says that regarding to the years of luni-solar calendar written beside the western calendar years, only those of the first year (1629) and the second year (1630) agree correctly with those of the official calendar, but those of the third year and the fourth year have evident difference and are rather similar to those of the contemporary Chinese (the Min dynasty) calendar. By this reason Uchiyama thought that as official calendar for years after the third year of the Solar Table of the Book, or 1631, or the eighth year of Kan-ei had not been published yet, Kouun Ikeda used the Chinese calendar in spite of troublesome work of translation of calendar. I have entered into details of the calendars of the Solar Table of the Book, because, by mentioning this example, I would like to emphasize efforts done by Kouun to make up his solar declination table for practicable use of Japanese mariners, even having trouble of complicated computation with the Chinese calendar though he was not a specialist of calendar making of the Japanese government. Actually at that time in China, a solar calendar made by German T. Adam Schall von Bell, Italian Giacomo Roh, Italian Nicolas Longobardi and Chinese Xú Guâng qî was officially used from September 1629 to July 1643.

4. Yottu no *dekirinasan* (Four declinations)

1) Fundamental knowledge and practice for use of the Solar Table

Under the title of "Yottsu no *dekirinasan*", fundamental knowledge for use of the Solar Table and how to use it is written. Kouun explains "Yottsu no *dekirinasan*" as "it means a diary of the Sun for four years". After this explanation he wrote about movement of the Sun on the ecliptic starting from the vernal equinox, the summer solstice, the autumnal equinox and the winter solstice. I am going to translate the two parts from the vernal equinox and from the summer solstice into English as follows. The description of the other two parts is similar to these. (Annex 3)

— On the 21day and the 22day of *maruso* (the middle day of the second month in Japan) the Sun is in the middle line called *ekinusiaru*. It enters the beginning of the sign of the ram called *Ariesu*. After the 23rd day of the same month, the Sun goes to the North.

— On the 22day and the 23day of *jiuniyo* (the middle day of the fifth month in Japan) the Sun is in the line called *riineya* (This means line.) *zauna tenperaada,* which is 23 *garabu* and half (i.e. 23 dan and half) apart the middle line to the North. That is the sign of an insect called *kanseru*. After the 24day of the same month, the Sun returns to the middle line from the North.*28

2) Conversion from degree and minute to distance on the Earth with varied cases

And conversions between degree and minute to terrestrial distance are given in many cases. This type of conversion did not appear in old Iberian books of navigation, and we can interpreter that Kouun made efforts to facilitate use of the western distance system for Japanese mariners, calculating so many numbers of conversions by him. I am going to translate the beginning some items as follows: (See Annex 3)

— Calculation of degree (The world is 360 degree around, i.e. 360 dan.)

○ We divide one degree into 60 parts, and one of these is called *minuuto*.*11 This *minuuto* has 25chou, 1tan, 1ken,4shaku, 5sun.

○ One *garabu* has 17ri and half of measurement of nanban. *11 regarding the 1ri, as it is said that this is equivalent to 3 ri of Japanese measurement, so one *garabu* is equivalent to 52 ri and half of Japanese measurement. This is an error. But 1 ri of measurement of nanban is equivalent to 2 ri, 14 chou, 1tan and half, 1shaku, 5sun (36chou is equivalent to 1 ri.) By this reason one *garabu* is equivalent to 41ri, 31chou, 6tan, 5ken, 3shaku, 5sun.　I write down calculation of 1ri of measurement of nanban as follows.

○ Half of *garabu* has 30*minuuto*. (It is called *meugaubu**[29] in nanban.). Equivalent to 20ri, 33chou, 8tan, 2 ken, 5shaku.（6 shaku is equivalent to 1 ken, and 6ken is equivalent to 1tan, 60ken is equivalent to 1chou, 36chou is equivalent to 1ri.）*[30]

○ Two third of *garabu* has 40 *minuuto*. Equivalent to 27ri, 33chou, 8tan, 2ken, 5shaku.

And similar description continues on 1/3°, 3/4°, 1/4°, 4/5°, 3/5°, 2/5°, 1/5°, 1/6°, 1 /10°, 2', 3', 4', 5', 7', 8', 9'.

3) How to observe altitude of the Sun and how to get latitude from such observed altitude and the Solar Table

The next is a description about how to obtain latitude using observed altitude of the Sun and the Solar Table. I am going to translate all sentences in English as follows.

— To catch the Sun (What is said as "*tomasooru*"*[31] in Nanban means to get the Sun.　(In Japan it must be said to measure the Sun.)

○ If the Sun is in the South of the middle line and the ship is in the North of the middle line, you will know *aruzuura* (dan of pass) of a place where you are by means of *garabu* which remains after number of the daily Sun table is subtracted from the number of *garabu* measured by *asutororabiyo*.

○ If the Sun is in the North of the middle line and you are in the North of the Sun, you will know *aruzuura* of a place where you are by adding number of the daily Sun table (*dekirinari*) to a curved point of scale gotten by measuring the Sun. In case the North changes to the South, do the same as this.

○ If you are between the Sun and the middle line, you will know a place where you are by means of *garabu* which is remained after number of curved point of scale measured by *asutororabiyo*, directing it to the Sun, no matter it is in the South or in the North, is subtracted from number of the daily Sun table .

If the Sun is above your head, and light of the Sun falls straight to *asutororabiyo*, even if directing it any of the East, the West, the South, and the North, you will know you are just in a place same as it of day of the daily Sun table.

In next two pages, from the page 101 through the page 103, Kouun explains on history of adoption of Gregorian calendar and how to correct it under the title of

"Nichirin shoutoku no mawari wa nishi yori higashi he mawaru koto", or " Natural revolution of the Sun is a turn from the West to the East". (Annex 4)

Kouun Ikeda signed once more just after this sentence.

4) Regimento de Légua

After his signature Kouun presents "Regimento de Légua" in a written form, which was called by A. Fontoura da Costa as this. *32 This regiment was used for a traverse navigation in present terminology. A drawing corresponding to the Regimento de Légua appears in page 105 of the Book (Annex 5). I am going to translate the part of the due South which comes at first to English as follows:

To calculate how long it has advanced, taking a way to vertically or diagonally or horizontally

○ If it passes one *garabu*, navigating to the direction of the south, it has advanced 17 ri and half of measurement of nanban, that is 41ri, 31chou, 6tan, 5chou, 3shaku of Japanese measurement.

The following Table B is a comparison of numbers of eight directions of the Book with those of some Iberian book of navigation and of astronomy book of Pedro Nunes.

Table B

Books of navigation(year of published or written)	Léguas of 11.25° ×n from south to west							
	n=0	n=1	n=2	n=3	n=4	n=5	n=6	n=7
Gennakoukaisho (1618)	17 1/2	18	19	21 1/2	25	31 1/2	46	88
João de Lisboa (1514) *33	17 1/2	18	19	21 1/2	25	31 1/2	46	88
Fransisco Fareiro (1535)	17 1/2	17 5/6	19 1/6	21 1/3	24 3/4	31 1/4	46 1/2	87 1/6
Pedro Nunes (1537)	17 1/2	17 5/8	19 3/8	21	24 3/4	31 1/2	45 3/4	89 3/4
Gaspar Moreira (end/16th century) *34	17 1/2	18	19	21 1/2	25	31 1/2	46	88
Manuel de Figueiredo(1616)	17 1/2	18	19	21	24 3/4	31 1/2	45 3/4	89 2/3

In the above Table B, Rodorigo Çamorano does not appear because his numbers are completely different from any number mentioned above and consist of only seven numbers, and interval degrees between diagonal lines are not same each other. The numbers of João de Lisboa and of Gaspar Moreira are exactly same as those of Gennakoukaiki. As the fact that the manuscript of Gaspar Moreira was not original of him and was transcribed from other book(s) of navigation was admitted by Luis de Albuquerque, a possibility of existence of unknown manuscript of the art of navigation, which might affect *Manoerugonsaru* and Gaspar Moreira, cannot be deniable.

5. Drawings

1) Drawing of the Regimento de Légua

In the page 105 a drawing of the Regimento de Légua appears. On every one fourth of one circle, numbers of léguas which consist of $17^{1/2}$, 18, 19, $21^{1/2}$, 25, $31^{1/2}$, 46 and 88 are written. These léguas mean distances which a ship has advanced when it has gone (11.5×n)degree of latitude, and there are no number of léguas in cases of advance from the East to the West and the West to the East, because it cannot be measured. It is interesting that the drawing of Kouun Ikeda looks like Gaspar Moreira's drawing and especially a drawing of codex Bastião Lopes (anonym author) [*35]quite well. We can see it in Annex 3.

2) Compass rose with thirty two points

In the page 106 a compass rose with thirty two points is shown. In the outside of the circle of the compass, directions phonetically transferred from Portuguese language are written and in the inside of the circle sixteen major directions are written in Japanese language. (Annex 6)

3) "Koden no zu" or " A drawing comes from old time"

In the page 107 a drawing of so called "Regimento do Norte", or "Regiment of North Star" with eight directions is shown. 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. There was a regiment to assume position by meridian altitude of the North Star as same as "Regimento do Sol", or "Regiment of the Sun", which is called the calculated observed meridian altitude of the Sun in the present days, however, as accomplishment of a dairy table of the North Star was delayed and the calculated observed meridian altitude of the North Star was not used in the end of the sixteenth century and the beginning of the next century. The Regimento do Norte, which calculated right position of the North Star, was used as a supplement to the Regimento do Sol.

In the time of Kouun the polar distance of the North Star was nearer than 3° 30', and even Çamorano explained the Regimento do Norte using the same numbers as those of Kouun in his Compendio del Arte de Navegar of 1588, but in addition to this explanation, he said that mariners were saying this number was anachronistic, and Çamorano offered new numbers as follows. He was offering newly 2° 41' in place of 3°, 3° 8' in place of 3° and half, 1° 20' in place of 1° and half, 0° 27' in place of half degree. This drawing of Gennakoukaiki has the title "Koden no zu", or "Drawing comes from old time" (Annex 7), and I have never seen any same drawing in Iberian books of navigation. In "Livro de Marinharia, Tratado da Agulha de Marear" of João de Lisboa[*33], an early Portuguese book of navigation, there is a drawing and supplementary numbers put in this drawing, however, these numbers are not same as those of the Book, and disposition of the stars α, β and γ of the Ursa Minor is opposite to that of the Book. The disposition of these stars of the book of João de Lisboa is strangely opposite to disposition shown commonly in other books of navigation or of astronomy(perhaps an error of the book of João de Lisboa), to which Gennakoukaiki also follows. By this reason it is not considered that Kouun referred to the book of João de Lisboa. One of other early books which have a drawing and same supplementary numbers as those of the Book is "Livro de Marinharia" of Bernardo Fernandes published approximately in 1548[*36], but there is not disposition the disposition of the three stars of the Ursa Minor. In the book of Çamorano, he shows the dispotion of these three stars naming α as A, β as B, γ as C, but there is no sketch of this constellation at different times. I assume that *Manoerugonsaru* knew anachronism of this number 3° 30' as a polar distance of the North, and so he taught Kouun this number with commenting its oldness, and Kouun gave the drawing a title "Koden no zu" that is to say the "Drawing comes from old time". Even if my assumption is correct, I wonder from where did *Manoerugonsaru* get idea of this drawing? Most Iberian books of navigation of those days explain on adoption of numbers for correction by applying on which line of eight lines of compass rose comes the line drawn between the stars α and β, or by applying in which direction the star β is.

4) Drawing of the Regimento do Norte improved by Kouun

This drawing appears in page 108 (See Annex 7) and is an answer of Kouun Ikeda to the third question put in the Preface. The third question is "Considering on the North Stars, even there is a drawing of the eight directions in old teachings, four directions are met in day time. And one direction is out of sight as in morning or in evening. Lastly, the other three directions are in their positions in night.

However, if one cloud covers them at that time, just we lose the time. Are there ways to know these three things at any time, or not?" Kouun 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" *37 published in 1602, for example The numbers of correction of Kouun are 1/2, $1^{1/6}$, $1^{3/5,}$ $2^{1/6}$, $2^{1/2}$, $2^{4/5}$, $2^{5/6}$ and 3. However, the numbers of correction of Pedro de Syria are very simple ones as 1/2, 1, $1^{1/2}$, 2 , 3 and $3^{1/2}$. I have no idea how Kouun got these numbers. I do not think that he got them by observation or he calculated them by himself. A drawing similar to this improved drawing is shown in "Breve Compendio de la Sphera y de la Arte de Navegar" of Martín Cortes published in 1551.*38 (Annex 8) The numbers 1, 2 and 3 are written repeatedly four times in the fourth ring counted from the outermost ring, and the numbers 4 and 9 added to the numbers 1,2 and 3 are shown in the drawing of Martín Cortes. I would like to ask meaning of the numbers to anyone who knows it.

5) Drawing of an instrument for the Regimento do Cruzeiro do Sul designed by Kouun

In the drawing of the page 109 (Annex 9) , 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. "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 declination table. It is considered that black letters are to be subtracted from observed altitude of the star α , if the star comes in the North side of the 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 α , or "Estrela de Pé" nearest of four stars of the Southern Cross to the South Pole had the polar distance of 30° . As the line made by connecting the star α and the star γ , 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 α , which is known by direction of a line connecting the star α and the star γ . 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 α 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 α and "B" as a name to the star γ .[*39] 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 α is in the North, 19° 25'(Kouun :20°)minus in case of the star α is in the Northwest, 5° 38'(Kouun :7°)plus in case of the star α is in the East, 19° 25' plus in case of the star α is in the Southeast, 28° 25' plus in case of the star α is in the South, etc.[*40] Although, in the Book 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. I agree with his interpretation and also with his unique idea regarding to an instrument which looks like astrolabe, so I am going to present his idea as follows:

First of all, though this instrument looks like an astrolabe, but it isn't an astrolabe, because its alidade is not fixed to the center of a circle, because this circle is not a disk but a blanked hole of certain size. And the alidade is fixed to a circle band drawn outside of the hole at two points where the alidade crosses the circle band. From one side of the face of this instrument through the hole we can see stars which are in heaven of the other side of the face of the instrument through the hole. The circle band with the alidade is separated from the outer part of the instrument, which has edge of the instrument, and can be turned freely from the outside with a ring to be held. We get an angle of inclination of the line got connecting the star α and the star γ of the Southern Cross by turning the alidade in order to fit the line of the alidade to the line made by two stars. (Annex 10) Thus we put the instrument maintaining the angle on the half circle and read a correction number from the half circle. This is the interpretation of Iida on the instrument with the half circle proposed by Kouun. *41

I think the ideas shown in pages 108 and 109 were original of Kouun Ikeda, however, I doubt slightly whether these directions divided into so small ranges had practical use for observation on board.

Though I appreciate Kouun had an excellent intention to improve the art of navigation as stated in the Preface, but I think that in his actual proposals the ideas thought out by him surpassed consideration on practicability.

6) Drawing of a large quadrant

In a drawing of the page 110 a man is aiming at the star γ of the Ursula Minor by a large quadrant. He may put the Regimento do Norte in practice. (Annex 10) Though large astrolabes appear in old books of navigation guide many times, I have never seen so large size of quadrant as this even in drawing, and I assume this would be made of wood.

7) Drawing of an astrolabe

In the page 111 an astrolabe is sketched, however we cannot know size of this astrolabe because there is no object to be compared with, like an observer as the previous page. So I assume that Kouun might propose to emphasize the largeness of the instrument in the case of the quadrant, but in the drawing of the astrolabe he was proposing to show details of the astrolabe. He was not showing a scene of observation but explaining how to observe the sun passing its beam of vermilion color through two holes of the alidade, not looking the sun directly through two holes in a correct manner. (See Annex 10)

6. Table of days of the full moon and the new moon

From the page 112 through the page 116, there are the numbers of the Epact, which is written as "*ehakuta*" phonetically transferred from Portuguese "Epacta", and the Golden Numbers, which is written as "*aureyohoumere*" phonetically transferred from Portuguese "Aurero Numero" and years of luni-solar calendar represented by the western solar calendar and also by the Jukkan (10kan) corresponding to every numbers on the right side of the *ehakuta* respectively. On the left side of the *aureyohoumere,* the days of the full moon by mark ○ and of the new moon by mark ● from January to December are mentioned. (Annex 11)

I am going to translate the beginning part of this table including January to English language, omitting the remainder after February as follows:

Janeiro	31days	*a-h* (#)	*ehakuta*		1600	1600	1600	1600
●30	○15	1	1	Otu-U(##)	15	↓ 34	↓ 53	↓ 72
●19	○3	2	12	Hei-Tatu	16	↓ 35	↓ 54	↓ 73
○22	●8	3	23	Tei-Mi	17	↓ 36	↓ 55	↓ 74
●27	○11	4	4	Bo-Go	18	↓ 37	↓ 56	↓ 75
○30	●16	5	15	Ki-Bi	19	↓ 38	↓ 57	↓ 76
○18	●4	6	26	Kou-Sin	20	↓ 39	↓ 58	↓ 77
●23	○8	7	7	Sin-Yuu	21	↓ 40	↓ 59	↓ 78
○27	●12	8	18	Jin-Jutu	22	↓ 41	↓ 60	↓ 79
●31 Ne●6	●2	9	29	Ki-Gai	23	↓ 42	↓ 61	↓ 80
●20	○5	10	10	Kou-Si	24	↓ 43	↓ 62	↓ 81
3U○23	●9	11	21	Out-Chuu	25	↓ 44	↓ 63	↓ 82
●28	U ○13	12	2	Hei-Chuu	26	↓ 45	↓ 64	↓ 83
Ne-Usi○31	17●U-Tatu○2	13	13	Tei-U	27	↓ 46	↓ 65	↓ 84
Ne○30	●6	14	24	Hei-Chuu	28	↓ 47	↓ 66	↓ 85
●24	○9	15	5	Ki-Si	29	↓ 48	↓ 67	↓ 86
Sin-Sin○28	○14	16	16	Kou-Go	30	↓ 49	↓ 68	↓ 87
Tatu○18	○4	17	27	Sin-Bi	31	↓ 50	↓ 69	↓ 88
●22	○6	18	8	Jin-Sin	32	↓ 51	↓ 70	↓ 89
Inu-I ○25	●11	19	19	Ki-Tuu	33	↓ 52	↓ 71	↓ 90

(#):In the place of *a-h*, it is written actually as "*aureyohoumere*".

The purpose of this table is to predict the ebb and flow of the tides at port or haven bay by knowing the wax and wane of the moon. It is necessary to synchronize the solar calendar with the lunar calendar in order to know the wax and wane of the moon perpetually. Greek philosopher Meton found that the same wax and wane movement of the moon returns on the same day of the solar calendar every nineteen years, namely one cycle of 235 lunar months corresponds to one cycle of 6940 days of nineteen solar years, and he proposed a solar-luni calendar based on this fact. The number "nineteen" originated from this cycle of nineteen years called as "Golden Number" and in the present time this cycle of nineteen years is called "Meton's Cycle". And the age of the moon at the New Year's Day, which is necessary to fix Easter Sunday closely related to the lunar calendar is named as "Epact".

In this table the nineteen numbers of the *aureyohoumere* (the Golden Number) are put vertically at the middle of the page112, and at the right side of the Golden

Number the numbers of the *ehakuta* (the Epact) come and these numbers mean the age of the moon at the New Year's Day of the years written right hand of the Epact by means of the Jukkan (luni-solar calendar) and by means of the Gregorian calendar side by side. The year of 1615 (1600+15), namely the year of Otu-U （##） is the first year of the Golden Number 1, and at its right side there is the year of 1634 (1600+15+19) , which comes after the Meton's Cycle turns once. I dare to omit the years of the 60Kan-Si of the luni-solar calendar, which are written in places marked "↓" actually in the Book, in order to avoid intricateness. All marks of "↓" mean that the years of the 60Kan-Si written in the Book are omitted. Consequently this table is a table of the wax and wane of the moon of everyday of the years from 1615 through 1690. At the left side of the Golden Numbers there are marks of ● and ○ with numbers at their sides. The marks ○ and ● mean the full moon and the new moon respectively, and the numbers written beside mean days of the month. For example, we can know that the day of the new moon of the January of the years of 1615, 1634, 1653 and 1672 in the first line of the Golden Number 1 is the day 30, and the day of the full moon of the January of these years is the day15. And those "Ne", "U", "U-Tatu", etc. written at the sides of the marks of ● and ○ mean hours when occur high or low tide by the full moon or the new moon in Japanese time expression system.

It seems that Kouun copied some Iberian everyday table of the wax and wane of the moon through *Manoerugonsaru*, however, I have never found original of this table. As far as I know, the navigation book which has the nearest content to the Gennakoukaiki with respect to this theme, is "EXAME de Pilotos" of Manuel de Figuereido*42. In the EXAME de Pilotos published in 1614 (four years before the date of Gennakoukaiki) through the page 37 to the page 41, there are articles titled "Epact and Golden Number"; the Article 11, "How to know days of wax and wane of the moon"; the Article 12 and "Tides"; the Article 13 and appear the similar numbers as Gennakoukaiki. At first, the year of 1615 is given as the first year of the Golden Number and of the Epact, and 1652 is given as the last year, and completely same numbers as Gennakoukaiki are shown in a form of table. Next a table of new moon corresponding to the Golden Number from January to December is shown as a perpetual table, so I am going to make a comparison table of January with Gennakoukaiki as follows:

Golden Number	1	2	3	4	5	6	7	8	9	10
Figuereido	29	17	7	26	16	4	23	12	30	19
Gennakoukaiki	30	19	8	27	16	4	23	11	31	20

Golden Number	11	12	13	14	15	16	17	18	19
Figuereido	8	27	17	6	24	14	3	21	10
Gennakoukaiki	9	28	17	6	24	14	4	22	11

Also there is a time table of high tide corresponding to ages of the moon in the Article 13. The numbers and expression of the EXAME de Pilotos of Manuel de Figuereido differ from those of Gennakoukaiki, however, the EXAME de Pilotos of Figuereido has all elements same as the elements of Gennakoukaiki.

In the Compendio del Arte de Navegar" (1588) of Çamorano from the page 50 through the page 56 there is a "Regra" which takes into consideration the Golden Number and high tide and low tide by the wax and wane of the moon, but there is no table as Gennakoukaiki. In "Arte de Navegar" [*43] published in 1605 in Lisbon, Simão de Oliveira is explaining on the Golden Number in the Article 44 (page 157)and on the Epact in the Article 45(page159) and showing a table of the new moon in the page 159 whose numbers are completely same as those of Manuel de Figuereido. [*42]

"Regimento de Navegación" published by Andrés García de Céspedes in 1606 (See Note[*40]) explains on the high and low tides in Article 33, on the age of the moon in Article 34 and on the Epact in Article 35, in Article 35 there is a table of the Epact from the year 1582 to the year 1899. In this table of the Epact, Numbers of one to twenty-nine of the Epact are put in turn with corresponding days of January through December. This idea with regard to structure of the table is totally diferent from that of Gennakoukaiki.

Anyway it might not be possible that Kouun made by himself the table of days of the full moon and the new moon of Gennakoukaiki, which even has the days of full moon. Then, from which Iberian navigation book did Kouun copy the table of days of the full moon and the new moon as he copied the solar declination table of Çamorano? This remains for a study in future.

7. Router

There is a router (hereafter called the "Router") from the page 117 to the page 134. Motoharu Fujita studied on the Router in detail in the Article 6 titled "Gennakoukaiki kouro no kenkyuu", or "Study on the router of Gennakoukaiki" in his "Nissi koutuu no kenkyuu", or "Study on communication between Japan and

China" published in 1938*44. He succeeded to identify almost all the names of places and landscapes which appeared in the Book, consulting with Chinese names, contemporary maps, old Japanese books and Japanese routers of 1930s. Also Kouun gave seasonal wind direction, climate, distance, period of navigation, depth measurement and research of nature of sea bottom by lead and line. Fujita appreciated accuracy of description of Gennakoukaiki after identification of places. It seems that Kouun knew some Portuguese "roteiro(s)" through *Manoerugonsaru* and he imitated its style and items of description, however, its contents suggest that he made his router basing on his own experience of navigation.

Outline of the Router is as follows.

1) From Nagasaki to Amakawa, or Macao and from Nagasaki to Annan of South Vietnam

From the page 117 through the page 125, every page is divided to two parts above and below and each above and below part has independent description. The above part is treating about "Router from Nagasaki to Amakawa" and describing its router navigating along the coast of China to Macao.

The below part is treating "Same as the above, navigation between China and Takasago (Takasago is Taiwan, or Formosa.), as it says "same as the above", we are inclined to read that this is a router from Nagasaki to Macao through Formosa, but actually is a router from Nagasaki to Annan of the central part of Vietnam.

2) From Amakawa (Macao) to Nagasaki

From the middle of the page 125 through the page 127, a returning router from Macao to Nagasaki is written.

3) From Siam to Lamma Island

From the page 128 through 134, a router from Siam to Lamao Island which is located north of Siam, and at the last, it is written "Regarding to the way to Japan, see the router from Amakawa.

8. Remarks on navigation

1) 124 items mainly on weather

From the page 135 to the page 146, one hundred twenty four items mainly regarding to climate are written.

8) Good days and bad days to set sail

On the page 147, good days and bad days for setting sail are written, however, the reason why good or bad is not explained.

9) Portuguese units of length and conversion of légua and grau to"ri", a Japanese unit of distance, with varied cases, some comments on luni-solar calendar and the dimension of the Earth are presented from the page 148 to the last page 157.

9. Conclusion

Japanese reached to the Malay Peninsula about the fifteenth century, committing pirate along the coast of China. But they only sailed in not so large ships, not losing sight of shores until they knew European ship perhaps by Portuguese. At the end of the sixteenth century and the beginning of the seventeenth century, Japanese began to sail on oceangoing junks or *Misutuisu* ships mixed Chinese junk with European ship to trade with the southeastern Asian countries and learned the art of navigation by Nanbanjin. It was Gennakoukaiki a book which was prepared to popularize such art of navigation introduced from Europe to Japanese mariners, not only a navigation guidebook but also explanatory book about western solar calendar and Iberian measurement units with which were not familiar Japanese people. In addition to his every effort for facilitation of using the European art of navigation, Kouun proposed some ideas for improvement of the contemporary art of navigation.

What Kouun Ikeda pretended to appeal in the Preface were his intention to convey precious foreign technologies correctly and his high-minded intention to give them improvement, which never had been proposed by anyone. By means of what was written in Gennakoukaiki, we can know how was transferred the technologies born and grown in Iberian countries to the Far-East of Asia. Perhaps *Manoerugonsaru* who taught Japanese these technologies, had not only one guidebook of Portugal or of Spain, but he might have copies taken from different sources or he himself might make something like a manuscript with gathered information, because Gennakoukaiki contains information from many different sources, such as João de Lisboa, Rodrigo Çamorano, João Baptista Lavanha, Gaspar Moreira, Manoel de Figueiredo, etc.

Contemporary Portuguese and Spanish mayor pilots or officers of high rank always lamented a low technical level of pilots or mariners of their mother countries, however, *Manoerugonsaru* approved that knowledge and practice of a certain good level were maintained between them.

Short time after Gennakoukaiki was written, Japan chose the way to be isolated from distant countries, and unfortunately chance to utilize fully this Book was lost and consequently his ideas of improvement had no opportunity to receive comment as Kouun expected.

Note

[*1] "Teppou-ki": A book about the introduction of European harquebus to Japan written by a Buddhist priest Bunshi Nanbo who served Daimyo Tushima-shi of Satuma. This book says that harquebus was presented to Japanese as the first time by two nanbanjin (See Note[*7]) who were passengers of a Chinese junk which drifted to Tanegashima Island with some hundred Chinese passengers in August, 1543. Both of Antonio Galvão, the Governor of Moluccas and João Rodrigues, a Jesuit wrote that it happened in 1542 and there were three Portuguese.

[*2] Fernão Mendes Pinto,"Peregrinação" A printed edition by Adolfo Casais Monteiro,1983,Lisbon, p386 and thereafter.

[*3] "*misutuisu*" came from Portuguese word "mestiço" or Spanish word "mestizo".

[*4] Full copy of the Book in color is available by accessing to Kyoto University Digital Library, Rare Materials Exhibition. http://edb.kulib.kyoto-u.ac.jp

[*5] A.Fontoura da Costa, "A Marinharia dos Descobrimentos" 4ºed. Lisbon, 1983, 363p

[*6] idem,49p

[*7] "Nanban" means barbarian countries of the south. "Nanbanjin" means people of Nanban and was used to mention Portuguese and Spanish in principle, who were the first Europeans came to Japan. Dutch and English who came after Iberian people were called "Koumoujin", which means red hair man. So "Koumou" means Netherland and England in principle. "*Manoerugonsaru"* was quite possibly a Portuguese, because Kouun received his teaching in Portuguese language. However, not excluding possibility of a Spanish, we can guess that spelling of his name may be "Manuel Gonçal" or "Manuel Gonzal" As the Chinese letter used to pronounce "ru" of "Gonçal" has a pronunciation resemble to "ro", we cannot eliminate possibility of spelling of "Manuel Gonçalo" or "Manuel Gonzalo".

[*8] "Genna" is Japanese name of an era continued from 1615 to 1623 in European calendar. "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.

*9 "*Ruson*" is Luzon Island of Phillipines. To pronoun this "ru", the same Chinese letter as "ru" of "Gonçal" or "Gonçal" is applied.

*10 "*arutoura*" is also written as" *aruzuura*". This came from Portuguese "altura", i.e. "altitude" in English.

*11 "*garaho* " came from Portuguese "grau", i.e. English "degree", and Kouun translated it "dan" in Japanese, but in modern Japanese it is said "do". The word "minute" is said as "*minuuto*" phonetically transferred from Portuguese "minuto". In another sentence of the Book, 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, 3*shaku* 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 the Book and it is making a confusion. "*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 "sei" means "star", so "Dai Sei" means "Stand Star" and it is the star α 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 ".

*12 "*minuuto"* came from Portuguese "minuto", i.e. English "minute" and Kouun translated it "fun" in Japanese, which is also used in the present Japanese language.

*13 "*dekirinasan* (in other place described as "*dekirinari"*) came from Portuguese "declinação", i.e. English word "declination". Kouun used this word as if it were a table, saying "Yottsu no *dekirinasan",* or "Four declinations.

*14 "*rejimento"* came from Portuguese word "regimento", i.e. English "regiment" and was translated as "chuumon" in Japanese, but this "chuumon" has no meaning of "regiment" in modern Japanese, and I find no exact translation in modern Japanese also, I am using the word "*regimento*" without translation in this paper.

*15 With regards to "Genna "and "Jutu-Go", see Note*8. "Jutu-Go" is a year of sixty years cycle calendar as the year of "Hei-Sin".

*16 "Kikuchi in Higo" is actual Kikuchi City of Kumamoto Ken.

*17 Detail of life of the author of the Book, Ikeda Yoemon Nyuudou Kouun is not known. It is reported that he salvaged silvers from a sunken ship in Nagasaki Bay.

*18 Frazão de Vasconcelos "Pilotos das Navegações Portuguesas dos séculos XVI e XVII",1942, Lisbon; Sousa Viterbo "Trabalhos Náuticos dos Portugueses, séculos XVI e XVII", 1988, facsimile edition of 1898, Lisbon; Amélia Polónia "Mestres e Pilotos das Carreiras Ultramarinas (1596 – 1648),1995,Porto. I have never consulted directly with original documents in Iberian archives. However, in "Libros de Ementas" belonging to the Archivo Nacional da Torre do Tombo of Lisbon the name of "Manoel Gonçalves" was registered as the first pilot of the Portuguese pilot system, but the family name is different. Another case appears in "Actas de la Universidad de Mareantes". In the record of 4 August, 1593 of the meeting of the Seaman's Union of Seville, "Gonzalo Manuel" is mentioned as the owner of a Nau named "La Trinidad", even were his family and first name contrary, I think he might not have relation with Manoel (or Manuel) Gonzal (or Gonçal)of Gennakoukaiki for all circumstances.

*19 Rodrigo Çamorano, "Compendio del Arte de Navegar", 1588, Seville, possession of Biblioteca National de Lisboa,

*20 Moritune Uchiyama "Gennakoukaiki no *dekirinasan* ni tuite", or "About *dekirinasan* of Gennakoukaiki", in "Ronsou of Yokohama University", tomo.6, no.1, 1954, "Gennakoukaiki no sakujitu-hyou ni tuite", or "About the new moon days in declination table of Gennakoukaiki", in "Ronsou of Yokohama University", tomo.7, no.1, 1956, and "Gennakoukaiki no sakubouhyou ni tuite" or "About the lunar table of Gennakoukaiki", in "Ronsou of Yokohama University", tomo.10, no.114, Yokohama,1956.

*21 Itaru Imai, "Astronomy of Gennakoukaisho no tenmonngaku ",or "Astronomy of Gennakoukaisho", and '"Koden no zu of Gennakoukaisho" ,or "Old drawing of Gennakoukaisho" in "Tenkansho" ,tomo XIX, May 1956, and "Nanban Koumou Taiyou sekii hyou no kenkyuu", or "Studies on Solar Declination Tables of Nanban and Koumou", Kyoto,1966.

*22 Pedro Nunes, "Tratado da Sphera & Astronomici", OBRAS vol.I, Lisbon,1940, William Bourn, "A Regiment for the sea, 1612", Hakluyt Society, 1963, Lucas Waghenaer, "Sppiegel der Zeevaerdt, 1584", Lausanne,1964, Willem J. Blaeu, "The Light of Navigation, 1612", Amsterdam,1964

*23 I(J)oão Baptista Lavanha "Regimento Nautico", 1595, Lisbon, possession of Biblioteca Nacional de Lisboa, RES 576P

*24 Kazuo Urakawa, "Miscellanea; Gennakoukaiki", Quarterly Journal, in The Suiro (Hydrography)Vol.27,no.1 through no.4,Japan,1998。

*25 Yoshihiro Yamada, "The original version of the table of the Sun's declination appeared in Gennakoukaisho", Kaiji Shi Kenkyu no.62 ,2005, no.63 ,Tokyo, 2006.

*26 Antonina Saba, "El léxico del Compendio de la arte de navegar de Rodrigo Zamorano" ,UNED,2004,Madrid, p.XIII.

*27 "mainly Chuu,Go,Jutu" means that 12Shi which appear in fifteen years written bellow are mainly Chuu,Go and Jutu. "You" means that this year is a year of "You" of the Oriental In-You Thought, and these You year and In year come alternately.

*28 "*maruso*" came from Portuguese "março" and "*ekinusiaru"* came from Portuguese "equinocial". Portuguese word "signo", or in English "sign" is a word to indicate a zodiac, however Kouun translated it to "shuku" in Japanese which means costellation because there was no idea of zodia in Japan. But he might be taught idea of "sign" related to zodiac, and he said" *ariesu* no *siino*" in other place. "*siino*" came from Portuguese "signo". "*Ariesu*" is a zodiac "Aries". "*jiuniyo*" came from Portuguese "junho"、 or June. "*riineya"* came from Portuguese "linha", or line. "*zauna tenperaada*" is Portuguese "zona temperada", or temperate zone. With regard to "*garabu* ", see Note *11. I am translating "*kanseru*" to "insect", because Kouun uses an unclear Chinese letter which may mean some insect, but the word "*kanseru*" is a zodiac "Cancer".

*29 "*meugaubu*" came from Portuguese "meia grau", or half degree.

*30 Japanese distance units "ri","chou","tan","ken","shaku", etc. are indicated as notes. One shaku consists of ten sun, and one shaku corresponds to 10/33 of one metric meter.

*31 "*tomasooru*" came from Portuguese "toma sol".

*32 A.Fontoura da Costa "A Marinharia dos Descobrimentos",363p.

*33 João de Lisboa, "Livro de Marinharia, Tratado da Agulha de Marear" , 1903, edit. by Brito Rebello, Impresa de Libanio da Silva,Lisbon,

*34 "Livro de Marinharia de Gaspar Moreira",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

*35 " códice Bastião Lopes" (de autor anónimo),introdução de Luís de Albuquerque, Imprensa Nacional-Casa da Moeda,Portugal 1987.

*36 "Livro de Marinharia de Bernardo Fernandes; prefácio e notas por A.Fontura da Costa", 1940, Agència Geral das Colónias,Lisbon, 24p.

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

*38 Martín Cortes "Breve Compendio de la Sphera y de la Arte de Navegar 1551",fol.lxxxiiii,1945, Zaragoza, Spain

*39 Rodrigo Çamorano," Compendio del Arte de Navegar",1588,Sevilla、possession of Biblioteca National de Lisboa,35p.

*40 Andrés García de Céspedes, "Regimento de Navegación mando haser el Rei Nuestro Señor por Orden de sv Conseio Real de las Indias",1606, Madrid, possession of Biblioteca Nacional de Madrid, R.9047,49p.

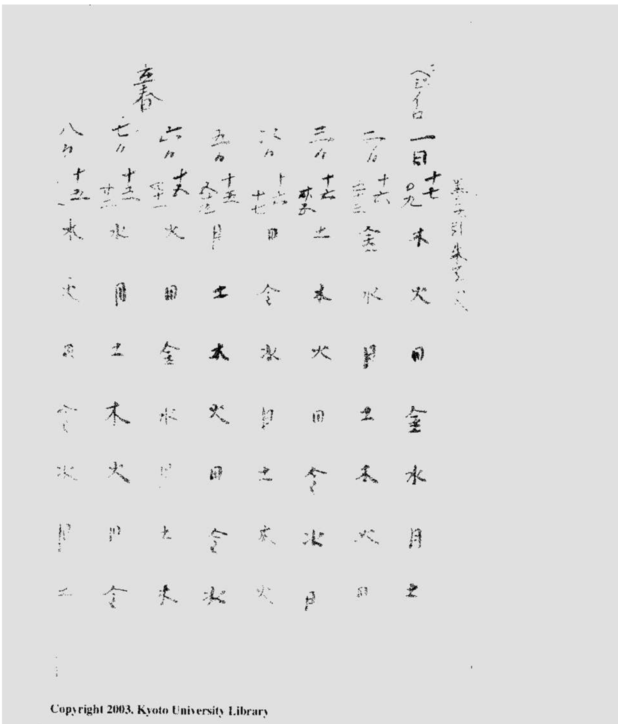
*41 Yoshiruo Iida "Nihon Koukai Jutu Shi", 1980, Harashobou, Japan.

*42 Manoel de Figueiredo, "Hydrographia, EXAME de Pilotos, no qual se contem as regras que todo Pilotos deue guardar em suas nauegações, asi no Sol, variação dagulha, como no cartear, com alguas regras da nauegação de Leste, Oeste, com mais o Aureo numero, Epactas, Marès, & altura da Estrella Pollar. Com os Roteiros de Portugal pera o Brasil, Rio da Plata, Guinè, Sam thomé, Angolla, E Indias de Portugal, E Castella",1614, possession of Biblioteca National de Lisboa

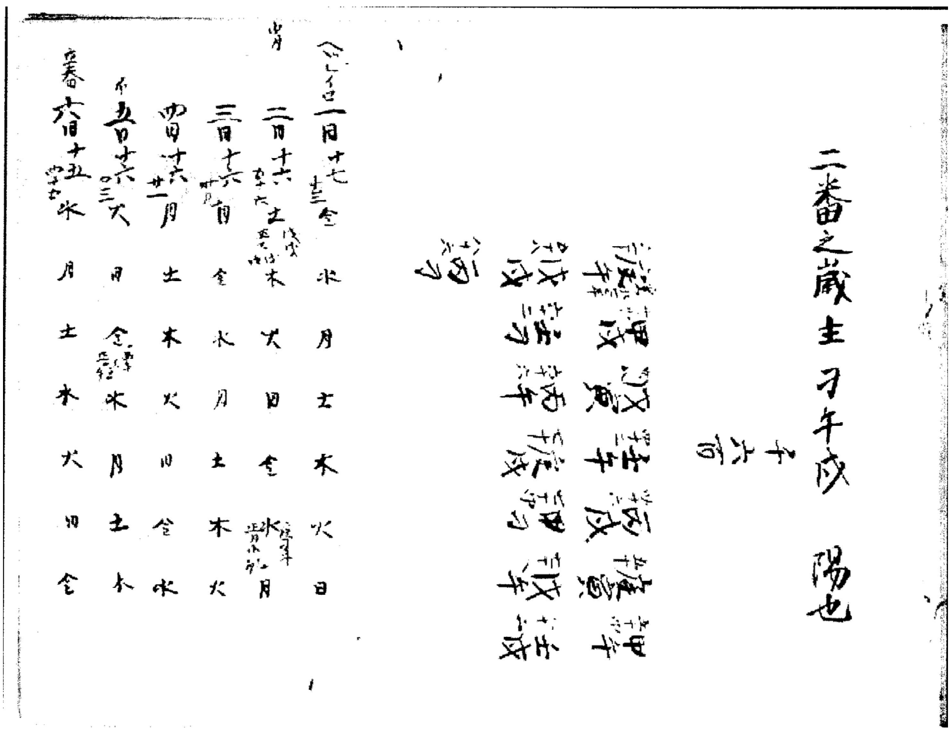
[43] Simão de Oliueira, “Arte de Navegar”,1605,Lisbon, possession of Biblioteca National de Lisboa,159p.

[44] Motoharu Fujita “Nissi koutuu no kenkyuu”, Fuzanbou,Tokyo,1938.

Annex 1 Solar declination table for four years



The beginning of the first year of the Table



The beginning of the second year of the Table

Annex 2 "Compendio de la Arte de Navegar" ,1588 by Rodorigo Çamorano

COMPENDIO

DEL ARTE DE NAVEGAR,

del Licenciado Rodrigo Çamorano,

Cofmografo y Piloto mayor

de fu Mageftad.

CATEDRATICO DE

Cofmografia en la cafa dela Contratacion

de las Indias.

***

CON PRIVILEGIO.

IMPRESSO EN SEVILLA

en cafa de Ioan de Leon.

Año,

1588.

Cover

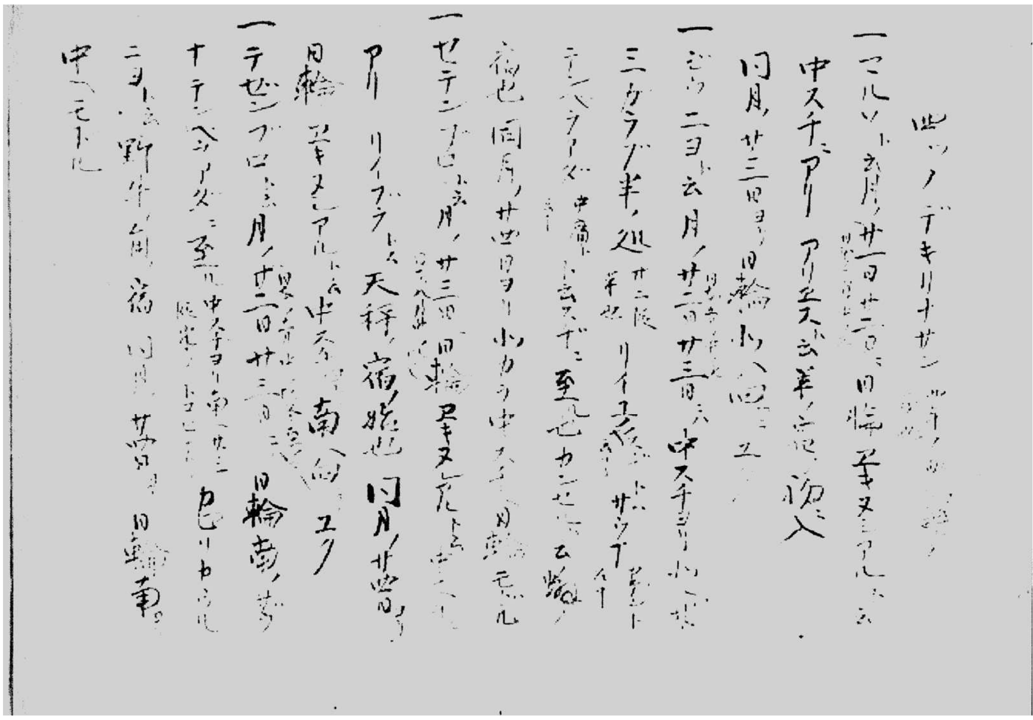
ANNO PRIMERO. 18

Enero.			Febrero.			Marҫo.		
Declinacion.			Declinacion.			Declinacion.		
Dias	Gra.	Min.	Dias	Gra.	Min.	Dias	Gra.	Min
1	23	1	1	17	9	1	7	40
2	22	56	2	16	52	2	7	17
3	22	51	3	16	35	3	6	54
4	22	45	4	16	17	4	6	31
5	22	38	5	15	59	5	6	8
6	22	31	6	15	41	6	5	45
7	22	24	7	15	22	7	5	22
8	22	16	8	15	3	8	4	59
9	22	8	9	14	44	9	4	36
10	22	0	10	14	25	10	4	13
11	21	51	11	14	5	11	3	50
12	21	41	12	13	45	12	3	27
13	21	31	13	13	25	13	3	4
14	21	20	14	13	5	14	2	40
15	21	9	15	12	45	15	2	16
16	20	58	16	12	24	16	1	52
17	20	47	17	12	3	17	1	28
18	20	35	18	11	42	18	1	4
19	20	23	19	11	21	19	0	40
20	20	10	20	11	0	20	0	16
21	19	57	21	10	39	21	0	8
22	19	43	22	10	17	22	0	32
23	19	29	23	9	55	23	0	56
24	19	15	24	9	33	24	1	20
25	19	0	25	9	11	25	1	44
26	18	45	26	8	49	26	2	7
27	18	30	27	8	26	27	2	30
28	18	15	28	8	3	28	2	53
29	17	59				29	3	16
30	17	43				30	3	39
31	17	26				31	4	2

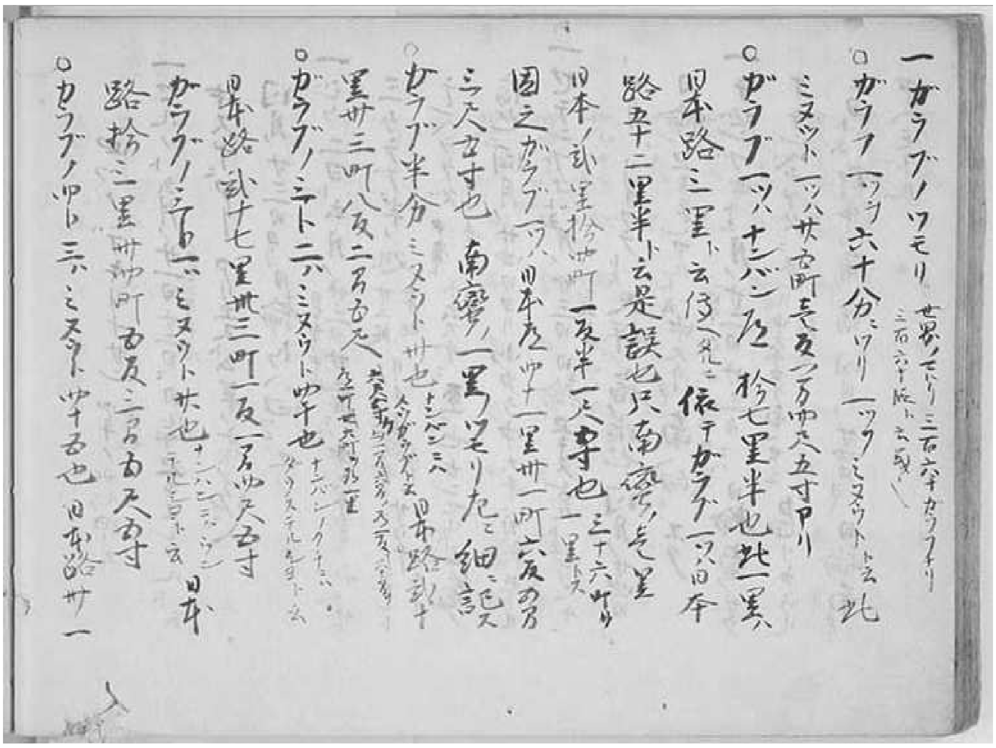
F

The first year of solar declination table

Annex 3 *Yottu no dekirinasan* (Four declinations)

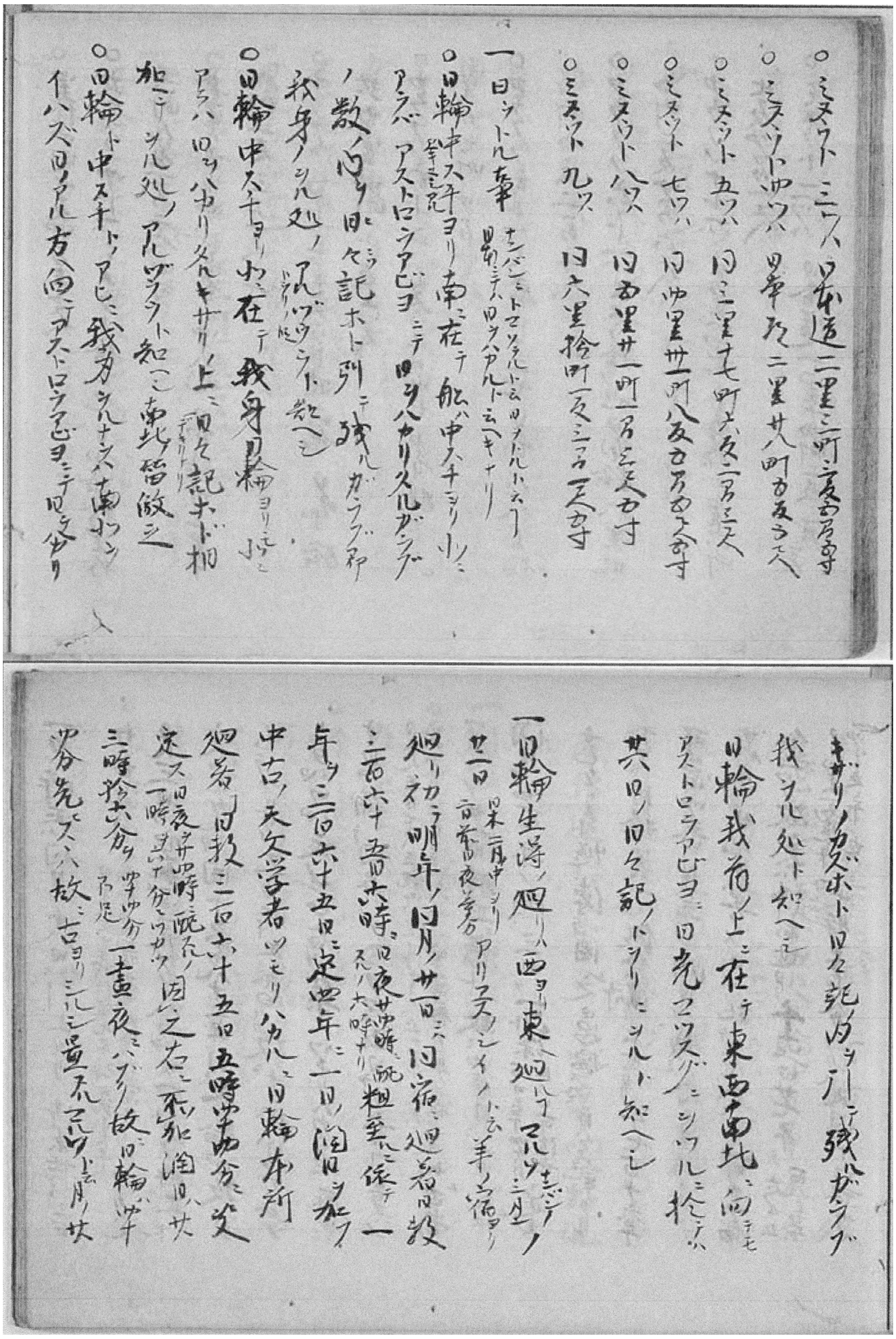


Yottu no dekirinasan Annual movement of the Sun



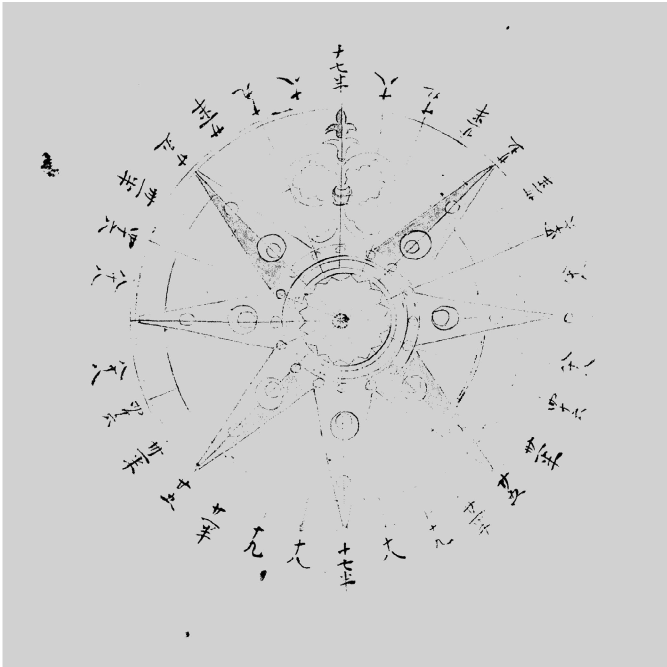
Yottu no dekirinasan Conversion from degree and minute to distance on the Earth

Annex　4　"tomasooru" (Toma sol) and
"Nichirin shoutoku no mawari" (Natural revolution of the Sun)

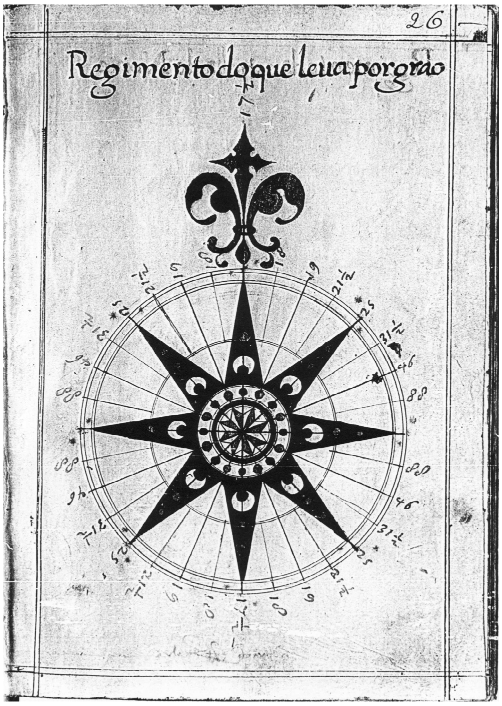


above:"tomasooru"（Toma　Sol）　　below:"Nichirin　shoutoku　no　mawari"
(Natural revolution of the Sun)

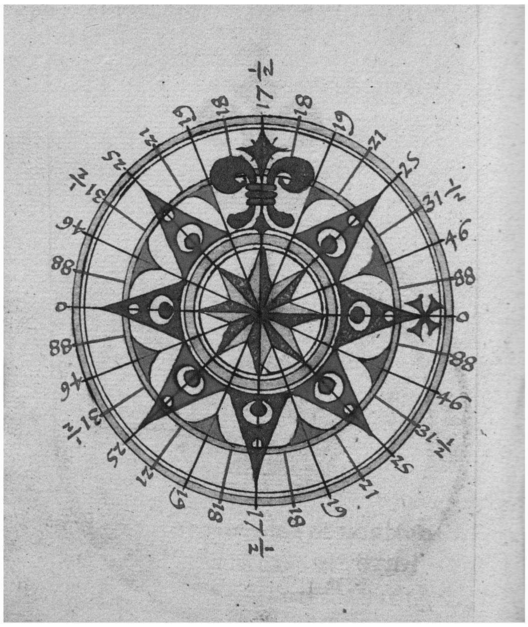
<u>Annex　5　Regimento de Légua</u>



“Tate naname yoko ni yotte miti no nori wo hakaru koto” of Gennakoukaiki



“Regimento do que leva por grão”
of Gaspar Moreira



“Regimento de Légua”
of Bastião Lopes

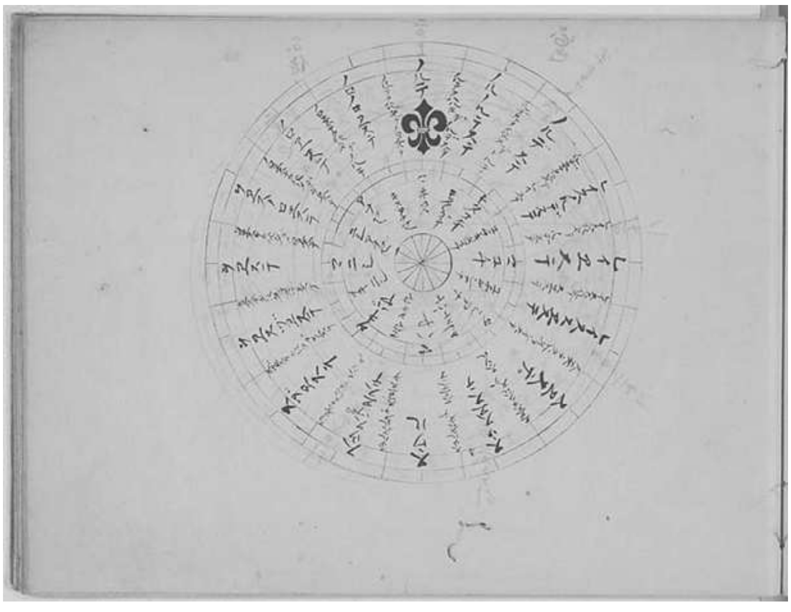
Annex 6 Compass rose with thirty-two directions

In the page 106 a compass rose with thirty-two directions is drawn. I am going to transfer thirty-two directions written by Japanese letters phonetically copied from Portuguese outside of the circle and main sixteen directions by Japanese language inside of the circle.

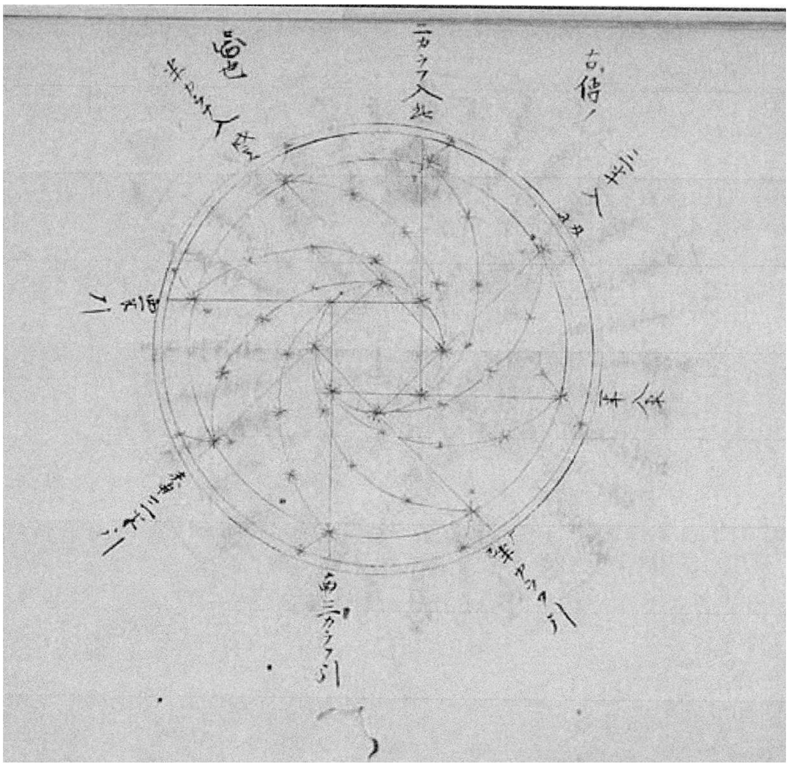
Gennakoukaiki: Phonetically Transferred from Portuguese	Portuguese (1712) Manoel Pimentel"Arte de Navegar & Roteiro"	Gennakoukaiki: Japanese Language
Norute	Norte	Makita
Norute kuwaruta de norudesute	Norte quarta a nordeste	
Norunorutesute	Nornordeste	Kitakitagochi
Nordesute kuwaruta de norute	Nordeste quarta a norte	
Norudesute	Nordeste	Kitakochi
Norudesute kuwaruta de reisute	Nordeste quarta a leste	
Reisunorudesute	Les nordeste	Kochikitakochi
Reisu kuwaruta te norudesute	Les quarta a nordeste	
Reisute	Leste	Makochi
Reisu kuwaruta de suesute	Leste quarta a sueste	
Reisusuesute	Lessueste	Kochiosiana
Suesute kuwaruta de reisute	Sueste quarta a leste	
Suesute	Sueste	Osiana
Suesute kuwaruta de suuru	Sueste quarta a sul	
Suusuesute	Susueste	Osianabaya
Suuru kuwaruta de suesute	Sul quarta a sueste	
Suuru	Sul	Mahaya
Suuru kuwaruta de suzuesute	Sul quarta a sudoeste	
Suusuzuesute	Susudoeste	Mahayaokibaya

Suzuesute kuwaruta de oesute (**)	Sudoeste quarta a sul	
Suzuesute	Sudoeste	Okibaya
Suzuesute kuwaruta de oesute	Sudoeste quarta a oeste	
Oesuzuesute	Oesudoeste	Okinishi
Oesute kuwaruta de suzuesute	Oeste quarta a sudoeste	
Oesute	Oeste	Manishi
Oesute kuwaruta de noroesute	Oeste quarta a noroeste	
Oesunoroesute	Oesnoroeste	Nishianaze
Noroeste kuwaruta de Oesute	Noroeste quarta a oeste	
Noroesute	Noroeste	Anase
Noroesute kuwaruta de norute	Noreste quarta a norte	
Noronoroesute	Nornoroeste	Kitaanase
Noroesute kuwaruta de noroeste	Norte quarta a noroeste	

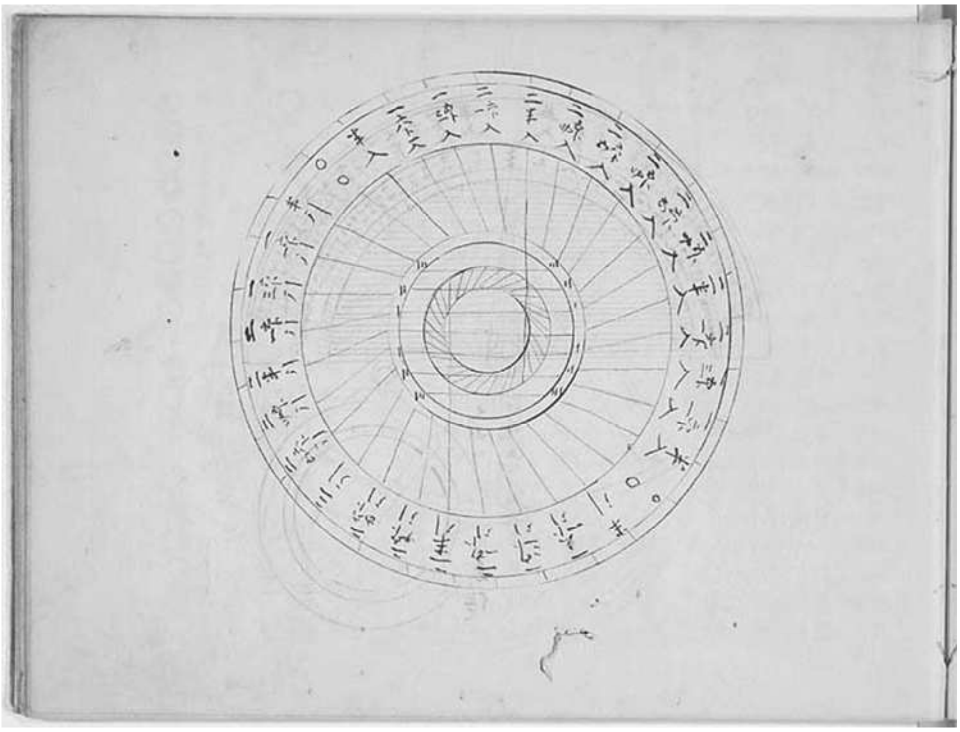
** "oesute" must be "suuru" and this may be an error. Except this, other all words are correctly listened. After words "quarta" always come "a" in place of correct "de". This seems a habit of *Manuerugonzaro*.



Annex　7　“Koden no zu” or “Drawing comes from old time”



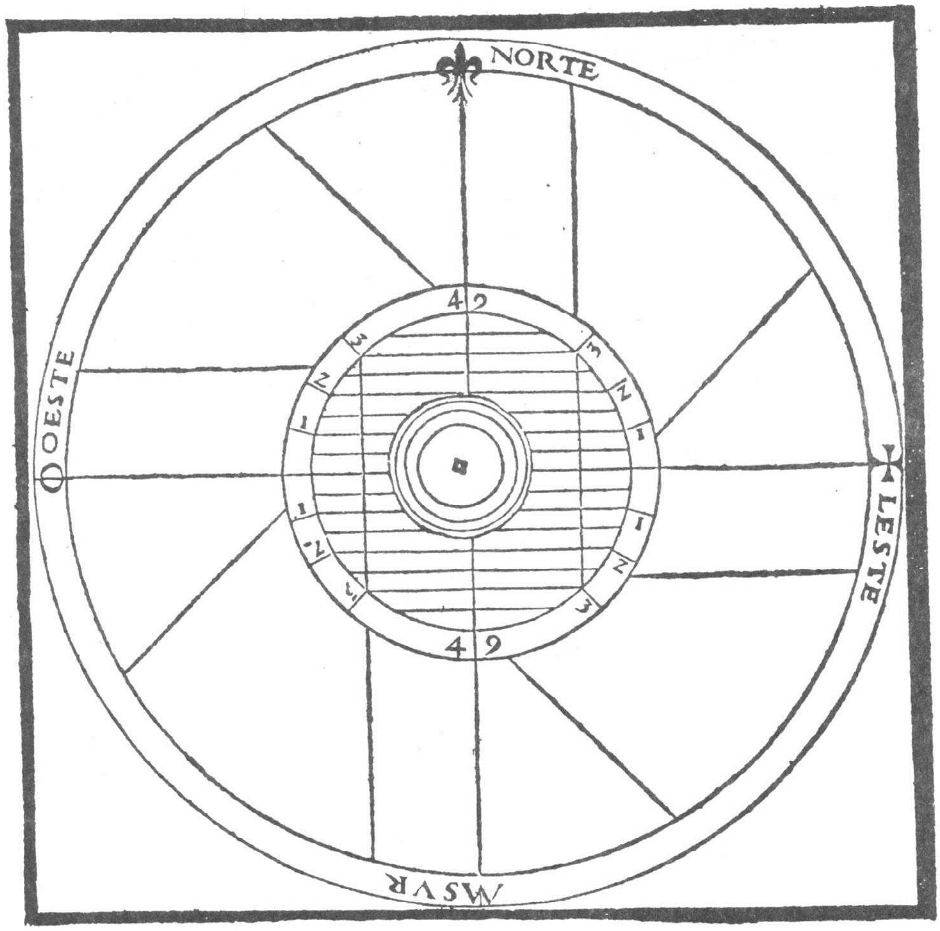
“Koden no zu”　It is written that “2 *garufu* iri”, or “Add 2 degrees” at north, however, “Add 3 degrees” must be correct. Perhaps” ―” of Japanese letter 3 goes outside.



Improvement idea by Kouun

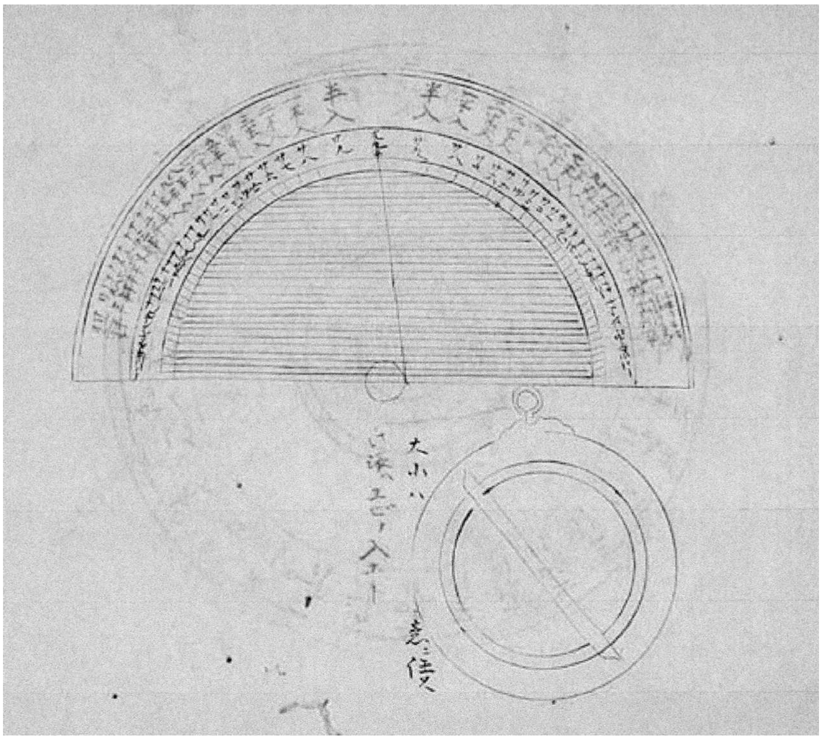
Annex 8 "Regimento de Norte"

in "Compendio de la Sphera y de la Arte de Navegar"of Martín Cortes (1618)

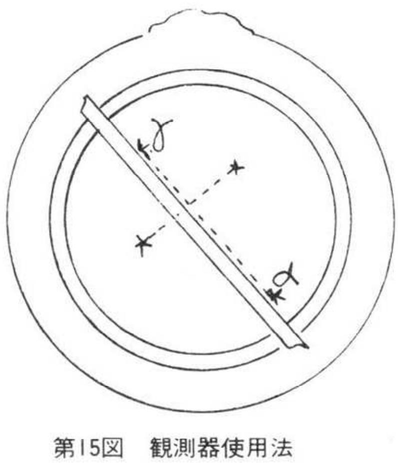


Annex 9　Drawing of an instrument for the Regimento de Cruzeiro Designed by Kouun

Instrument proposed by Kouun



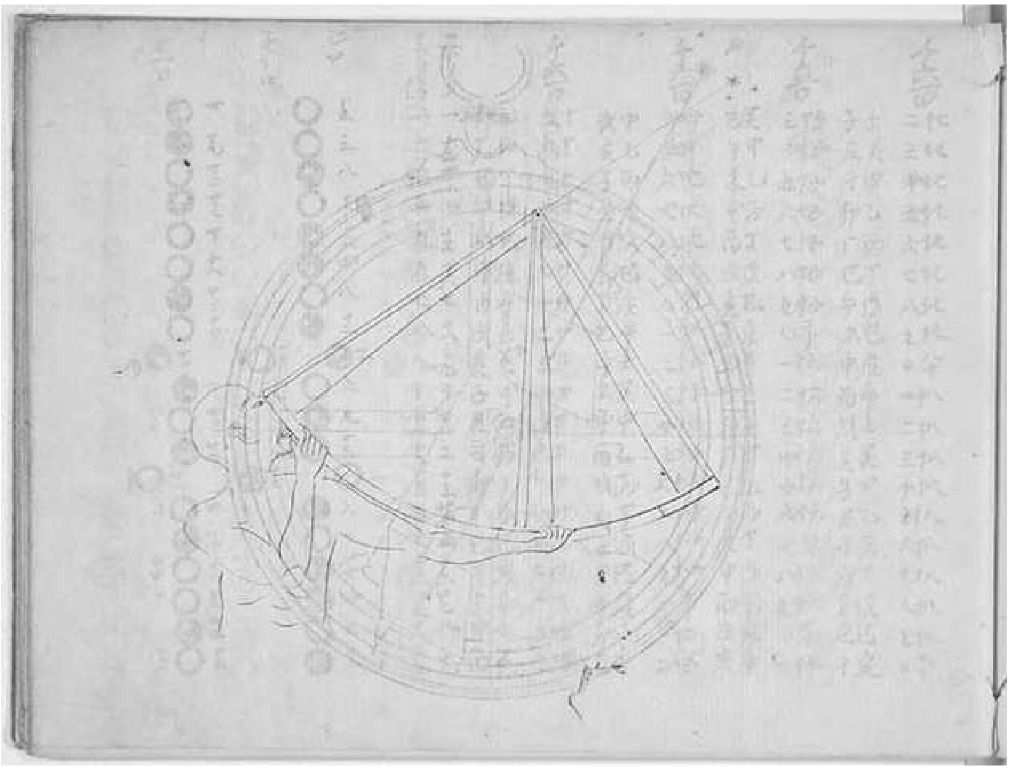
Idea of Yoshirou Iida how to use the insrument for the Regimento do Cruzeiro proposed by Kouun



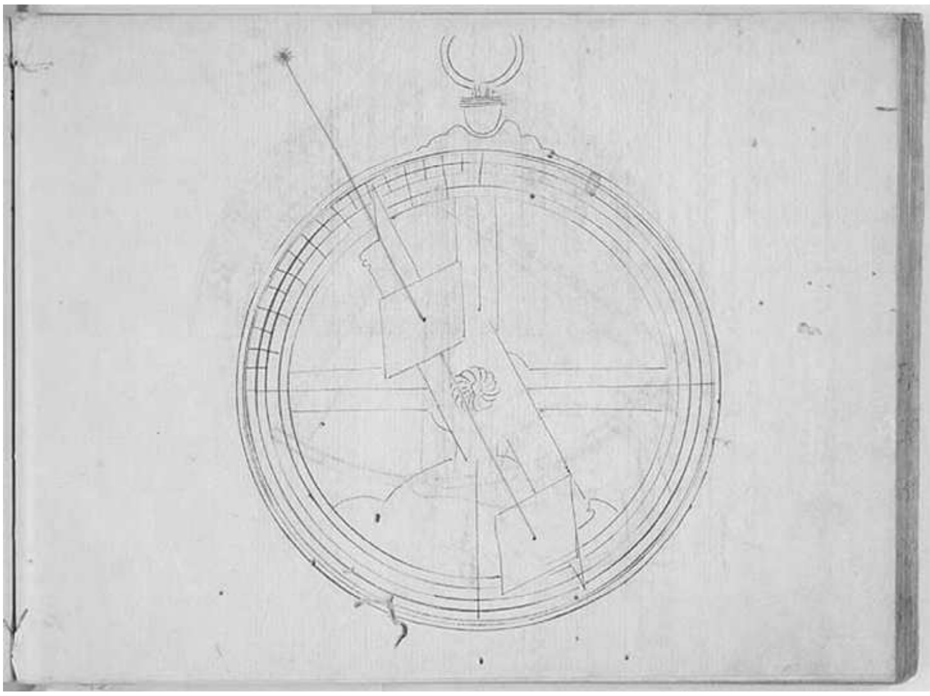
第15図　観測器使用法

Annex 10 Drawings of a quadrant and astrolabe

A man is putting the Regimento do Norte in practice by a large quadrant.



Astrolabe



Annex 11 Table of days of the full moon and the new moon

Beginning part of the table including January