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Nanhai, a Chinese territory boundary as surveyed by the “Four Seas Sun-shadow-lengths Survey” of the Yuan dynasty period
《元代‘四海測驗’中的中國疆宇之南海》

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Translated by Wang Guan Yio

Ever since 1276 the year the Mongols captured Hanzhou, the capital of South Song Dynasty, the die of unifying entire China by the Mongolian Yuan dynasty was thrown. The Mongolian imperial court was then determined to reform the existing Song calendar by setting up the Astronomical Bureau, which later became the Astronomical Academy. In making a calendar, on-the-spot survey is of primary importance. It must carry out observations and sundial readings at various places from the North to the South of the whole country to collect data so that the calendar system reform can have real help and solid ground. In the spring of 1279, Zhao Bing (趙昺), the emperor of Southern Song Dynasty, was “defeated and fled to Yai Shan (崖山)”(1). After receiving the news, Kublai Khan, the First Emperor of the Yuan Dynasty, sent Guo Shoujing (郭守敬) to Nanhai(南海) to survey the sundial’s noon shadow lengths”(2). And the other observatory officials were also separately sent out to their sundry observation destinations(3). As Nanhai (南海) was the starting point of the “Four Seas Survey” in this distant observation, and it was also the location of Yuan China’s territory boundary lying at the prime meridian centered at Dado (大都, now Beijing)(4), Khublai Khan ordered Guo Shoujing to go to Nanhai personally and to conduct the sundial survey. Even though the mission was difficult and the time pressing, Guo Shoujing succeeded in executing the task. Later on, he also undertook to compile the data of the sundial readings of the survey forwarded from the various observatory spots, finally completed the calendar reformation in midwinter of 1280, and designated the new calendar system, “Shou-shi Li” (《授時曆》[or the Time Service Calendar, using 365.2425days/year in calculating the calendar year—by *Translator]*, which was promulgated nationwide in the next year.

The Nanhai Guo Shoujing had arrived is in fact lying at the eastern part of the South Sea, covering today Maroona Island or Scarborough Shoal, 117°45’ E, 15°08’N, as well as the sea surface thereof. But for the conservative faction in the Astronomical Bureau, in their minds, Nanhai remained somewhere “further south than Zhu Yai (朱崖, Vermilion Cliff i.e. 海南島 Hainan Island)”, about as south as 15°N. Here it means the western Nanhai, then off Luo Shan(羅山) of Champa, at the longitude of 109°07’E and the latitude of 15°22’N, and its sea surface. China used to refer to this location as the sea of demarcation

and as ‘South Sea’, [as the name in Chinese, 南海, implies—by *Translator*], to separate the territories between China and foreign countries. Such was the long-standing practice ever since Song-Yuan dynasties to Ming-Ching dynasties(5).

This article is to clarify that as Yuan China’s territory boundary, Nanhai is verified by on-the-spot survey as the Yellow Rock Island (黃岩島, or Scarborough Shoal), the eastern part of Zhong Sha Isles (中沙群島, or Macclesfield Bank), at the longitude of 117°45’E and the latitude of 15°08’ N, and its western part lies at the sea of demarcation bordering with the extension of Luo Shan(109°07’E 15°22’N). It was here that the so-called Nanhai “further south than Vermilion Cliff or Hainan Island” was referred to. As China national territory boundary, Nanhai, both its starting and ending points at its eastern and western parts are using the Yellow Rock Island and off Luo Shan nearby sea surface as the sea of demarcation for national boundary. Ever since the Yuan nationwide “Four Seas Survey” carried out in the Yuan Dynasty, this national boundary of Nanhai had been consistently followed throughout Ming and Qing dynasties.

I. The “Four Seas Survey” Carried out in the Yuan Dynasty All Over China’s Territory

In November 1271, Kublai Khan founded the Great Yuan Empire, and renamed Zhongdu(中都,or Central Capital) as Dadu (大都, or Great Capital, now Beijing)(6). Before his death in 1274, Liu Bing-zhong (劉秉忠) had proposed to the Court to reform the Da Ming Calendar (《大明曆》)(7). In 1276, the Yuan troops captured Hangzhou (杭州), the capital of the Southern Song dynasty. As a result, the prospects of unifying the whole of China emerged before Kublai Khan at this moment. “Southern China was now pacified, the Emperor thought of accepting Liu’s advice” to reform the Da Ming Calendar. Then in the same year of 1276, the Yuan Court set up the Astronomical Bureau to reform a new calendar”(8). In 1278, “the Astronomical Office was founded with a director of rank 3 (official ranking) in charge of the astronomical and the calendar affairs”. “The Astronomical Bureau was manned by the Director and other officers each post a person.”(9) From founding the Astronomical Bureau to changing it into the Astronomical Academy, Zhang Wen-qian (張文謙) the central officer of the Tribunal of Censors, and Zhang Yi (張易), the Privy Councilor of the Privy Council, the highest military command organ of the state had always led in submitting their reports. Xu Heng (許衡 a great neo-Confucianist, 1209-81), the deputy Prime Minister, participated in the affairs”. And Guo Shoujing and Wang Xun(王恂)separately led the local officers of the Astronomical Bureau to carry out the survey gradually down south from the north to the south of the country”.(10) Wang Xun argued that Calendar specialists such as Guo Shoujing knew only numerals and calculations in calendars and not the theory, and thus Xu Heng should lead the project instead. As Xu Heng was the Grand Academician of the Academy of Scholarly Worthies as well as the Chancellor of the National University, he was made the head of the Astronomical Bureau”(11).

But in the process of reforming the calendar, there emerged a scenario where Wang Xun became the chief of calendar calculations, Guo Shoujing, the inference maker, the Minister of Instruction (Xu Heng) to have clarified the theory of the Calendar"(12). Often, those who were doing the practical work like Guo Shoujing and his colleagues were faulted and criticized adversely by Xu Heng and his like, who knew only the so-called theory and Confucian interpretations in calendar making. Guo Shoujing emphasized, for example, summer solstice survey whereas Xu Heng advocated the importance of winter solstice survey(13). Ever since the establishment of the Astronomical Bureau in 1276, most surveys were mainly winter solstice surveys(14). As Xu Heng headed the Bureau, all others in the bureau must obey him. Of course, winter solstice survey was fine too. But in the process of practical survey the day in the winter solstice was the shortest, which could have hampered the practical survey work. What's perhaps most pedagogic was the use of the archaic place names for the locations surveyed. Instead of using the contemporary ones, they had deliberately used the antique place names, such as Tiehle (鐵勒), and also those strange and misleading place names like Heng Mountain(衡嶽) and Yue Tai(嶽台).

More importantly, Guo Shoujing advocated that in the practical survey " during the solar and lunar eclipses, it must find out at various surveyed locations the difference in fractions and in hourly time, the difference in the lengths of day and night, and the difference in the altitudes of the sun and moon and stars above the horizon."(15) In a word, the Four Seas survey work must collect the data of the above three different items at all on-the-spot surveyed locations. However, in the "Four Seas Survey Work", Xu Heng and his like stressed only on deriving the data of North Pole's altitude above the horizon, leaving the other two items all unattended to. Thus in 1280, there were two kinds of the data results derived from the "Four Seas Survey". The first kind was the survey locations in priority for the seven pre-chosen spots, i.e. including the six locations from Nanhai (南海) to Beihai(北海, or as the name in Chinese implied, 'the Sea in the Northern part of China'—by *Translator*), and Dadu(Beijing). The results thus derived from the surveyed spots were consisted of three items of data, i.e. the difference in North Pole's altitude above the horizon, the difference in summer solstice sun shadow lengths on the sundial, and the time difference in the lengths of day and night on the summer solstice.

The second was that "subsequently, the Bureau had also surveyed twenty spots from Shangdu or Upper Capital (上都, today *Doulun* in Inner Mongolia) to Qiongzhou (瓊州, now Hainan), with only the data of difference in North Pole's altitude above the horizon, leaving out all the other two items of data. In total, the Four Seas Solstice Surveyed locations across the country were 27 altogether if the two categories were combined. " The surveyed areas covered as farthest east as Korea(高麗), the farthest west as Dian Chi (滇池 today Lake Dian in Yunnan), the farthest south beyond Zu Yai(today Hainan, or Vermillion Cliff), and as farthest north as Tiehle(鐵勒). Such huge scale of survey work was entirely unprecedented and even surpassing any predecessors in the past"(16). Here Xu Heng and his like were having their

noses in the air. Yet they avoided mentioning why they did not observe Kublai Khan's approval of Guo Shoujing's original suggestion to collect the three items of data in carrying out the survey work at distant places. If indeed following Guo Shoujing's original suggestion, "even if we have too few people to do the survey work, we can still set up sun dials from the north to the south of the whole country first and take the sun shadow measurements at various locations along the [celestial] vertical circle from the sky and intercepting the [celestial] ecliptic at right angle."(17). Translation: drawing a vertical circle from the sky and intercepting the [celestial] ecliptic at right angle on the very day of summer solstice, and then choose six spots along this celestial vertical circle in succession from north to south to build gnomes or sundials for measuring sun shadow lengths. As a result, picking six observatory spots — six survey locations from Nanhai to Beihai — were already good enough to represent the rest. And this was exactly what Guo Shoujing had done by personally went to Nanhai this far to conduct the survey in setting up a distant sundial and taking sun shadow length measurements (18).

II THE LONGITUDE AND THE LATITUDE OF NANHAI AND THE CALCULATION OF LONGITUDE AND LATITUDE

On the summer solstice day, daytime is the longest in the northern hemisphere. The sun is just at the Tropic of Cancer (23°27'N) in the sky. If on this day of the summer solstice, drawing a [celestial] vertical circle to intercept the [celestial] ecliptic at right angle, or intersect the [celestial] Equator at an angle of 66°33", and along this intersection circle at different latitudes or at a difference of 10° in succession on the [celestial] vertical circle to determine a few selected places from the north to the south of the whole country for sun shadow lengths survey, six selected places for the distant survey from the south to the north of China in the Yuan dynasty period could be determined. First, select the contemporary Yuan Nanhai of 15 degrees N in latitude or where the Polaris is 15 degrees above the horizon. Then determine each individual place to survey above Nanhai 10 degrees in succession gradually up North of the [celestial] vertical circle of interception. The [celestial] vertical circle with the surveyed places on it would be extending up to Beihai , which is 65°N in latitude or where the Polaris' altitude is 65° above the horizon. Indeed, how to determine the various selected places for survey along the [celestial] vertical circle of intersection with the [celestial] Equator at an angle of 66°33' on summer solstice day(19) was no easy task in light of the conditions during then. But because of the globe that was already introduced to China, it could help determine the [celestial] vertical circle intercepting the [celestial] ecliptic at right angle. Utilizing sundial to measure sun shadow lengths on the summer solstice to find out the Polaris' altitude above the horizon was not any of Guo Shoujing's new contributions. Indeed, thousands of years before him, the Chinese had already done just that (20).

However, the sundial he used was five times as large as those before. The eight Chinese feet long sundial was enlarged to 40 Chinese feet long [(*ci* 尺, length unit, 1 *ci* = 1/3meter), from 8 *ci* to 4 *zang* (丈, length unit, 1 *zang* = 3 1/3 meter), i.e. 5 times 8=40 ci—by *Translator*] , as a result of which the error margins were reduced by 1/5 (21). He also used "*Jing fu* " ["景符", a shadow

definer as a more precise instrument devised to supplement existing sundial—by *Translator*] to measure the center of the sun — unlike in the past the sundial could only measure the edges of the sun (22). In this way, with a larger scale of sundial and a more accurate shadow definer, the accuracy in measuring the sun shadow lengths had increased remarkably (23). Still, the most remarkable Guo Shoujing's contribution of all times is his use of the time differences between various places along the vertical circle intercepting the equator at 66°33' to find out their corresponding differences — the difference in '*li*"(里, a unit in Chinese mile, 1 *li* =1/2kilometer, i.e. the difference in Chinese mileage)(24)(or equivalent to today's longitude)(25). To find out the difference in longitude between two places called *li cha* (里差) in Chinese then by observing the time difference between various places in sunrise and noon on the summer solstice day along the same 'Meridian' circumference [i.e. that Meridian of the earth's projected on the celestial sphere— by *Translator*] was indeed Guo Shoujing's most amazing accomplishment.

In the following, we'll take the results of Guo Shoujing's personally supervised and participated Nanhai's sun shadow lengths measurement and convert them into today's longitude and latitude denotation. From here we can see the high degree of accuracy in sun shadow lengths measurement taken from the gnomes built by the Yuan Court at various distant locations. The error margins with the longitudes taken were only within 1° to 2 or 3 degrees at the most. And those with the latitudes were mostly less than 1°. In comparison with 500 years later the nationwide longitude and latitude survey with the participation of Westerners conducted by the Qing Court resulting in more or less one degree of error margin in the longitude, Guo Shoujing's Four Seas Survey was no less a great achievement if not any the greater.

In the Yuan "Four Seas Survey Work", seven pre-selected locations were surveyed first. Three items of data were taken down from each of the surveyed locations: i.e. the Polaris' altitude above the horizon; the sun shadow lengths on the sundial on the summer solstice; the lengths of the summer solstice day and night. From all of these data collected, we can work out by some calculation equivalent to what their longitude and latitude denotations are today. The tables as follows could serve as a reference to find out where the surveyed locations are by the equivalents of today's longitude and latitude denotation.

(1) The Calculation of the Longitude

As regards the longitude, long before Guo Shuojing this problem had already been solved as early as at the times of Yelu Chucai (耶律楚材). In 1221, Chang-cun Zen-ren (長春真人, or the Master of Eternal Spring), the Master in Taoism, carried out a sun eclipse and sun shadow lengths survey along the Mongolia's ancient Kerulen River (古克魯倫河) on the summer solstice day(26). The time differences in the sun or moon eclipse between places in different longitudes was also called 'difference in *li,* or Chinese mileage '("里差", 1 *li* = 1/2 kilometer)(27). In addition, the globe (28) introduced by Arabians into China had also enriched the Chinese knowledge in longitude between the

eastern and the western hemisphere (29). In the “Four Seas Sundial Survey” conducted by Guo Shoujing, he demanded to pay special attention to 3 kinds of important differences. One was that, during the survey every official was required to pay attention to “the fact that there were minutely or hourly time differences when the sun and moon eclipses were observed at various surveyed locations.”

Here is why. By making use of the time differences, earlier or later in the sun and the moon eclipses at various surveyed locations, the difference in longitudes of the various surveyed locations could be inferred. However, sun eclipses are normally limited to certain dates and visible only to certain parts of the earth. Under the conditions and the standard of astronomy in the Yuan China, it was quite difficult to predict when and where it will occur in advance. But moon eclipses are much more easier to be sighted from the earth, for it occurred 29 times in about each Saros (沙羅週期, 18 years 11months per cycle)(30), averaging more than one time of lunar eclipse every year. Thereafter China frequently used lunar eclipses to find out the longitudinal location of a place. According to Ruan Yuan(阮元 1764-1849, a scholar official in the Qing dynasty period—by *Translator*) edited works: *Guangdong Tongzhi* [《廣東通志》, or the General Local History of Guangdong province] and *Local History of Hainan Province*《瓊州府誌》), saying, “ to ascertain the degree of inclination towards the east or the west (today longitude) of a place, we must survey the same lunar eclipse from two places at the same time and compare their different timings of the lunar eclipse. If it occurred earlier by 2/60 of a *si-cen*[時辰, Chinese time system: instead of 24 hours/day, the Chinese in the past made use of the system of 12*si-ceng*/day in time divisions— by *Translator*], then the place was one degree inclined to the west. If it took place 2/60 of a *si-cen* later, then the place was one degree inclined to the east.”(31). In other words, the total longitude from the east to the west is 360°. It follows that every 4 minutes of an hour of the 24hr/day time division in the moon eclipse time difference between two places [i.e.2/60 x (2hrs.x 60min.)= 4min. of an hour, by the 24hr./day time division — by *Translator*] indicates one degree of difference in longitude between them [which goes in precisely what had been practicing in the West, in taking 4min. of an hour by the 24hr./day time division to a degree in longitude by definition — by *Tanslator*]. As for measuring the altitude of the Polaris (北晨星) above the horizon with the Chinese Sky Measuring Ruler (量天尺, quite like the Quadrant used in the marine navigation—by *Translator*)(32), provided it was not a dim night, it was possible to get the Polaris’ angular altitude above the horizon at the location anytime and anywhere. And then convert it into latitude denotation. On the other hand, it is not all that convenient, however, to use moon eclipses to survey the east and west distances of the location in longitude because this was clearly restricted by the frequency of moon eclipse occurrence (once or twice the most) each year. The popular saying recorded by Ruan Yuan says: “the *jingdu* (經度 or Chinese ‘longitude’) from the north to the south (meaning today’s latitudes—by Dr. Han Zheng Hua) are easy to survey but the *weidu* (緯度, or the Chinese ‘latitude’) from the east to the west (meaning today’s longitude—by Dr. Han Zheng Hua) are difficult to know for certain” (33), which was exactly saying how difficult it was to survey the

longitude of a place. The surviving records of the data taken by the 27 surveyed locations in the “Four Seas Survey Work” in *The Yuan History* (《元史》) leave no data of the sun and the moon eclipses at all for calculating their longitudes. It is comprehensible that *The Yuan History* has no sun eclipse data, as there was hardly a sun eclipse occurred during the Yuan’s rule. But the reason why the data of the moon eclipses for calculating longitude were nowhere to be found there is that although Guo Shoujing himself had attended to this task, those officers undertaking the survey did not resolutely support him and carry out the task conscientiously. Thus, the moon eclipse data for calculating various locations’ longitudes collected in the “Four Seas Survey Work ” weren’t preserved. Still, as Guo Shoujing himself having had attached great importance to surveying the different sunrise and sunset timings at various pre-selected locations on the summer solstice day during the Four Seas Survey, the *li cha*(“里差”, difference in Chinese mileage) in terms of minutes or hours between two places can thus be derived still by comparing the different sunrise and noon timings between two places, and converting them into today’s equivalent longitude in terms of degrees. Today, we can use several data with reference to the summer solstice longer day and shorter night preserved in the Yuan “Four Seas Survey” to find out the relatively accurate longitudes of Nanhai and other places — all this is certainly inseparable from Guo Shoujing’s great contributions and achievements in Astronomy and Geography.

As we all know, the rotation of our earth on its axis has brought us day and night and its revolution around the sun has brought us the four seasons. However, the rotation of our earth on its axis is not perpendicular to its revolution, but makes an angle of 66°33’ with the orbit of the revolution. In this way, the relative position of the sun to the earth is also varying continuously in the year: in summer, the sun reaches the Northern Hemisphere, and on the day of summer solstice at the Tropic of Cancer, i.e. 23°27’N. In winter, the reverse is observed, on the winter solstice day, the sun is at the Tropic of Capricorn, 23°27’S, and Spring and Autumnal equinoxes just above the Equator. If on the day of the Summer Solstice, six locations were selected for survey along the [celestial] vertical circle intersecting the [celestial] Equator at an angle of 66°33’. Each location is at a distance of the Polaris’ altitude 10° above the horizon in succession (i.e. each differs with the other 9.8562° in succession along the [celestial] vertical circle)(34). Since these six surveyed locations lie at the same ‘meridian’ circumference [i.e. that meridian of the earth’s projected on the celestial sphere. It is noteworthy here that at the dawn of astronomy in China, the Chinese had already propounded the hypothesis of the celestial sphere with the earth as its center. Gradually, the 3 co-ordinate systems, namely, the Horizontal Co-ordinate System, the Equatorial Co-ordinate System and the Ecliptic Co-ordinate System, were developed. — by *Translator*], the sun rises at the same time in all these six places. But then, as the rotation of the earth has drifted them all into the center of the [celestial] vertical circle or the projected ‘meridian’ on the celestial sphere [i.e. the earth—by *Translator*], the time elapses then will be different, either slower or faster, longer or shorter. As a result, the higher the northern latitude of the location, the longer or later the summer solstice day is there, and conversely, the lower the northern latitude, the shorter and earlier

the summer solstice day. Now that the different lengths of the summer solstice day in the six locations from Nanhai to Beihai [北海, the Sea in the Northern China then, today Gora Narodnaya Peak at 1,984 m. of Russia's Ural Mountains, it was called the People's Peak in the Soviet era then—by *Translator*] were recorded in the "Four Seas sun-shadow-lengths Survey", dividing them into half, we get the sunrise to noon timings of all the six surveyed places on the same projected 'meridian' circumference. And then, we can get the longitudes of all the six surveyed places by means of comparing the different sunrise timings amongst them and calculating their longitudes by the definition of 4 minutes of an hour by 24hr./day time division equal to a degree in longitude.

Here the data of the summer solstice day lengths are derived from: (i) the Yuan Court conducted on-the-spot surveyed summer solstice day lengths data of the six selected places ;(ii) the summer solstice day lengths inferred from the sun shadow lengths on the sundial; and (iii) the summer solstice day lengths deduced from the Polaris' altitudes above the horizon (35). Table I, Table II and Table III as follows had made use of the above-mentioned three kinds of the summer solstice day lengths data to calculate the longitudes of the surveyed places.

(2) The Calculation of the Latitude

The calculation of the latitude in the "Four Seas Sun-shadow-lengths Survey " falls into three kinds. First, taking 1 celestial degree in the Polaris' altitude above the horizon equivalent to 0.9856° in the 360° scale to calculate the latitude. Second, using the sun shadow lengths on the summer solstice day to calculate the latitude by applying the formulae (i) and (ii)(37). Third, taking every 1° of latitude between two places on the same [celestial] 'meridian' equivalent to 351.266*li* (里, Chinese mileage, or 1 *li*=1/2kilometer—by *Translator*). Meanwhile, assuming on the sundial of 8*ci* (尺, 1*ci* =1/3meter), 4 *cun* (寸) of the sun shadow length on the summer solstice day will then be 1,000*li*, (Chinese miles). Accordingly, we can calculate the Polaris' altitude above the horizon or its equivalent to today's latitude. Table IV, V and VI as follows (ref. P95-97), show the latitudes of the various selected spots in the Survey and their error margins, all within 1° in general.

Table I: Table of the Longitudes of the 6 selected Spots derived from the South Sea Sun-shadow-length Survey On the Summer Solstice Day

Name of place in the Yuan Dynasty	Length of the Summer Solstice day In the Yuan four sea	Sunrise Time Table of 2 Consecutive Places on the	Deduced Longitude of Today's Denotation	Location drawn up to Match the Place Today		
				NAME OF THE PLACE	Longitude	Error

	survey T	same Meridian Circumference				
Nanhai (南海)	54 *ke*(刻)	0.	117.5°	Yellow Rock Island (黃岩島)or Scarborough Shoal	117.5°	0
Hengyue (衡嶽)	56 *ke*(刻)	1 *ke*(刻)	114.15°	Ancient Hengzhou (古衡州) in Guandong (today Ta Luo Mountain of Yingde (英德大羅山)	113.1°	-1.05°
Yuetai (嶽台)	60*ke* (刻)	2 *ke*(刻)	106.95°	Yue Mountain Shaansi (陝西嶽山)	107.5°	+0.45°
Karakorum (和林)	64 *ke*(刻)	2 *ke*(刻)	99.75°	Karakorum Mountain(和林山) (昔勒。斡兒朵 Syra Ordo)	101°	+1.25°
Tiehle (鐵勒)	70 *ke* (刻)	3 *ke*(刻)	88.95°	Ancient Kanklis kingdom in the Han dynasty period (古高車) (Today Novokuznetsk *New Blacksmith City)* of Russia 今新庫茲涅茨克)	87°	-2. ° More or Less
Beihai (北海)	82 *ke*(刻) (88 *ke*(刻)	6 *ke*(刻) (9 *ke*(刻))	67.35° (56.55°)	Today The People's Peak or Gora Narodnaya of Russia Ural Range(烏拉爾山) It is the highest mountain of the Ural Mountain Range.	60°	+3° *half

KEY TO THE TABLES:
Words in italics denoting Less than a degree and their values:
By 1 celestial degree = 100 *fen* (分, divisions) and 365 1/4degrees = 1 celestial circumference
Or 1 celestial degree = 0.9855626283° in 360° geometric system
By the 360°system, 1° =1.014583 celestial degrees in the celestial scale

Weak =0.125 degree
Half = 0.5 degree
Little =0.25 degree

Strong =0.125 degree
Little Strong =0.3125 degree
Half Weak = 0.375 degree
Half Strong = 0.625 degree
Too = 0.75 degree
Too Strong = 0.875 degree
Too Weak = 0.625 degree
Little Weak =0.1875 degree

[Appendix — by *Translator*]
Chinese Time Unit
100*ke* (刻)=24hrs.=1 day
1 *ke* is equivalent to 14.4 minutes

Chinese Length Units
10 *fen*(分) =1 *cun*(吋)≒ 3 1/3dm
10 *cun* = 1 *ci* (尺) ≒ 3 1/3cm
10 *ci* = 1 *zang*(丈) ≒ 3 1/3m

Table II: Table of the Longitude and the Length of Day of the 6 Spots in Priority in the Test Deduced from the Readings on the Sundial on the Summer Solstice Day

NAME OF PLACE IN YUAN DYNASTY	SUN Shadow Lengths on SUMMER SOLSTICE DAY	LENGTH OF THE DAY DEDUCED	DIFFERENCE IN TIME FROM SUNRISE TO NOON OF TWO CONSECUTIVE PLACES ON THE SAME MERIDIAN	DEDUCING THE LONGITUDE	Locations drawn up to Match the Place Today		ERROR
					NAME OF PLACE	LONGITUDE	

			CIRCUMFERENCE				
Nanhai (南海)	1 *ci* (尺) 1 *cun*(寸) 6 *fen* (分)	54.1 *ke*(刻) =13.525 hours	0	117.5°	Yellow Rock Island (黃岩島, or Scarborough Shoal)	117.5°	0
Hengyue (衡嶽)	BEYOND THE END OF THE DIAL OF THE SUNDIAL	56.5 *ke*(刻) =14.125 hours	1.20 *ke*(刻) = 18 minutes	113.45°	Ancient Hengzhou (古衡州) in Guandong (today Ta Luo Shan of Yingde (英德大羅山)	113.1°	-0.33°
Yuetai (嶽台)	1 *ci* (尺) 4 *cun*(寸) 8 *fen* (分)	60.0 *ke*(刻) =15 hours	1.75 *ke*(刻) =26.25 minutes	107.13°	Yue Shan in Shaansi (陝西嶽山)	107.5°	+0.37°
Karakhorin City (和林)	3 *ci* (尺) 2 *cun*(寸) 4 *fen* (分)	65.4 *ke*(刻) =16.35 hours	2.70 *ke*(刻) = 40.5 minutes	97.41°	Karakorum Mountain(和林山) of Mongolia	101°	+3.19°
Tiehle (鐵勒)	5 *ci* (尺) 1 *fen* (分)	73.1 *ke*(刻) =18,275 hours	3.85ke = 57.75 minutes	83.55°	Ancient Gao-cher(古高車 Today New Novokuznetsk 今新庫茲涅茨克)	87°	+3° +
Beihai (北海)	6 *ci* (尺) 7 *cun*(寸) 8 *fen* (分)	87.4 *ke*(刻)	7.15 *ke*(刻) =1.7875 hour	57.81°	Today the Ural' s Mountains(烏拉爾山)' Gora Narodnaya Mountain in Russia	60°	+2.19°

TABLE III: LONGITUDE TABLE AND THE SUMMER SOLSTICE DAY LENGTHS OF NAN HAI AND THE SIX SELECTED SPOTS DEDUCED FROM THE POLARIS' ALTITUDES ABOVE THE HORIZON

NAME OF PLACES IN YUAN DYNASTY	LATITUDES OR THE POLARIS" ALTITDES ABOVE THE HORIZON	LENGTHS OF THE SUMMER SOLSTICE DAY DEDUCED	TIME DIFFERENCE OF SUNRISE ON THE SAME MERIDIAN CIRCUMFERENCE	IINFERENCES EQUIVALENT TO TODAY'S LONGITUDE	LOCATION DRAWN UP TO MATCH THE PLACE TODAY		ERROR
					NAME OF PLACE	LONGITUDE	
Nanhai (南海)	15 degrees (1 degree =0.98562°)	54 *ke*(刻) = 13.5 HRS.	0 *ke*(刻)	117.5°	Huang Yan Island (黃岩島)	117.5°	0
Hengyue (衡嶽)	25 degrees (1 degree =0.98562°)	56.8 *ke*(刻) = 14.2 HRS	1.4 *ke*(刻) =21 MINUTES	112.71°	Ancient Hengzhou (古衡州)in Guandong (now Ta Luo Shan of Yingde (英德大羅山)	113.1°	+0.4°
Yuetai (嶽台)	35 degrees (1 degree =0.98562°)	60.1 *ke*(刻) = 15.025 HRS	1.85 *ke*(刻) = 27.75 MINUTES	106.05°	Yue Shan in Shaansi (陝西嶽山)	107.5°	+0.45°
Karakhorin (和林)	45 degrees (1 degree =0.98562°)	64.5 *ke*(刻) = 16.125 HRS	2.2 *ke*(刻) =33 MINUTES	98.13°	Karakhorin Mountain(和林山) Today Karakhorin of Mongolia (昔勒。斡兒朵)Syra Ordo	101°	+2.87°
Tiehle (鐵勒)	55degrees (1 degree =0.98562°)	71.4 *ke*(刻) = 17.85 HRS	3.45 *ke*(刻) = 51.75 MINUTES	85.71°	Ancient Gao-cher(古高車 Today Russia's New Novokuznetsk 今新庫茲涅茨克)	87°	+1.3°
Beihai (北海)	65 degrees (1 degree =0.98562°)	87.3 *ke*(刻) = 21.825 HRS	7.95 *ke*(刻) =1.98 HRS	57.09°	Today Russian Ural Mountain's (烏拉爾山) The People's Peak(人民峰)	60°	+2.91°

TABLE IV : FROM THE ANGULAR ALTITUDE OF THE NORTH CELESTIAL POLE TO FIGURE OUT THE EQUIVALENT LATITUDES TODAY OF NANHAI AND THE OTHER PLACES

PLACE NAME IN YUAN	ANGULAR ALTITUDE OF THE	LATITUDE BY DEDUCTI	ASSUMING THE PLACE TO BE AT THE LOCATION TODAY AS DEDUCED		
			NAME OF PLACE	LATITUDE	ERROR

	POLARIS ABOVE HORIZON	ON			IN LATITUDE
NANHAI (南海)	15 degrees	14°48' (14.784°)	Yellow Rock Island (Scarborough Shoal)	15°08'	+21'
HENGYU (衡嶽) Supreme Mountain Of Hengzhou	25degrees	24°38' (24.64°)	Ancient Hengzhou (衡州) in Guondong (Today's Daluo Mountain 大羅山) in Yinde, Gunagdong Province)	23°54'	-34'
YUTAI (嶽台)	35degrees	34°30'	Yu Mountain(嶽山) in Sha'angxi(陝西)	34°	-30'
HORIN (和林) or Karakhorin	45degrees	44°21' (44.352°)	Karakorin Mountain (和林山)	46°	+1°39'
TIEHLE (鐵勒)	55degrees	54°13' (54.208°)	Ancient Kanklis (古高車) (Today's Novoknznetsk)	53°30'	-0°43'
BEIHAI (北海)	65degrees	64°04' (64.064°)	People's Peak (人民峰) in Ural Mountain Range (Russia)	65°	+56'
DADU (大都) or BEIJING	40 degrees *too strong*	40°15'	BEIJING(北京)	39°54'	-21'
SHANGDU (上都)	43degrees *little*	42.6288° (42°37')	North west of Torlun (多倫) in Inner Mongolia	42°10'	-28'
BEIJING (北京)	42degrees *strong*	42.504° (42°30')	Ning City (寧城) in Liaoning (遼寧) Province	41°45'	-15'
YIDU (益都)	37degrees *little*	36.7136° (36°43')	YIDU (益都) in Shandong (山東) Province	36°40'	-3'

DENGZHOU (登州)	38degrees *little*	37.6992° (37°43')	Fenglai (蓬萊) in Shandong (山東) Province	37°50'	+8'
KOREA (高麗)	38degrees *little*	37.6992° (37°42')	Kaesong (開城) In Korea	38°	+18'
XIJING (西京)	40degrees *little*	39.6704° (39°40')	Datong (大同) in Shanxi (山西) Province	40°06'	+26'
TAIYUAN (太原)	38degrees *little*	37.6992° (37°42')	Taiyuan (太原) in Shanxi (山西) Province	37°50'	+8'
XI'AN PREFECTURE (西安府)	34degrees *half strong*	34.1264° (34°07')	Xi'an (西安) In Sha'anxi (陝西) Province	34°14'	+7'
XINGYUAN (興元)	33degrees *half strong*	33.1409° (33°08')	Hanzhong (漢中) In Sha'anxi (陝西) Province	33°05'	-3'
CHENGDU (成都)	31degrees *half strong*	31.1696° (31°10')	Chengdu (成都) In Sichuan (四川) Province	30°40'	-30'
XILIANGZHOU (西涼州)	40degrees *strong*	39.5472° (39°32')	Wuwei (武威) In Gansu Province(甘肅)	38°	-1°32'
DONGPING (東平)	35degrees *too*	35.2352° (35°13')	Dongping (東平) In Shandong (山東) Province	35°55'	-1°18'
DAMING (大名)	36degrees	35.4816° (35°28')	Southern Daming (大名之南) in Hebei (河北) Province	36°20'	+52'
NANJING (南京)	34degrees *too strong*	34.3728° (34°22')	Kaifeng (開封) In Henan (河南) Province	34°48'	+26'
YANGCHENG (陽城) in *HENAN* Prefecture (河南府)	34 degrees *too weak*	34.1264° (34°07')	Gaocheng Township (告成鎮) of Denfeng (登封) in Henan Province (河南)	34°24'	-17'
YANGZHOU (楊州)	33degrees	32.5248° (32°31')	Yangzhou (楊州) In Jiangsu (江蘇)	32°25'	-6'

			Province		
ERZHOU (鄂州)	31degrees *half*	31.0464° (31°03')	Wuchang (武昌) In Hubei (湖北) Province	30°30'	-33'
JIZHOU (吉州)	26degrees *half*	25.9744° (25°58')	Ji'ang (吉安) In Jiangxi (江西) Province	27°06'	+58'
LEIZHOU (雷州)	20degrees *too*	20.4512° (20°27')	Haikang (海康) In Guangdong (廣東) Province	20°54'	+27'
QIONGZHOU (瓊州)	19degrees *too*	19.4656° (19°28')	Qiong Mountain (瓊山) in Guangdong (廣東) Province	20°	+32'

TABLE V: LATITUDES OF THE SIX SELECTED SPOTS IN PRIORITY FOR THE SURVEY
FROM THE SUN SHADOW LENGTHS ON THE SUMMER SOLSTICE DAY
BY THE 8CI (CHINESE LENGTH UNIT) GNOMON

PLACES IN YUAN DYNASTY	SUN SHADOW LENGTH ON SUMMER SOLSTICE DAY	LATITUDE BY DEDUCTION	ASSUMING THE PLACE TO BE AT THE LOCATION TODAY AS DEDUCED	LATITUDE	ERROR IN LATITUDE
NANHAI 南海	1*ci* 1*cun* 6*fen* (Shadow on The southern side of the dial)	15°02'	Scarborough Shoal of MACCLESFIELD BANK 中沙群島黃岩島	15°08'	+6'
HENGYU 衡嶽	NO SHADOW ON THE END OF THE DIAL	23°49'	ANCIENT HENGZHOU (古衡州) IN GUNADONG PROVINCE (TODAY'S DALOU 大羅 MOUNTAIN IN	23°54'	+5'

			YINDE (英德) GUANDONG PROVINCE)		
YUTAI 嶽台	1*ci* 4*cun* 8*fen*	34°18'	YU MOUNTAIN (嶽山) IN SHA'ANGXI PROVINCE(陝西)	34°	-18'
KARAKHORIN 和林 Or Karakhorum	3*ci* 3*cun* 4*fen*	45°52'	Xyra Ordo or KORUM MOUNTAIN (和林山) TODAY MONGOLIA'S BAYANHONGOR	46°	-83'±
TIEHLE 鐵勒	5*ci* 1*fen*	55°53'	ANCIENT KANKLIS (古高車) CURRENT NOVOKUZNETSK	53°30'±	-2°23'±
BEIHAI 北海	6*ci* 7*cun* 8*fen*	64°07'	The PEOPLE'S PEAK (人民峰) IN THE URAL MOUNTAIN RANGE	65°	+53'

TABLE VI : LATITUDES OF NANHAI AND HENG YUE BY THE DEUDCTION OF THE SCALE 4*CUN* TO 1,000LI FROM THE SUN SHADOW LENGTHS ON THE 8*CI* GNOMONS ON THE SUMMER SOLSTICE DAY

PLACE NAME IN YUAN DYNASTY	SUN SHADOW'S LENGTH ON SUMMER SOLSTICE DAY IN CHINESE LENGTH UNITS	CELSTIAL LATITUDES AND DISTANCE BETWEEN 2 PLACES EITHER NORTH OR SOUTH OF THE OTHER	GIVEN LATITUDE OF THE PLACE TO BE	ANGULAR ALTITUDE OF THE POLARIS OR POLARIS' LATITUDE DEDUCED	ASSUMING THE PLACE TODAY TO BE AT THE LATITUDE AS DEDUCED	ERROR IN LATITUDE

DADO (大都) or the Great Capital	2*ci* 4*cun* 7*fen* (Shadow on The North side Of the dial)	9,100 *li*(里)	39°54'			
NANHAI (南海)	1*ci* 1*cun* 6*fen* (Shadow on The South side Of the dial)	or 25.90 Degrees		14.969degrees Or 14°45'	Scarborough Shoal (黃岩島) OF MACCLESTIAL BANK (中沙群島) 15°08'	+33'
DIZHONG (地中) Or Standard Time Zone Center (Yangcheng 陽城)	1ci 5cun (Shadow on The North side Of the dial)	3,700 *li*(里)	34°10'			
HENGYU (衡嶽)	NO SHADOW BY THE END OF THE DIAL	Or 10.675 degrees		24 degrees or 23°39'	DALOU MOUNTAIN (大羅山) OF YINGDE (英德) IN GUANGDONG PROVINCE 23°54'	+15'

3. Deducing the Longitude and Latitude of Nanhai
From the Prime Meridian Along Dadu — Nanhai

On March 27 of 1277, Kublai Khan “ordered Guo Shoujing departing from Shangdu(上都, the summer capital, near today Duolun in inner Mongolia) and Dadu(大都, the national capital, or Beijing) via the Prefecture of Hennan(河南府) to Nanhai to survey its sun shadow lengths on the sundial”. In order to carry out the survey afar, Guo set out from Shangdu(the upper capital) and Dadu(the great capital), via the Prefecture of Henan and finally arrived at Hainan. Originally, China’s prime meridian was centered at Yang Cheng(陽城 or the City of the Sun) in Henan Prefecture as its (*di zhong*,地中) Standard Time Zone Center of the whole country. But now that the whole of China was unified, it should take Dadu(Beijing) as its center and choose another prime meridian with Dadu (Beijing) as its center. In this way, there were two prime meridians, one old and the other, new, running from the north to the south of

the whole country. The new one was at a little more than 116 degrees E. with Dadu(today Beijing) as its center. The old one was with Yang Cheng ['the city of the sun'—by *Translator*] of Henan Prefecture as its center, at 113°E. The new meridian running from Dadu in the north and ending at Nanhai in the south, had a difference of nearly 25 degrees in latitude, covering a distance of nearly 3,000 km. and with an error margin in longitude of only 1° or more(1.3°). This was no simple thing at all. Until the time when there were Westerners participating in the nationwide longitude survey during the Qing dynasty period in the eighteenth century, the error margin in longitude remained within one degree more or less. Clearly, 500 years since Guo Shuojin, the standard of longitude survey in the world stayed at the same level of Guo Shoujin's era. In comparison with that time and even 500 years later, we can see how extraordinarily high the standard had been achieved by the Yuan new prime meridian from Dadu to Nanhai as surveyed by the Yuan "Four Seas Survey".

Thus established: the old prime meridian with Yang Cheng of Henan Prefecture as its center and the new one with Dadu (Beijing) as its center, assuming 4 *chun*(寸 unit of Chinese length measurement) of the summer solstice sun shadow length equals to 1,000 *li*(里, or Chinese mile), and the celestial sphere scale of one degree equals to 365.266 *li* (里, or Chinese mile) in distance from the North to the South of China, it is possible to calculate the latitude of Nanhai, lying approximately on the similar meridian as that with Dadu (Beijing) as its center. Similarly, it is also possible to calculate the latitude of Yang Cheng as center of the old meridian and that of Heng Mountain(衡嶽), which is almost at the same meridian of Yang Cheng (see Table VI).

The latitude of Nanhai is at 14°15' N. This was a result from the calculation. Comparing with what is supposed to be today's Nanhai at the Yellow Rock Island(黃崖島, or the Scarborough Shoal) in the Middle Sand islands(中沙群島, or the Macclesfield Bank) , i.e. 15°48'N, this is within the error margin in latitude of +33'. This is also within the error tolerance of no more than one degree. As the meridian from Dadu to Nanhai is at one and the same longitude, it was also considered that the longitude of Dadu was also that of Nanhai's. Given the longitude of Dadu (Beijing) is 116°24' E, and assuming that the longitude of Nanhai was today the Yellow Rock Island, lying 117°45'E, the error in longitude was only -1°21', not really too big an error indeed.

III. The Places and Locations Under Study and Research

(1) Nanhai (南海)

During the Yuan's rule, Nanhai could be referred to the sea confronting Guangdong Province(廣東), called Nanhai (the Southern Sea), i.e. Cankhai(漲海), or the 'Swelling Sea'(38) then; sometimes, it could also be referred to the city called Nanhai i.e Guanzhou(廣州)now(39). The Nanhai in the "Four Seas Survey" during the Yuan Dynasty was not referred to Guangzhou in Guangdong. To say it was Guangzhou is surely wrong (40). It

was referring to the sea territory of China covering the region over the sea from 15 degrees of the Polaris' altitude above the horizon(almost nowadays 15°N) and upwards. It remained so ever since the Yuan to Ming and Qing dynasties. Ever since Guo Shoujing of the Yuan did the on-the-spot survey on Nanhai's geographical location, both China and foreign countries alike considered the territory above the 15 degrees North as China's Nanhai(41). More often than not they referred to the Western Ocean navigational passage through what were later days known as the Eastern and the Western oceans ("東西洋") as China's Nanhai and determined its location at about 15°N. As for where the eastern end of Nanhai would have been, it was relatively less mentioned about.

Both the eastern and western sea territories of Nanhai at above today 15°N are rather vast. Can we now find out where it starts from the east? The answer is yes. The equivalent of today latitude of Nanhai, where Guo Shoujing had personally made the distant survey has been very clear. It could be obtained not only from directly observing the Polaris' altitude above the horizon from
the summer solstice sun shadow lengths and the duration of the day's length on the summer solstice day. As regards its longitude in its today equivalent, it could also be deduced by calculating the actual Nanhai day length in Guo Shoujing's on-the-spot survey. Meanwhile, having its latitude inferred from the Polaris' altitude above the horizon and the sun shadow lengths on the sundial on the summer solstice day, then, the longitude could also be deduced from its summer solstice latitude. As a result of this calculation, Nanhai, this surveyed location, should be today's Yellow Rock Island(黃崖島, or the Scarborough Shoal) in the Middle Sand Islands (中沙群島, or the Macclesfield Bank). Its longitude should be 117.75°E and the latitude, 15.13°N(see the Tables above), according to the calculation.

As regards the western end of Nanhai, the quote that "down south beyond the Vermillon Cliff"(further south beyond Hainan Island), according to the *Preface in General for the Annals of Astronomy, The Yuan History*(《元史。天文志。總序》), is indeed referring to the western side of Nanhai. Here it should be referring to the demarcation ocean between China and Champa (today middle part of Vietnam) at about 15° N and 109° more or less East, the nearby sea off Lou Shan(羅𠺘), the western part of which was 15 degrees the Polaris' altitude above the horizon(42).

Guo Shuojin personally arrived in Nanhai. He was taking that which was known in later days as the Eastern ocean route between the Eastern and the Western oceans. Only by this sea route could he arrive at the Yellow Rock Island of the Middle Sand islands—the eastern side of Nanhai, and used it as the starting point of China's Nanhai eastern boundary. He also took this Yellow Rock Island — the Nanhai in the Eastern ocean sea route — as the southern starting point for the new prime meridian with Dadu(today Beijing) in the north of China (this meridian has an error margin of only 1 degree and 21minutes in today's east longitude). Guo conducted a large scale on-the-spot survey on the *dongxi li cha*(東西里差, or the difference in Chinese mileage

between the east and the west)(43) as practiced by Yelu Chucai. Since then, Dadu (Beijing) time(44) was made the standard time throughout the whole of China. (45). Hence forth, the *dongxi li cha* or the longitudinal difference in Chinese mileage between two places in the whole country could be deduced from the time difference from Dadu. " If it's in the east, the greater the *li cha* (the difference in Chinese mileage) between Beijing and the place under consideration, and if it's in the west the lesser the *li cha*(the difference in Chinese mileage) between Beijing and the place considered "("東則加之，西則減之"). But we need not go that far, because calculating Guo Shuojin's surveyed summer solstice day lengths could directly give us all those today equivalent longitudes of the places. We need not use Dadu or Beijing as the reference point for the time difference between places. (46) This is indeed one of Guo Shuojing's greatest achievements that should be highly valued and further developed. That was also why Guo Shoijing personally took such a long and toilsome journey to Nanhai, so as to acquire the sun shadow lengths and the day length of the summer solstice day from the sundial.

As regards going "south beyond the Vermillon Cliff(Hainan Island)" to survey the Polaris' altitude above the horizon, China had long been paying great attention to do the survey on this. To wit, the erections of gnomes from the south to the north of the country for the surveys by Tang Yixing(唐一行) and Nan Gongshuo(南宮說) bespoke better than words(47).

The History of the Yuan Dynasty (《元史》) says that Nanhai in the "Four Seas Survey" is at 15 degrees of Polaris' altitude above the horizon. But it also says, "below the Polaris' altitude 15 degrees above the horizon was the boundary of Lin Yu(林邑, or Champa)"(48). As said above, traditionally the sea boundary between China and foreign countries was defined by the boundary of Champa at about 15°N. The sea surface at 15° N and a little more than 109°E, off Lou Shan(羅山, today islet groups of Vietnam and Guangdong) until Ming times still served as the Demarcation Ocean to define the boundary between China's and foreign territories. The western side of Nanhai in the Yuan "Four Seas Survey" was also the Nanhai at "further south than the Vermillon Cliff(Hainan)" as mentioned in the *History of the Yuan Dynasty*(《元史》). It was also the 'demarcation'("分水") ocean(49) close to off Lou Shan. As the Chinese had long been using and very familiar with the Western ocean route, Guo Shuojing didn't have to get there personally to survey the Nanhai that was "further south beyond the Vermillon Cliff(Hainan)". Therefore it was more sensible for him to place great emphasis on personally conducting the on-the-spot survey at the Nanhai that is today's Yellow Rock Island instead.

Ever since the Yuan Court defined China's southern boundary at Nanhai, defining its southeast boundary at today's Yellow Rock Island at 15°08'N and 115°45'E, from then on until the 16th and 17th centuries, the ages of Western domination in the East, the Yellow Rock Island had all the while been considered as China's Nanhai. In accordance with the two Chinese maps(50) copied from the Map of Asia made by the Westerners, at the location equivalent to the position of Yellow Rock Island now, there was on the map a

Chinese transcription, reading: *Mao-shi Zhi-ma Sheng-yu-luo*(貓士知馬升禺洛) or *Mao-shi Zhi-ma Sheng-y'u-luo*(貓士知馬升愚洛). This was the Portuguese name for Mar Sud, Masinaru or Mar S. de Masinaru, meaning "South Sea of Great China" or "Great China's South Sea". As early as when the Portuguese first came to China, China was used to be called by them as Sin or Masin(51). Thus in their early world maps, the name Sinaru (升禺洛) was found on them to refer to China(52). "-aru" is a variation in the suffix of the word, and its root is "Sin" or "Masin". Undoubtedly, this Masinaru (馬升禺洛) must be referring to Great China. "Mar" in Portuguese means "sea", and transcribed in another language pronunciation as "Mao"(貓), which was not unusual in the Fujian dialect for all other foreign phonic of "Ma(r)"(53), where the "r" sound at the end of the word had often been dropped out in the Chinese pronunciation of the whole word(54). "Sud" in Portuguese could also be abbreviated as "S.", which means "south", and in the Chinese pronunciation of this letter, it sounded "Sud" (士知) or (士)[(知) could be the corresponding phonic with the "-d" in "Sud", and also the connective, "de", in Portuguese]. As the map was translated and made by Si Shipiao(施世驃), a Chinese of Fujian Quanzhou origin, or by someone else employed by him, it was not strange at all to find the names of the places to have most of them transcribed in the southern Furjian Chinese pronunciation.

Besides, there emerged from those maps another place name "*Mao-shi-zhi bo-ni-lao*"(貓士知無呢耄). This place name in Portuguese should be *Mar Sud*, *Bolinao* or *Mar S. de Bolinao*, a Chinese transcription meaning "South Sea of Bolinao"(in the north western part of Luzon Island, now translated as Polinao) or Bolinao of South Sea(55). It must have meant to say today's Polinao's straits and the nearby sea surface is the South Sea of Bolinao, just in the way like the South Sea of *Mao-shi zhi-ma sheng-yu-luo*(貓士知馬升禺洛)[Great China's South Sea] is referring to the South Sea of Great China. Mar Sud, Bolinao or Mar S. de Bolinao lies at 15°25'N and about 120°E, where the Polinao's straits and the close by sea surface are. And not far away in the north west of Mar Sud, Bolinao, or Mar S. de Bolinao, lies Mar Sud, Masinaru or Mar S. de Masinaru, that is "South Sea of Great China" or "Great China's South Sea". The South Sea here is exactly where the Yellow Rock Island is if we presume it to be at the position not far away from the south west of Polinao's straits, at 15°08'N and 117°45'E. At the time when Guo Shoujing of Yuan times personally arrived at Nanhai to do the on-the-spot survey of the summer solstice sun shadow lengths and day length there, the Nanhai then is now called the Yellow Rock Island or Maroona island today. We have also had figured out from the data collected by Guo Shoujing (refer to the tables in this article) and having converted the results into today's longitudinal and latitudinal denotations, we found that the denotations were identical with the longitude and latitude respectively of today's Yellow Rock Island. Hence, the Nanhai, that is that Nanhai with Yellow Rock Island as its eastern side starting point, had, after the "Four Seas Survey" during the period of the Yuan dynasty, already been acknowledged in the maps and atlases of China and other foreign countries, which "South Sea of Great China" or "Great China's South Sea" can well be an example of.

The Yellow Rock Island amidst the Middle Sand Islands was also known as *Si-jia-bu-luo Tan* (斯加布羅灘, or Scarborough Shoal) by foreigners. Scarborough Shoal was called after the ship named Scarborough stuck the shoal in the night of September 12 in 1748. It is a dangerous reef of rocks little more than mid-way from the Macclesfield Bank(i.e. Middle Sand Islands) and the sea coast of Luzon Island, in the Philippines.[The Scarborough shoal had sparked a heated territory dispute between China and the Phillipines in the late 90's. —by *Translator.*] Stretching from its north to the middle of the Bank, it measured about 9 1/2 miles from east to west. The southern shoal was all made up of steep reefs. Nearby the reefs, the depth of the sea was not fathomed. Only few of the reefs emerged above the waters and spread to the shoal everywhere. In April, 1800, an admiral of the Spanish Navy, stationed in Manila, sent out a cruiser to make an investigation and found its length from North to South measured 8 3/4 miles, lying 15°04' E in longitude and 15°12.75'N in latitude and its eastern side at 3°6.75'W of Manila. All the figures above were obtained from the use of the marine chronometer. Meanwhile, it was 131 nautical miles from the nearest part of Point of Capones. From here, the center point of the Bank was at 117°48.5' E, while that of Point of Capones was at 120°03'E. On 20th October of the same year, Captain T. Robertson of the boat, *Cirencester*, passed the Bank and used the chronometer to survey the Bank. It was 8°47' E of Pulo Sapata Island(i.e. Cao-sh'ye-sih 草鞋石 called by the Chinese) at 117°49.5'E in longitude(56). Today the Scarborough Shoal is found at 117°45'E and 15°08' N, 160 nautical miles east of the Macclesfield Bank. It "is a ring of reefs forming a triangular shape, 10 nautical miles long. The fringes of the reefs are high and steep. It has a shallow lagoon clear and green in color. There is a large coral reef spreading over its basin at the bottom of the sea, in huge column shape, and visible far away, while the highest of the coral column was called 'nan-sih'(南石, or the 'southern rock'), 1.8 meters above sea level, at the south eastern part of the reef. There is an entrance, about 360 meters wide, average water depth 9-11meters, in the north of its southern side. There are huge rocks in the passage of the entrance here. The water over here is only 2.7 meters the deepest. However, Yellow Rock Island is surrounded with deep sea, water depth more than 3,500 meters. It seems like a huge coral reef column, soaring from the sea basin to a height of 3,500-4,000 meters out of the sea."(57)

(2) Hengyue (衡嶽 Heng Mountain)

Generally speaking, the Heng Shan(衡山, Heng Mountain) of the Southern Mountain Range(南嶽) in Hunan(湖南), was one of the renown hills or mountains in China. But was it the Heng Mountain in the "Four Seas Survey" during the Yuan dynasty period? In my view, it was not. From the point of view of the latitude, Hunan's Heng Mountain is 27°N or more, whereas that of Heng Mountain is only 23°more or 24°, so that there is a discrepancy of 3° more to 4° or so in the latitudes of the two places. In overall examination of the Polaris' altitudes above the horizon in the 27 surveyed spots in the "Yuan Four Seas Survey", the error margin in their latitudes equivalent today's is averaged within 1° only. Now that the error margin has all of a sudden increased to 3° more to 4° or so, clearly the name of the place hereby identified must be wrong and evidently Heng Mountain simply cannot be today Hunan's Heng Mountain.

In ancient China, places with the name of Hengzhou(衡州), other than the Heng Mountain in Hunan's Hengzhou, Guandong's Hengzhou was also called Heng Mountain(衡嶽). In the old days, there were several places named Hengzhou in Guandong: Shaoguang(韶關)'s South Hengzhou, Shi-xing(始興)'s East Hengzhou and Yingde(英德)'s Hengzhou(58). According to the ancient Chinese poetry, *Er-ya*(《爾雅》), "a mountain, soaring high and held in high esteem with respect to its altitude, is called a mountain"("山高而尊曰嶽"), Guandong's Hengzhou could also therefore be called Heng Mountain and according to the *Essentials of Geography for Reading History* (《讀史方輿紀要》) by Gu Zuyu(顧祖禹)(1631-92) in Ming times, Guangdong, "has five mountains in the north, and Luofwu(羅浮) Mountain is the famous one". It also quotes *Notes on the Renowned Mountains (*《名山記》) in saying: "there's a cave in Loufwu mountain with a circumference of 5 Chinese miles, which was considered as the unique beautiful scenic spot by Taoist books. It is one of the ten famous mountain caves in China. The mountain was linked with some rivers flowing inside the mountain cave. At its top there is a watershed called the 'fairyland of the fountainhead' (泉源福地). The mountain range embraces five peaks, surrounding the Heng Mountain as if they were surrounding the emperor like his loyal retainers. And Luofwu mountain stood out in the midst of them, helped to serve the majestic Heng Mountain (59)."

In the past, people used to think of Guangdong's Luofwu Mountain Range to have stretched past the five peaks in the northern region of Guangdong and down south, until it reached the area of Polo(博羅) and Zhenceng(增城), with its middle section spanning the region so called Hengzhou in the past(60). The so called Heng Mountain in the Luofwu Mountain Range was referring indeed to that Heng Mountain in Hengzhou region in the past, being "a hill, soaring high and held in high esteem with respect to its altitude, is called a mountain", thus called Heng Mountain. However, there was a Yao Shan (堯山, or Yao Hill), in the old Hengzhou's Yingde(英德). According to the book, *Si-xing-ji*(《始興記》) by Wang Shao(王韶), in the Jing dynasty, "the Emperor Yao had patrolled to the south and climbed the hill, so that it got its name after

the Emperor, Yao Shan ” (61), and according to *Shui Jing Zu*(《水經註》) by Lih Daoyuan(酈道元) in North Wei dynasty, “Yao Hill stretches and meanders hundreds of Chinese miles”(62), and *Taiping Huangyu Ji* (《太平環宇記》) by Song Yuesih (宋樂史), “Yao Mountain is 4,000*zhang*(or more than 13km) high, and comparing with Loufwu Mountain, which is “500 Chinese mileage long from north to south at the foot of the mountain” and 3,600*zhang (丈,* unit of Chinese length measurement) high (63), Yao Mountain is 400*zhang* higher than the Loufwu Mountain. This could not but have been the exaggeration deliberately expounded by the Taoists and their like. As it was used to take Guangdong’s Heng Mountain (i.e. at the Yao Shan in ancient Hengzhou of Guangdong), to be the highest peak in the Luofwu Mountain Range, so that Heng Mountain was treated with the kind of respect like treating all haughty and arrogant regality as the high and majestic Yao Shan had been. In the views of those Taoists, who had specialized themselves in interpreting the unique beautiful scenic spots of the Land of Luck, Heng Mountain or Yao Shan should be entertaining to the geomancers to be the highest and commanding respect mountain in Guangdong. Consequently, words like “Heng Mountain is like a king”, or Yao Shan “ is 4,000*zhang* (more than 13km) high” were propagated in books, with the five summits amongst the numerous peaks in the mountain range behind the Heng Mountain, described as a mass of “attendants”, and together with Luofwu Mountain, said to be 3,600*zhang* high, a little lower than Heng Mountain (also an exaggeration by the Taoist), described as a team of outstanding chivalrous figures serving the king. In the “Four Seas Survey” during the period of Yuan dynasty, those in power in the Bureau or Academy of Astronomy were not the people like the scientist, Guo Shoujing, but Zhang Yi(張易) and his like(64), the big bureaucrats, who were superstitious in the mystic ideologies of the priesthood and Xu Heng(許衡), who only knew how to talk of calendar making theories. Only these people could have appraised the rottenness advocated by the geomancers and made use of the places, which were only frequently mentioned by Taoists and their like, such as “Heng Mountain, like a king”, and selected the so acclaimed Heng Mountain to be included in the survey.

As a matter of fact, Yao Shan lies in the south west of Yingde(65), that is today’s Da Luo Shan(大羅山, or Great Lou Hill), with a height of 900 meters or more, and compared with the major peak in Luofwu Mountain Range, 1,282 meters high, is 300 meters or so lower. But in the eyes of the geomancers, it was the Heng Mountain in Guandong’s ancient Hengzhou the highest mountain respectable like a king (i.e. the so called Yao Mountain 4,000*zhang* high). No matter it was Heng Mountain or Yao Mountain, it is today’s Great Luo Mountain, at today’s 113.1°E and 23.9°N. This could be verified by the result of the conversion of the data in the Tables to the longitude and latitude of Heng Mountain, which is identical with the location of today’s Great Luo Mountain.

(3) Yue Tai (嶽台)

During the time of the Tang dynasty, sun shadow lengths and lengths of day and night were taken from the sundials set up in Yue Tai, south of Kai

Feng(開封). The Yue Tai in the *History of the Yuan Dynasty* had nothing to do with this place. From *Er-ya* (《爾雅》) “hill as high as a mountain is respected as a mountain” makes good for this, as the word “yue(嶽)” in Chinese is a common noun for ‘mountain’. Nevertheless, taking “yue” to be the name of some mountain, such as the Yue Mountain(嶽山), we will find there are some quite renown ones, in the old days, like that Yue Mountain, one of the five mountains in the Han dynasty, which according to some, was that Yue Mountain in Sha’angxi (陝西)Province, located in the south west of today’s Long County(隴縣)(67), about 34.8°N and 106.8°E. However, others said, it was in the south east of today’s Boaji(寶雞)(68), about 34°N and 107.5°E. Now that the term “tai(台)” in Chinese is a figurative rhetoric for “position inferior and low”, describing the appearance of people as like the subjects and servants towards their masters, and since it is close by the western side of Tai Bai Shan(太白山 or Tai Bai Mountain, 3,666meters high), Yue Tai should refer to the Yue Mountain, one of the five antique mountains, at 34°N and 107.5°E, owing to the fact that it has the word “tai” in its name, signifying its low altitude. What’s more, people during the Yuan’s rule still called the servants of the servants “zhong-tai”(重台, meaning doubly inferior and low)(69). Although Yue Mountain is not high, it could still be respected as a mountain and in comparison with the Tai Bai Shan(太白山) close by, it is humble and low like the subjects and servants, and therefore called Yue Tai. These were also the jargons that the Taoists, who were good in talking of “unique beautiful spot of the Land of Luck” in those days, would very much pleased to juggle with.

(4)Kharkhorin (和林)

The vast territory of Khara-khorin was originally the homeland of Naiman Mongols'. Having conquered the Naiman Mongols, his principal opponents, Genghis Khan and his army settled down in this region and selected Karakorum (west-southwest of modern Ulaanbaatar, near modern Kharkhorin) as their capital and the seat of his new empire. Outside the city he built four movable palaces as his residence(70). Karakorum, this cosmopolitan city, in which Persian merchants and Chinese craftsmen had constituted the major inhabitants, served as the provisional base for the 'actual capital'. In 1219, Genghis Khan, setting out for another military expedition, left the capital to his brother. Wo'chi'jin(斡赤斤)'s protection(71). Meanwhile, it was from here (Naiman Kingdom Wordu (72)) that he had decreed Liu Zhonglu(劉仲祿) to go down south so as to welcome the Taoist Master of Eternal Spring(長春真人), who was on his way up north. "In 1235, Genghis Khan conferred the lands amongst his sons, and Karakorum(哈剌和林) was given to his youngest son, Tolui(拖雷). Subsequently, Ogedei Khan(窩闊台 1229-1241), the Grand Emperor of the Yuan Empire, founded his capital here(73)." In 1235, Yuan Taizhong(元太宗, or the Great Khan of Ogedei Ulus) began to build the capital of the early Mongol empire at Karakorum. [Ogedei rebuilt Karakorum in 1235 and re-established Karakorum's trade along the silk Road. **Karakorum** also known as Kharakhorin, second capital of the Mongol Empire(from 1235 until 1360). It was built by Ogedei on the Orkhon River in central Mongolia in the land that had once belonged to Ong Khna of the Kereyid. See Jack Weatherford, *Genghis Khan and the Making of the Modern World,*(Three Rivers Press, NY 2004)p.290 — by *Translator*].

Before the conquest of Ghengis Khan's, Kharakhorin had been a vast region of Naiman Mongols. There were four *Ordu*'s or movable tented palaces built by Genghis Khan. As Mongolian empire was originally a nation formed by nomads who have no settled capital city for their emperors to stay put for good, Genghis Khan lived in the movable palaces outside the city like all other nomadic rulers. As there are four seasons in a year, Spring, Summer, Autumn and Winter, so there were four *Ordu*'s or movable tented palaces (namely, 兀里朵, 斡耳朵, 窩兒朵 and 斡兒朵, which are the transcriptions in pronunciation by the Chinese)(74) for the emperor to take temporary recess in. Genghis Khan had four *Ordu*'s in Kharakhorin.[**ordu or horde,** the court of the Khan's. The word adopted into English as *horde*. It was also used in Turkish, *ordu,* and became the word *Urdu,* the camp or army language that became the official language of Pakistan. See Jack Weatherford, p.291 — by *Translator*]. All his queen and concubines separately lived in each of these *Ordu*'s(75). In later days, it was used to refer the first *Ordu* 斡兒朵 of the four *Ordu*'s as the "Great *Ordu*," also known as Kharakhorin(76). But such a title of the first *Ordu* as Kharakhorin is vague and even ambiguous in fact, because the first *Ordu* was only one of the four Genghis Khan's *Ordu*'s, lying along the upper stream area of the great Kerulen River (怯綠連河) [today Orkhon River](77).

And Khrakhorin is the place name for the capital city and the four *Ordu*'s as a whole.

Ogedei's(窩闊台) Kharakhorin city and his four *Ordu*'s outside the city: Ogedie was crowned in Kharakhorin, lying along the upper stream of the great Kerulen River(怯綠連河) or Orkhon River(78). In the spring of 1235 the city of Khrakhorin or Kharakhorin-balik was built, with the *Wan'an* Palace (萬安宮) within it". And in the spring next year, i.e.1236, "the Wan'an Palace was inaugurated(79)". As it is, the original name of the city of Kharkhorin was Ordu-balik(窩里朵。八里), meaning the city of the *ordu,* or the city of movable palaces, or the city of field headquarter(80). It was only thereafter that the name of Kharakhorin City (和林城) began to emerge in history. In the year 1246, Johannes de Plano Carpini(拍蘭諾加賓尼), the monk, visited this Kharakhorin city as well as the western *ordu*. According to him, it took half a day to travel from one place to the other. He also said that Sy'la-ordu(昔剌。斡兒朵)was the summer palace or summer capital of Ogedei's (81). In 1248, Zhang De'hui (張德輝)in the Jin times(金)had also reached the river of Khrakhorin, the city of Kharakhorin(82). However, the time when the monk Rubruck visited Kharakhorin city in 1253, there were only two streets in it(83).

During that time foreigners all followed the Mongolians to call the city Kharakhorum, meaning the "Black Camp"("黑營")(84), or the black field headquarter". One might disagree with this and argue that the name Karakorum was indeed only a popular saying and instead its original name should be *Ordu-balik*(窩里朵。八里) (85)meaning the city of the movable palace or the city of field headquarter. Year in and year out during their lives, Mongolians live in camps set up in different places, rotating according to each season. Subsequently, the *Ordu* or field headquarter of the Mongolian khan's too had to move from one place to another with the tents of his people. Therefore, to the Mongols, Kharakhorin was a capital rotating all year round in each season and not one that was fixed in one place throughout the year. According to the *New History of the Yuan Dynasty*(《新元史》), in 1235, Ogedei began to build Karakorum as his imperial capital. In spring, the emperor dwelled in Wan'an Palace(萬安宮) for one month; stayed in Jie-jie -'cha-ha Palace Hall(揭揭察哈殿) for two months. In summer, the emperor took resort in Syla-ordu(昔剌。斡兒朵)to get away from the summer heat. In autumn, he stayed in Guo-guo-rdu Palace Hall(闊闊兒行宮). And in winter, he led his court's men to go hunting along the Wangji River banks (汪吉河). Throughout the year, the emperor habitually visited and stayed in each of the four *ordu*'s in turn according to the seasonal change."(86)

In fact, so far as spring temporary palaces in Khrakhorin were concerned, there was the Wan'nin Palace (萬寧宮) within the city itself; about 70 Chinese miles north of Kharakhorin city there was Jia-jian-cha'-han Palace Hall (迦堅茶寒殿)(87), i.e. the Palace Hall of Jie-jie- 'cha-'ha (揭揭察哈殿). In addition, there was also the Syra ordu (昔剌。斡兒朵)—the emperor's

summer resort in half a day journey from Kharakhorin(88). Around Kharakhorin there were many historical relics. In his book entitled, *The Drunkard's Hermitage in the Land of the Two Streams,* (《雙溪醉隱集》), Yelu Zhu (耶律鑄) in Yuan times writes: "The city of Kharakhorin was originally the ancient capital of Bihjia Khan(苾伽可汗) in the T'ang dynasty. In the Yi-wei (乙未) Chinese lunar year (i.e.1235), the First Emperor of the Yuan dynasty, Ogedei, founded his imperial capital here. He built the Wan'an Palace (萬安宮) here too. Northwest seventy Chinese miles of the city, there was a historical relic of the Bihjia Khan palace. And northeast seventy Chinese miles of the city there was a *Jue Te Qin* stone stele(《闕特勤碑》) inscribed with the handwriting by the Enlighten Emperor(明宗)of the Tang dynasty in 732 A.D. (89). Thus, Kharakhorin, the city, a city frequently visited by the Mongolian emperors in four seasons, was hardly comparable to any of the imperial palace capital cities where the Chinese feudal emperors resided within all year round. If we persist in making such a comparison, then we would be mistaking the Khan's one month stay every year in the Wan'an Palace within the Kharakhorin city as his nearly a year long stay throughout every year in the four *Ordu*'s outside the city. Needless to say, nothing can be more misleading than making such an inappropriate comparison. [Prof Han Zheng Hua is absolutely right. Despite the fact that the city became a true urban, diplomatic and commerce center during the reign of Ogodei, it managed to retain a strongly nomadic feature, the palace was built only for official receptions, the court did not live in town and instead setup their camps in the surrounding area. —by *Translator*]

Indeed, the territory of Kharakhorin was in an extent vaster and bigger than the city of Kharakhorin itself. Kharakhorin, where the Mongolian nomads moved around with the grass and waters and made a living on hunting, was certainly incomparably much larger than the city of Kharakhorin itself, which had only two streets inside it. However, Kharakhorin city was named after the Kharakhorin River(和林河), "in the west of Khararhorin city flows the Kharakhorin River, (哈剌和林河), from which the city got its name"(90). Thus it is clear from this that the Kharakhorin city is today's Erdene Zuu (額爾德尼昭), the eastern bank by the Kharakhorin River or today's Orkhon River (鄂爾坤河), about 47°N and 107°40'E.(91)[today Kharakhorin is located at the lower end of the upper valley of the Orkhon River, part of the World Heritage Site Orkon Valley Cultural Landscape. The location marks the eastern foothills of the Hang'ai Mountains(杭愛山), where they meet the rolling steppe of central Mongolia. Nearby are the ruins of the ancient town of Karakorum, which had for a short time in the past served as the capital of the Mongol Empire under Ogedei Khan. Another landmark is the Erdene Zuu monastery. Kararkhorin district has a population of 13,496 in 2003. —by *Translator*]. But in the past, Karakorum, one of the four *Ordu*'s, of which the western part ended at Karakhorum Mountain(和林山)(92), and its eastern part ended at the Great *Ordu*(大窩里朵)in the upper stream of Kerulen River(怯綠連河, or Orkhon River).

The Summer Capital of Kharakhorin in the south west of Kharakhorin

Mountain: In his *Jami-al-Tavarikh* (Collected Chronicles) (《史記》), Rashid al-Din(拉施特。哀丁), the Persian historian says: “Karakorum city derived its name from Karakorum mountain.” It is clear from this that the names of Kharakhorin city and Kharakhorin were derived from Karakhorum Mountain. Since Kharakhorin River has its source in the Karakorum Mountaintop, Kharakhorin city at the eastern riverbank of Kharakhorin River, be it named after the mountain or the river, they all ultimately derived from one and the same source --- the Karakorum Mountain. Karakorum Mountain was a renown mountain throughout the history of Mongols. In the ancient times it was known as the Ud’jian Mountain(烏德鞬山)(93). And according to the *Biography of Ba’-r-su’-Ah-er-xin’-de-jin*(巴而術阿而芯的斤傳) in the *History of the Yuan Dynasty*(《元史》), “ there were two rivers sprung from the Kharakhorin Mountain, one called ‘Tu-’hu’-la’(禿忽剌) and the other ‘Selenge’(薛靈哥)”. “Once, a T’ang Imperial Court’s ambassador and the geomancers arrived here and said: ‘Thanks to the blessings of this Kharakhorin mountain, Kharakhorin has emerged as a powerful country’.”(94) Tu’hu’la River is today the Tula water flows or Tula River. And Selenge River is now today’s Selenge River (色愣格河). Both rivers have their sources sprung from the Karakorum Mountain, which must be referring to the eastern part of today’s Hangai Mountain(杭愛山) in the Hangayn Numu (Mountain Range).

What’s more, according to the book, *Shui Dao Ti’gang*(《水道題綱》, or the *Outlines in Water Routes),* “Hangai Mountain Range(杭愛山), where its edge ends high and huge, lies 14 degrees and 3 minutes west of Beijing, and 47 degrees of the Polaris’ altitude above the horizon, where the south of Ta’mil River (塔密爾河) has its source in the north of the mountain; Orkhon River (鄂爾坤河) has its source in the east of the mountain;… at the south west, all the rivers flow into the Tui River(推河).”(95)Horin Mountain is just situated amongst these rivers, which have their sources in the eastern part of the Hangai Mountain Range(杭愛山), lying about 14.3° East of today’s Beijing(116.4°E), i.e. 102.1°E and about 47°N.

Southwest of Karakhorin was the source of Tui River. As for the area along the Tui River, according to the *Later Records of Traveling North of the Great Wall*(《後出塞錄》) by Gong Zhiyue(龔之鑰) of Qing times, “In the past, the Tui River has been a beautiful garden of the Yuan Court. …Its annual harvest has always been abundant.” As a garden in the Yuan dynasty, the Tui River must be referring to the summer palace Of Ogedei Khan prior to founding the Yuan Court -----*Syra-Ordo*(as it was called as *Syra Ordo* by Rashid al-Din, the Persian historian). According to the above-mentioned Johannes de Plano Carpini, *Sira-Ordo* means ‘yellow temporary dwelling palace’ or ‘the yellow Royal camp’(96). Syra Ordo, situated in the

region along the Tui River, with its source at the south west of the Karakhorin Mountain (47°N, 102.1°E) was one of the four big *Ordu*'s within the region of Karakhorin. Its location today is about 47°N and about 110°E(97), exactly southwest of the Karakhorin Mountain.

Here the Karakhorin in the Yuan "Four Seas Survey" must be referring to the Karakhorin Mountain. In particular, it meant the Syra-ordu, southwest of the Karakhorin Mountain. It was not only one of the four big *Ordu*'s but at the same time the summer palace for the Ogedei Khan to get away from the summer heat every year. Amongst the four big ordu's, it was only here that the survey could meet the summer solstice and measure the sun shadow lengths and the day length of the summer solstice day. Whereas in the other three ordu's in Karakhorin, the capital of Mongolia in spring, fall and winter, simply can't meet the requirements for the summer solstice survey. Thus, the survey spot of Karakhorin can only be *Syra-ordu*, the summer palace of Karakhorin, lying at about 46°N and 101°E today.

(5) *Tiehle* (鐵勒, todays' Novokuznetsk in southwestern Siberia—by Translator)

There was once a nation in the north of China during the Han dynasty, a place called *Ding'ning, Dinglin*(丁寧、or 丁零、丁令), where the folks rode on high wheel carts. And at the time of the North Wei dynasty(北魏), these carts too were called high carts, later on called *dili* (狄曆), *shu-le* (敕勒) or *tieh'-le*(鐵勒)(98). During Yuan times it was called Kanklis. According to the Persian historian, Rashid al-Din (1247-1318)'s *Jami al-tawarikh* or *Universal History* (in Chinese called *Shiji* 《史記》): "The Gokturks or Kok-Turks (or *Tujue* 突厥) called wheeled carts 'kankli's(康里 *kangli*), because they mostly rode on these wheeled carts to migrate to other places, so they called wheeled carts as Kanklis." (99)This was identical with the Chinese historical records. *The Story of Gaoch'e,* or *the High Wheeled Cart Nation*(《高車傳》), in *The Book of the Wei Dynasty* (《魏書》) says: "most of the people there rode in carts, 'with wheels high and large, strung with numerous spokes from the hub to the rim'"(100). Thus the country was called Gaoch'e or "the high wheeled cart nation". And the *Biography of the Turk Bukhumu* (《不忽木傳》) in the *History of the Yuan Dynasty* says: "Kanklis was the country of the high wheeled carts in Han dynasty."(101) Accordingly, the kingdom of Kanklis or Gaoch'e was indeed the kingdom of Tiehle during the Sh'ui-T'ang dynasty. Although in the *On Ambassadorial Mission to the North* (《北使記》)by Jin' Wu'gu(金吾古) and Soong Zhong-duan(孫仲端), the name, *Han'gli* (航里), was used instead of Kanklis, in the *History of the Jin Dynasty* (《金史》) and in *the Yuan History* (《元史》) the kingdom was still called Kanklis, for Gaoch'e(102).

The Secret History of the Mongols (《元朝秘史》) says: Genghis Khan "again ordered the warriors of Subodei(速別額台) to conquer the eleven tribes including *Kanglin*(康鄰)"(103).[Subodei had been the greatest general in Genghis Khan's army. He had played a major role in every important campaign the Mongols had fought. He was then 60, probably blind in one eye, and according to some reports so fat that he could no longer ride a horse. — by *Translator*]. *Kanglin* here was an alternative in transcription for "Kanklis". Before the conquest of Ghengis Khan's, the territory of Kanklis covered a vast plain from the east of Jaik River (i.e. east of Ural River today) to the north of Khorazm (i.e. north of the Aral Sea 咸海 today). Its western boundary was bordering Kipchak Khan or Golden Horde (or *Qincha hanguo,* 欽察). Its eastern boundary bordered along the area of the Issikol Lake (伊塞克湖), Chu River and the Talash River(104). Indeed, the Kanklis during the Yuan period was the ancient *Gaoch'e* or *Tiehle.* It lied in one of the most important routes from Mongolia traveling northwest to Kipchak. In 1246, Johannes de Plano Carpini, an Italian Franciscan monk, had traveled from Kipchak eastward passing Kanklis to reach Karakhorum of Mongolia(105). Also, on 16th September, 1253, William of Rubruck(1220-1293), a member of the Flemish Franciscan missionary and explorer, left the Volga River, and passed Kanklis. Three months later, he had crossed the country of Kanklis on November 1 that year and headed east for Karakhorin.(106)[The empire of the "Golden Horde" or the Qibcaq Ulus, the greatest of the succession in the empires after

Genhis Khan's empire, founded by Batu after the death of Great Khan Ogodei. The name of this 'Ulus' is derived from the Qibcaq, the Turks that built a great part of the Mongol troops and invaded Russia, Poland and Hungaria. — by *Translator*.]

In the *Treatises on Astronomy*, the *History of the Yuan Dynasty* (《元史。天文志》), there is an inscription on the astronomical instrument, Yeang'yi[仰儀, innovated by Guo Shoujing, in the form of a hemispheric concave, with its wide opening facing outwards, and structured with grids resembling the celestial system of right angled coordinates, as well as a movable cross bar to view the stars in the center of the hemisphere. —by *Translator*] saying: "the fortress of *Tiehle* is measured fifty odd degrees as deep"("深五十奇，鐵勒寨也").(107) That is to say, Polaris was measured 50 degrees above the horizon at the fortress of*Tiehle*. Moreover, according to the same source,(《元史。天文志》) *Tiehle*, or the ancient *Gaoch'e*, was also the contemporary Kanklis in the Yuan "Four Seas Survey". The fact that the archaic name of *Tiehle* was used instead of the contemporary name of Kanklis was simply the masterpiece of those conservative power holders in the Bureau of Astronomy such as Zhang-yi, Xu-heng reading too much neo-confucianism into calendar making. Indeed, if not examining the relevant details carefully, it is just not possible to know what they called *Tiehle* in the "Four Seas Survey", was referring to the Kanklis in Yuan times. Gathering from the few data left from the survey, it can be established that the surveyed location of *Tiehle* or Kanklis is not far from the source of the upper stream of the eastern branch of the Ob River (鄂畢河) where the current Novokuznetsk (新庫茲涅茨克, called Stalinzk 斯大林斯克 in the past) is, 87°E and about 53°N.[Novokunetsk is a city in Kemerovo Oblast, in southwestern Siberia of Russia with a population of half a million or 550,000(2002 census). It is also the largest city in the oblast exceeding even the administrative center, Kemerovo, in terms of size. In 1931-32, the city was known as Novokuznetsk and in 1932-61 as Stalinsk, after Stalin. — by *Translator*]. The location of above-mentioned longitude and latitude covers the area of Mongolian settlements and activities in the Yuan Kanklis, i.e, *Tiehle*.

(6) Beihai (北海, including Kara Sea and Mt. Gora Narodnaya of Russia—by *Translator*)

Of the 15 parts of the *Tiehle* empire, the northernmost part was Kourika'n(骨利干). According to the *New T'ang History* (《新唐書》), "Kourikan is situated in the north of Hanhai(瀚海), or the Gobi Desert"[The Chinese call the Gobi desert *Hanhai* meaning 'a sea of sand'. — by *Translator*], "the land of Kourikan at the north off the *Hanhai*, was the farthest place away from the capital. Besides, after crossing the desert, the day becomes long and the night short. Moreover, cooking a goat's ribs at sunset, by the time it is cooked, it is already twilight in the east. That is because the land is close by where the sun rises."(108) Both the Pijia Khan's Stele (《毗伽可汗碑》) and Gorturks or Tujue's *Q'ue-te-qin* Stele inscription (《闕特勤碑》) of the T'ang dynasty period mentioned of **Kourika'n**, which agrees in pronunciation with the Chinese transcription, *Guligan*.(109) [Pijia Khan's stele was found in 735 AD. The façade is ancient Chinese characters and while the shaded part of the tablet is inscribed in Turkic, praising the military conquest of Pijia Khan. It is now a national treasure of China and was exhibited in a public exhibition of ancient national documents for three months from mid December 2001 to mid February 2002 in Beijing by the National Library of China. —by *Translator*].[The Gorturk rulers originated from Ashina tribe, an Altaic people who lived in the northern corner of the area presently called Xinjiang. Under their leadership, the Gorturks rapidly expanded to rule huge territories in northwestern China, North Asia and Eastern Europe (as far west as the Crimea). They were the first Turkic tribe known to use the name "Turk" as a political name —by *Wikipedia*].

Indeed, Kourikan in T'ang times was Kipcha in Yuan times. In his *Account of a Journey to the West* (《西遊錄》), Yelu Ch'ucai (耶律楚材 1189-1243) says: "traveling from India to the north west, there is a country called *Ke-fu-cha*(可弗叉國, i.e. the Chinese transcription of Kipcha)". "In this country, the day is long and the night short. Cooking a goat's ribs at sunset, by the time it is cooked, the sun is already risen in the east". It was not different from the country of *Guligan* in *the T'ang History*(《唐史》). The only difference here is the names of the country concerned. It is quite possible that the different pronunciations of the country's name arose from the long passage of time. " *Xun-si-gan*(尋思干, current Samarkand 撒馬爾干)[Population 412,300 in 2005, is the second largest city in Uzbekistan and the capital of Samarkand Province. —by *Wikipedia*] was 20,000 Chinese miles away from China. It was equally far from India to there as well. And *Kefucha* (Kipchak Khanate) to India was equally far in distance. Although winding and meandering, the journey was certainly long and weary through tens of thousands of miles away from China," says Yelu Chucai(110). *The Yuan History* (《元史》) says: "*Qincha* (欽察, or Kipchak Khanate 1243-1502—by *Translator*) is more than 30,000 Chinese miles away from China. In summer time, the night is extremely brief so brief that no sooner has the sun just set it is rising yet again"(111). This was indeed documenting in writing the long summer days and brief summer nights in the area of the North Pole. Also *the Old T'ang History* (《舊唐書》)

refers to Jiegu (結骨)[the Kirgiz, Kyrgyz, and Kirghiz are all belonged to a Turkic ethnic group found primarily in Kyrgyzstan. — by *Translator*] as a tribe of *Tiehle,* saying: “Its north, *Guligan* (Kourikan), is *Xuan Jue Zhou* (玄闕州)”(112). *Xuan* (玄) in Chinese means ‘dark’ or ‘black’, and *que* (闕), ‘land’. *Xuan Que Zhou* (玄闕州) means the ‘Land of Darkness’. Here it is referring to the lands near the Artic Circle, where the Ob River flows into the Kara Sea. Over here winter nights are very long and winter days very brief, so brief even the days during the whole winter are in darkness without the sun in sight.

Talking about winter, then in the Artic Circle, most of the days are dark as night. In a chapter, describing the Land of Darkness, *The Travels of Mraco Polo,* says: “In the months of winter, most of the time are dark without the sun in sight. And the moment you are just seeing the dawn then the night returns immediately and you can’t see a single thing yet again right away.”(113)

Besides, according to an Arabic source, “Merchants set sail off the coast of Bolgar [the country of Volga Bulgars, Muslim Turks who originally formed part of the same people for whom Bulgaria is named. The Bulgar country lay far to the north of Khazaria, around the intersection of the Volga and Kama Rivers – near the present-day Russian city of Kazan. — by *Translator*] sailing up the Volgar River and reach the point through the province of Julma [current Kama River and Viotka territory—by *Translator*]. From there they began to enter the country of Yughra — here is the northernmost limits of the earth.[The Yura or Yughra are said to have been “a savage people, living in the forests and not mixing with other men, for fear that they may be harmed by them”. To this day they occupy areas in northern Russia where fur-bearing animals are plentiful. They represent the northernmost limits of medieval Arab and Persian geographical knowledge. — by *Translator*]. Beyond this place there was only a gigantic tower built by Alexander the Great. This place is bleak and desolate. And beyond this place, only darkness all over and nothing could be seen.” At this point, the storyteller remarks: “There are only deserts and mountains over here, frost and snow all year round, without sunlight throughout the year too, neither plants grow nor animals live. Over the boundaries of those huge mountains there is the Sea of Darkness, where no sunlight is visible, only foggy, like the drizzling rain, and the land is covered with very thick snow all year round.”(114) Besides, Ibn Buttta(伊賓拔都塔 1304-1377) also had narrated of the Land of Darkness too, but I don’t think it is necessary to repeat it here.(115). Where the Arabs called the ‘Sea of Darkness’ in the Artic Circle is actually referring to the Kara Sea of Artic Ocean, meaning the Sea of Darkness.

All in all, all Chinese and foreign historical sources in reference to the neighboring areas of the Artic Circle had said that summer days were extraordinarily long and summer nights incredibly brief or winter days extremely brief and winter nights astonishingly long. Both the Chinese and foreign sources are quite reliable in this respect. Marco Polo also did mention of the ‘North Ocean’ as 40 days or so journey from Karakhorin or Karakoram, the political center of Mongolia(116). *Beihai* was indeed the Sea in the northern part of China then, or the ‘Northern Ocean’ called and known as

such in the Yuan dynasty period. According to the data of *Beihai's* sun shadow lengths and day lengths surveyed on the spot in the Yuan "Four Seas survey", we can tell that Beihai is at the location equivalent to today's 65°N and 60°E. Accordingly, the northernmost surveyed spot in the Yuan "Four Seas Survey" is here. It is approximately present-day Gora Narodnaya Peak or the People's Peak, the main peak in the Ural Mountain Range, west of the entrance into the sea of the Ob River. The peak soars to a height of 1,894 meters or 6,217 feet. [It is the highest mountain in the Urals (mountain range) but the system is largely comprised of a series of broken, parallel ridges with summits generally between 3,000 to 5,000 feet. — by *Translator*]. The Kara Sea, i.e. the Sea of Darkness is lying in the north of the Peak. The land belonged to the territory of *Gu-fu-cha* or Kifcha (ie, the country of Kipcha Turks)(117). This land was the northernmost territory of the Mongolian Yuan Imperial Court.

"At the time of the Four Seas Survey, there were altogether twenty and seven surveyed spots. The easternmost surveyed spot reached Korea, westernmost Lake Dian (Yunnan), southernmost beyond the Vermillion Cliff (Hainan) and northernmost *Tiehle* (Novokuznetsk). Never have any predecessors in history undertaken to do such unprecedented scale of survey work", says the *General Preface for the Treatises on Astronomy, the Yuan History* (《元史。天文志。總序》)(118). Here instead of saying the northernmost surveyed spot reaching *Beihai,* the *Preface* uses *Tiehle* in its stead. It is simply because the northernmost of *Tiehle's* 15 domains during the periods of the Sui and Tang dynasties was *Guligan* or Kourikan, i.e. *Xuan Que Zhou* (玄闕州) or the Land of Darkness. Thus the conservative officers in the Yuan Academy of Astronomy, who were so fond of using antique place names and the Ming authors of *the Yuan History* (《元史》) in Ming dynasty such as Song Nian (宋濂) all had preferred to use the antique place name *Tiehle* in the place of the contemporary place name, *Beihai* . In fact, the Yuan "Four Seas Survey" had used both the place name of *Beihai* and the place name of *Tiehle.* And now using the antique place name of *Tiehle* to substitute for the contemporary place name *Beihai* on account that *Tiehle* included *Beihai,* it will certainly be misleading. The two place names must be used separately, just as Guo Shoujing has pointed out in the Yuan "Four Seas Survey". Clearly, *Beihai* is *Kefucha* or Kipcha in the Yuan dynasty period, located at today's the People's Peak in the Ural Mountain Range and the Kara Sea on its northern coast, where the Ob River enters the sea. [The Kipchak people then were a Turkic tribe living on the plains between the northern shores of the Black Sea and the Caspian Sea. They led a herding life quite like the Mongols. —by *Translator*].

Endnotes

(1) The entry of the January(Chinese lunar month) *Ren-rong*(壬戌 Chinese lunar date) of the 16th year of the Zhiyuan reign(1279), and the entry of February *Wu-yan*(戊寅, Chinese lunar date) same year, in the *Annals of Two Kings*(《二王本紀》), *The Song History*(《宋史》)*J. (juan* 卷*). 47*, Kai Ming Edition(開明版), p.4589.

(2) *The entry of March*(Chinese lunar month) *Geng-rong*(庚戌, Chinese lunar date) *of* the 16th Year of Zhiyuan's reign(1279), the *Annals of theYuan Shizu* (《世祖本紀》), *The Yuan History* (《元史》), Kai Ming Ed. (開明版) P.6154

(3) The *Biography of Guo Shoujing*(《郭守敬傳》), in the *Yuan History*(《元史》)*J.*164, Kai Ming Ed., p. 6513.

(4) Ibid.

(5) Ibid.

(6) *The entry of November* (Chinese lunar month)*Yi-hai*(乙亥, Chinese lunar date) in the 8th year of Zhiyuan's reign(1271), the *Annals of the Yuan Shizu* (《世祖本紀》), *History of the Yuan Dynasty*, Kai Ming Ed. (開明版), p.6145.

(7) See the *Biography of Guo Shoujing*(《郭守敬傳》), *The Yuan History* (《元史》), *J.* 164 Kai Ming Ed. (開明版), p.6513 and the *Biography of Liu Bingzhong* (《劉秉忠傳》) *The Yuan History*(《元史》) *J.*157, Kai Ming Ed. (開明版)p.6497.

(8) *The Biography of Guo Shoujing*(《郭守敬傳》).

(9) *The Treatises on Official Titles* (《百官誌》), *the Yuan History*(《元史》), *J.*88, Kai Ming Ed. (開明版)p 6355.

(10) See Note(8).

(11) *The Biography of Xuheng* (《許衡傳》), *The Yuan History* (《元史》) *J.*158.

(12) *Shengdao*(神道, meaning 'the path of the sages') *Stele Inscription* by Yang Gongyi (楊恭懿), Chief of The Astronomy Academy*,* and Yao Shui(姚燧) in the Yuan Dynasty, in the *Shentao Stele Genre* (神道碑*類*), edited by Su Tian-jue(蘇天爵), Commercial Press(商務版) p. 868.

(13) See Note (11).

(14) Qi Liqian(齊履謙)'s *The Xing-zhuang*(行狀, or the Brief Biography) *of the Late Guo Shoujing, Director of the Astronomy Academy*, in *Xing-zhuang Genre*(行狀類),Su Tianjue(蘇天爵)'s *Genres of TheYuan Literature* (《元文類 》) *J.*50, , Commercial Press(商務版) p.718. Basically, much of the contents of the *Biography of Guo Shoujing* in *The Yuan History* are from this source.

(15) See Note (8).

(16) *The Preface in General for the Annals of Astronomy(*《天文誌。總序》, *The Yuan History* (《元史》), *J.*48, Kai Ming Edition (開明版), p.623.

(17) See Note (8).

(18) See the entry of March *Geng-rong* (庚戌, i.e. March 27 in Chinese lunar calendar) or April 20 (in the Gregorian calendar) in the 16th year of

the Zhiyuan's reign(1279) in "Shizu Shiji"(7), *The Yuan History,J.*10, Kaiming edition, p.6154. It says: "The emperor ordered Guo Shoujing to get to Nanhai to do on-the-spot sundial survey starting from the city of Shangdu and the city of Dadu passing through Henan Fu (河南府, Henan Prefecture)." The data compiled by Guo Shoujing on the length of the summer solstice daytime and nightime (April 19 in the Chinese lunar calendar or May 12, 1279 in the Gregorian calendar) that year for those top priority surveyed spots ("先測") in the first category of the "Four Seas Survey work "("四海測驗") are evidences that all the priority surveyed spots did indeed simultaneously do the summer solstice day sundial survey work on that day that year. Not a bit can the data show Guo Shoujing ever resisted the decree of Khublai Khan to get to Nanhai to do the on-the-spot survey. As the destination Guo Shoujing was decreed to reach was Nanhai and not Shangdu and Dadu, the starting points of his journey, nor Henan Fu (河南府), midway of his journey, there wasn't any reason to doubt that Guo Shoujing had ever resisted the imperial decree and didn't get to Nanhai to do on-the-spot sundial survey. What's more, it was no other than Guo Shoujing himself who made the proposal to the emperor to do such a nation-wide scale of sun shadow length survey. Otherwise, it might not get Khubulai Khan to have approved and instructed Guo Shuojing to execute the great expedition himself. Thus, his plan to do on-the-spot sun shadow length surveys, from the stage of drafting to the stage of implementation, was now in sight. For himself, there was even less reason to do anything to undermine what he had been wanting to do for years — to do a large scale nationwide summer solstice day on-the-spot survey from the north to the south across the Mongol Yuan empire. To Guo Shoujing, some parts of the old Da Ming Calendar (大明曆) were intermingled with personal bias and without the attempt to have any on-the-spot survey data verified"("皆私意牽就，未實測其數"). To the contrary, he consistently advocated making calendar by following on-the-spot surveyed data and not to be led by either personal opinions or biases." ("並依實測, 不以私意牽就". see *The Genres of the Yuan Literature* (《元文類》), *J.* 50, Commercial Press[商務版], p.719). Therefore, there's even lesser reason to doubt of Guo Shoujing's Nanhai summer solstice day survey data were not the results of on-the-spot survey work but the product of extrapolation. Just because some people were in doubts of Tang Yi Xing (唐一行)'s large scale sundials survey work having made use of the method of extrapolation to get the data, (see Joseph Needham:*Science and Civilisation in China*, Vol III Eng. Version, p.293 李約瑟《中國科學技術史》英文本第三卷第 293 頁), it doesn't mean likewise Guo Shoujing's Nanhai summer solstice day survey data could have been based on the calculation by extrapolation instead of the on-the-spot sundial readings. Certainly, to have such misgiving is wrong. Meanwhile it also shows how glaring a lack of understanding in what Guo Shoujing, the distinguished scientist in the Yuan Dynasty, had consistently advocated — making calendar by on-the-spot survey instead of being led by personal opinions."("實測，不以私意牽就") . In the face of hard facts, we should not be obstinately skeptical. If there was indeed any difficulty for Guo Shuojing to do as the decree says, "to reach Nan Hai" for on-the-spot sundial

readings, the greatest difficulty would be that the time was too pressing. From the day of receiving the imperial order (March 27), set out on the journey to Nanhai and to arrive there by the summer solstice day (April 19) or earlier, he had only 22 days to spend from the beginning to the end of the journey. Simply because the task was so urgent and the time so pressing, Guo Shoujing had no choice but to shoulder this heavy burden himself, and carry out the imperial decree to "reach Nanhai" by himself personally.

(19) "*Ku-lai-y'-ai-er(*苦來亦阿兒*)*, in Chinese, was simply the geographical annals (i.e the globe—by the *author, Dr. Han Zhen Hua*), made of wood and in the shape of a round sphere, 70% of which was green in colour indicating water, and 30% in white colour, indicating the land. Rivers, streams and lakes were drawn running like arteries and veins in between. Drawing a small square box to indicate how large the area covered and how far the region in distance, " says *The Instruments of the West (1)(*西域儀象) in *TheTreatises on Astronomy*《天文志》 of *The Yuan History*《元史》*,J.* 48. This was indeed the wooden globe Zaru Martin(札魯馬丁, Chinese transcription of the name of Jamal al-Din—by *Translator*) brought to Beijing in 1267. **In fact, such grids or small squares on the globe were the longitudes and the latitudes shown on the globe**. [See Note(20) and Joseph Needham p.556]. [In 1267 Khublai Khan invited the Persian astronomer Jamal al-Din to China to make known his discoveries. He brought along diagrams of an armillary sphere, sundials and astrolabe, a terrestrial globe and a new and more accurate calendar known in Chinese as the *Wan-nian-li*(萬年曆, calendar for ten thousand years) as a gift to Khublai. Four years later in 1271, Khublai finally established an Institute of Muslim Astronomy. There, the Chinese astronomer Guo Shoujing(1231-1316) used the Persian diagrams and calculations to build his instruments to device his calendar the *Shoushi Li*(授時曆, Calendar delivering the Season). See Bira Shagdar: "The Mongol Empire in the 13th and 14th Centuries" in Valime Elisseff.ed: *The Silk Roads: Highways of Culture,*(2000) p.137—by *Translator*.]

(20) "When the Greeks made use of the length of the day from the sundial reading on the days of summer solstice and winter solstice to determine the latitudes, the ancient Chinese too already knew different spots on the same longitude or the line from the North to the South of the country had different summer and winter solstice sundial readings," said Joseph Needham in his *Science and Civilisation in China,* Vol. III, p.542, Cambridge, 1959 edition

(21) According to *The Treatises on Astronomy*, *The Yuan History* (《元史》。《天文志》) all the summer solstice survey data were based on the use of 8 Chinese feet (尺) high rectangular gnomon sundials except in Dadu, where the 40 Chinese feet (5 丈 *zang*) high gnomon of the rectangular dial was used. Probably, this was due to the inconvenience of carrying the latter to far off places, and not the least the erection of such a dial in those places. Therefore, it was conceivable that even if the error reading of the 40 Chinese feet gnomon rectangular sundial could reduce 1/5 of those from the 8 Chinese feet sundials, it was in practice still not

widely used.

(22) There was no reading shown on the sundial at the Heng Mountain supreme, owing to the shadow having gone outside the edge of the dial on the summer solstice day there, according to *theTreatises on Astronomy, The Yuan History*(《元史》。《天文志》). Clearly the sundial survey remained targeting the sun's upper edge and not its center. Even though the use of "Jing-fu"(景符 or 'shadow definer') to survey the sun's center on the sundial was already known to them, this technology was however not being adopted by the leadership of the Astronomy Academy then. Indeed, the obstinate and conservative elements can't be eliminated overnight.

(23) Both *The Treatises on Astronomy* (《天文志》) in *Juan* 48 and *The Biography of Guo Shoujing* (《郭守敬傳》)in *Juan* 164 of *The Yuan History*(《元史》) say that the enlarged 5 times sundial and the "Jing-fu"('shadow definer') were all Guo Shoujing's innovations. But then Yang Gongyi(楊恭懿), the President of the Academy of Astronomy, as Guo Shoujing's boss, claimed credit for them all to himself. According to Yao Shui's *The Shengtao Stele of the President of the Academy of Astronomy, Yang Gongyi*(楊恭懿), "in the 17th year of Zhiyuan's reign(1280) the *Shoushi Calendar* (授時曆, i.e. the Calendar delivering Season) was completed" Yang Gongyi submitted a report to the Emperor saying "Now I, your humble official, is designing the new calendar," "enlarging the 8 Chinese feet large sundials five times and using the shadow definer to add or reduce the sun shadow lengths on the dial, so that the error margin wouldn't be too great."(See *Shentao Stele Genre*, *Yuan Literature Genres,* (《元文類》神道碑(類))*J.*60, Commercial Press, p. 869). This is really something like high-ranking officials know all, take all, and be all. In the same way, Yang Gongli unabashedly claimed every credit of innovation due to Guo Shoujin as if his own. This guy Yang Gongyi was really disgustingly shameless and low!

(24) For 里差 or the time difference in *li* , see *the Treatises on Calendars* (《曆志》(一))Part I*, the Yuan History*(《元史》), *J.*52, says: "**Yelu Chucai, (1189-1244)** the prime minister**,** in light of the incredibly geographical distance between China and *Xiyu* (西域, or countries west of China)**, invented the notion of *li-cha*(里差,** or ***the difference in longitude*** between the western countries and China—by *Translator)*. The further away from China the greater the difference in *li-cha* or longitude, the closer to China the lesser the difference in *li-cha* or longitude. Thus, although thousands of miles between the east and the west in distance, by adding or deducting the *li-cha* or the difference of degrees in longitude, there can be little or no mistake in getting the right timings." Kai Ming Ed. p.6250.

(25) Some scholars don't believe that the ancient Chinese had already embraced the concept of longitude (see *The History of Chinese Geography (*《中國地理學史》 by Wang Yong 王庸, Commercial Press, p.118, 1960 edition). But others think, "In terms of inventing the notion of longitude, the ancient Chinese were not in any way behind the ancient Greeks. It was only until the 18th century after the invention of the Marine Chronometer, the calculation of the longitude could then be possible to be accurate"(see Joseph Needham's *Science and Civilisation in China* Vol. III,

p.543, Cambridge 1959*).* Thus, it is certain that the Yuan China had already embraced the concept of the longitude. See also *The Concept of the Longitude and the Latitudinal Measurement in the Yuan Dynasty*(《元朝的緯度測量和經度概念》) by Li Guoqing(厲國清), Yih Peirong(裔培榮), and Li Botian(李勃田), a Printed Copy from the Tianjin Latitudinal Station of Beijing Astronomical Observatory, Academy of Sciences in China(中國科學院北京天文台天津緯度站).

(26) Yuan Li Zhichang(李志常): *Changchun Zhenren Xiyuji* [《常春真人西遊記》, or Travels of the Master of Eternal Spring to the West], *Juan* 1, says: "In 1221, on the southern bank of Luju River(陸局河), " it was the day of the new moon in May, and the sun was eclipsed at noon". After "traveling 10 days on foot" from the bend of the Luju River, "it was the summer solstice day then, and the sun shadow was measured at the length of 3 and a half *ci* (尺, Chinese length unit, like the English 'ft.' and 'ins'. —by *Translator*)". From here, Wylie Yali(偉烈亞力) deduced, the location should lie 47°21'N. (Ref. to *The Compiled History of Transportation of the West and China*(《中西交通史料匯編》) Book V, p.90, Note (14) by Zhang Xinglaang(張星烺), Chung Hwa Bookshop[中華書局] edition).

(27) Same as Note (24).

(28) Same as Note (19)

(29) Some people doubted that the Chinese people in Guo Shoujing's times ever knew the notion of 'longitude'. See Wang Yong's 王庸 *The Historical Outline of China's Atlas*(《中國地圖史綱》), p.75, Shan Lian 三聯 1958 Edition. **I think it is wrong to doubt the early Yuan Chinese ever knew longitudes. The above-mentioned Yelu Chucai's invention of the *Dongxi Iicha* or the calculation of the longitude difference between the east and the west and the introduction of the globe from the Islamic west into China are sufficient to prove that the Chinese by then already knew the notion by the term of 'longitude'.**

(30)As regards the Sarlos, refer to Joseph Needham: *Science and Civilisation in China*, Vol. IV, Book One,(Chinese translation) p.598 (Science Publisher, Beijing, 1975).

(31)*Starry Field*(星野)*, Yudizhi*(《輿地志》) *(2), The Local Annals of Qiongzhou Prefecture*(Hainan Island)(《瓊州府志》卷二)*, Juan 2,* p.4 ,1841 revised edition.

(32)Han Zhenghua, "The Ruler to Measure Stars' Altitudes above the Horizon in China's Navigation",(《我國航海用的量天尺》), in *Journal of Cultural Relics,* 1980, No. 2 (《文物集刊》第二集).

(33)See (31).

(34)In the Yuan dynasty period, 365 degrees make up a celestial circumference and in conversion, 1 celestial degree=0.98562° by the geometrical system of 360°, (i.e. 360°/365).

(35)With regard to the data of the summer solstice day length deduced from the summer solstice sundial shadow lengths, and the data of the summer solstice day length derived from the Polaris' s altitude over the horizon, are all adopted from the article: "The Concept of the Longitude and the Measuring of the Latitude in the Yuan Dynasty "(《元朝的緯度測量和經度

概念》) by Li Guoqing(厲國青), Yi Peirong(裔培榮) and Li Bot'ian(李勃田), in photocopy print, 1976, by the Tianjin Latitdudinal Office(天津緯度站) of Beijing Astronomical Observatory(北京天文台), Chinese Academy of Sciences(中國科學院).

(36) See Table 1 Beihai. That the day length on the summer solstice day in Beihai(北海 today's Gora Norodnaya Mt. of Ural Mountains) was 82 *ke* [刻, Chinese unit in the time division of 100ke=1day, therefore, 24hr*60min/100, 1*ke*=14.4min. by the 24hr./day time division—by *Translator*], seems to have been mistaking 88*ke* for 82 *ke*. Here in the Table both time durations of the day lengths have been converted into today's equivalent latitudes. And the 3°30' margin of error in latitude is based on the difference between 60° and 56°55' today's equivalent of 88*ke*.

(37) As for the calculating the latitude from the summer solstice day lengths, see Li Guoqing's article. The formulae applied were:

Formula (I) tanα= l /h

(l = the day length of the summer solstice day on the dial, h= 8*ci* (尺, height of the gnomon) and α is the angular distance of the center of the sun from the zenith).

Formula (II) Σ = 23°33'

α = the latitude of the spot where the observer is;

e = rectifying value

α =Σ ± α + *e*

If the sun is in the south of the zenith, use (+);

If the sun is in the north of the zenith, use (－).

Originally, Σ = 23°27', but as Guo Shoujing had deduced that the ecliptic was at 23 degrees 90 minutes. In his *The Brief Biographical Sketch of the late Guo (Shoujing), the Director of the Astronomy Academy*《知太史院事郭公行狀, Qi Liqian(齊履謙) of Yuan dynasty says, "In the case of the 'internal' and the 'external' [angular] measurements in degrees in respect of the [celestial] ecliptic and the [celestial] equatorial [i.e. in the Ecliptic Co-ordinate System and the Equatorial Co-ordinate System, those angular measurements of the celestial objects inside the celestial Ecliptic or the celestial Equator were considered as the 'internal' measurements, whereas those outside them, the 'external' measurements. —by *Translator*.], according to the accumulated data in the past practical survey, they are 23degrees and 90minutes. If 23 degrees and 90 minutes was applied, using the chord of the arc of the celestial circumference to form a right angled triangle, the daily distance from the pole agrees fully with what has been measured in practice." (*Genres of the Yaun Literature*《元文類》, The Commercial Press, p.720). Converting this figure into today's 360° system, 23 degrees and 90 minutes became 23°33'. Therefore, what was used in the Yuan dynasty for the value of Σ was indeed 23°33', and not 23°27'.

(38)In his *Self-Preface for Yu Tu (*or the *Map of China,*《輿圖自序》1311-1320), Zhu S'iben(朱思本) says: "Such as south east of Zanghai (漲海, or Canhay), and north west of the great desert so on and so forth…". See Luo Hongxian(羅洪先)'s *Guang-yu-tu* (《廣輿圖》1555)*j.* 1, citing Zhu

Sibeng's *Self-Preface*. Here, the Zanghai (or Canhay) was identified by Joseph Needham as Nanhai (see Joseph Needham: *Science and Civilisation in China*, Vol.V, Geology, First Division of the Vol., p.145 (Chinese translation by Science Publication, China, 1976 edition).

(39)The Yuan local annals of Guangzhou still entitled *the Annals of Nanhai* (《南海志》). Today, Beijing Library holds some of its surviving volumes. In this light, Guangzhou thus called Nanhai isn't simply because the city was comprised of Nanhai and Fanyu(番禺) these two counties.

(40) In his article of 31st December 1974 issue of *Tianjin Daily*(《天津日報》) entitled: *Guo Shoujing*, the author, Mu Hua(慕華), points out that Joseph Needham too identified Guangdong (Guangzhou) as Nanhai, where Guo Shoujing undertook the Yuan "Four Seas Survey" reported in the *History of Yuan*(《元史》). See Joseph Needham: *Science and Civilisation in China*, Vol.III, p.297 (Cambridge, 1959 edition).

(41) Han Zhenghua : "The Boundary And Sea Territory of Nanhai in the History of China" (《我國歷史上南海的海域及其界限》)

(42)See the entry of "Sea of Demarcation" [分水(洋)], under the subdivision of "Wei-tu" (畏途), in the *Haiyu, j.* 3(《海語》) by Huang Zhung(黃衷) of the Ming Dynasty(1536).

(43)See the *Calendar Annals* (《曆志》)(II) in *The History of Yuan* (《元史》)*j.*52, p.6250, Kaiming Publisher.

(44)In his *the Brief Biographical Sketch of the late Guo (Shoujing), the Director of the Astronomy Academy*《知太史院事郭公行狀, Qi Liqian(齊履謙) says, " The daytime and nightfall timings of the Da Ming Calendar (《大明曆》) are all using those of *Bianjing*(汴京, i.e Kaifeng 開封 today), the Song capital, as the national standard time. Those timings of Kaifeng are different from Dadu (Beijing)'s. Still, we can calculate the local timings of Dadu from here the altitude of Polaris above the horizon and the 'internal' and the 'external' [angular] measurements in degrees by the [celestial] ecliptic. [In ancient China, there were already in existence the three co-ordinate systems, namely: the Horizontal, the Ecliptic and the Equatorial, to gauge the celestial objects in the celestial sphere. In the ancient Chinese astronomy, the angular measurements (in degrees) taken of the celestial objects in the celestial Ecliptic or the celestial Equator, were considered as the 'internal' angular measurements, whereas those angular measurements (in degrees) taken of the celestial objects outside of them were considered as the 'external' angular measurements. —by *Translator*] By this calculation, we get the everyday daytime and nightfall timings of Dadu. It shows that Dadu's daytime is extremely long on the summer solstice day. The sun here rises on *Yin Zheng* 3 *ke* [寅正 Chinese time unit, e.g. *Yin shi* is the period of the day from 3 a.m. to 5 a.m. here, and *Yin Zheng* means 3 a.m. sharp —by *Translator*] or 3.45 a.m. And it sets on early *Rong Chu*, 2 *Ke* (戌初 7 p.m. sharp) or about 7. 30 p.m. The length of the daytime is 62 *ke* (or 14.88 hours) and the length of nighttime, 38 *ke* or (9.12 hours). And the length of the winter solstice day is the shortest. The sun rises at *Cheng Chu* 2 *Ke* (辰初 7 a.m. sharp) or about 7.30 a.m., and set at *Shenzheng* 2 *Ke* (申正 3 p.m. sharp) or about 3.30 p.m. The length

of the winter solstice daytime is 38 *ke* (or 9.12 hours) and that of the nighttime 62 *ke (*or 14.88 hours). This has become a permanent formula of all times ever since." (See Su Tianjue(蘇天爵) during Yuan times: *Biographical Sketch Category*(行狀類), *Genres of the Yuan Literature* (《元文類》) *juan* 50. (*Shangwu Publisher,* 商務 p. 719).[The *ke* is a traditional Chinese unit of decimal time lasting approximately a quarter of a Gregory hour. Traditionally the *ke* divides a day into 100 equal intervals of 14.4 minutes(i.e. 24hr*60min/100= 14 min. 24 sec. by 24hr/day time division). Alongside the *ke,* the ancient Chinese kept time with double hours (traditional *shichen*) also known as watches. Because one cannot divide 12 double hours by 100 *ke* evenly, each *ke* was subdivided into 60 *fen*. —by *Translator*].

(45)Yelu Cucai(耶律楚材 1190-1244) : *Collected Works of Shenran Jushi* (《湛然居士文集》). (Copy of The Collection of Publications 叢書集成本).[Yelu Cucai was well versed in Buddhist scriptures and a practioner in Taoism. Here he called himself a *Jushi*(居士) meaning a Taoist hermit. —by *Translator*].

(46)At the time when Guo Shoujing "reached Nanhai" to do the practical sundials survey, as yet there was no unified standard time based on Dadu's timings permanently for the whole of the Yuan Empire. So it was not possible to take the time difference in each place to compare with the time in Dadu, let alone to find out the longitude. During then, each place can separately calculate the sunrise and sunset timings on the summer solstice day only. Even without basing on the standard time in Biannjing(汴京, today's Kaifeng) or Dadu(now Beijing), taking 100*ke* =1 day, i.e. 1*ke* = 24*60/100=14.4min, to solve the problem, it can also find out how many *ke* in the lengths of the summer solstice day daytime and nighttime for each surveyed place .

(47) *The Annals of Astronomy, the Old Tang History* (《舊唐書。天文志》).

(48)The inscription on the *Yeangyi* (仰儀), (a concave hemispheric instrument innovated by Guo Shoujing) in the *Treatises on Astronomy*(I), the *Yuan History j.*48, (《元史》卷四十八。《天文志》(一)) p.6238, Kai Ming edition.

(49)Huang Zhong(黃衷) of the Ming Dynasty(1536) : the entry of "Sea of Demarcation" [分水(洋)], Weitu (畏途),in *Haiyu* (《海語》) *q.3*

(50) *Compass direction Maps for the Sea Routes to Barbarian Countries of the Southwest* (《西南洋各番針路方向圖》), by Jue-luo M'an-bao(覺羅滿保), and *Map of the Sea Routes in the Eastern Ocean and the Southern Ocean*(《東洋南洋海道圖》), by Si Shipiao(施世驃), both in Qing dynasty.

(51)The Persian historians called China *Machin*, meaning Great China; and in A.D.1490, Italian writings put it as '*Masin*' instead. Generally speaking,

before the arrival of the Portuguese in the east, Europeans called China, 'Cini' or 'Chin', and 'Macini' or 'Machin'. This can be seen in Barbaro's and Nikitin's works(see *Khitan and the Highway to its Great Country* 《契丹及通往其大國的大道》Vol I, p.9, 121, 151 Note, p.179 and Vol.III, p115 Note, London edition, 1915, by Yule (玉耳) and Cordier (高弟亞)). With reference to BEFEO (1924) p.597 (*School Magazine of Far Eastern French School* (《遠東法國學校校刊》), 1924, p.577 essay by l' Ru'seau (鄂盧梭)), foreign writers too referred to Vietnam peninsula, Malaya peninsula and the Islands in the South Sea as a whole as *al-sin* and referred to the China proper as '*Masin*'.

(52) The name of '*Sinaru',* is seen in the 1529 *World Atlas* (《世界地圖》), by Diego Libalo. There is a China's sea called Mare Sinaru' in the Atlas. See *The Atlas of the Portuguese Activities Abroad*《葡萄牙海外活動地圖集》, Vol. I, Map No.39, (Lisbon, 1960). 'Sin' was China and 'Masin' was Great China, see Note (51) above. Thus 'Masinaru' and 'Sinaru' were 'Great China' or 'China'.

(53)For example, the book entitled: *The Research on the Eastern and Western Oceans* (《東西洋考》) *j.*5, *Luzon*, by Zhang Xie(1618)(張燮) transcribed the name of Perez Dasmarinas, the Spanish Governor of the Philippines from the end of the 16th century to the 17th century, as "Bi-lis S'-mao-'linye-'si"(敝里絲 是貓吝爺氏)(Basic Book Series for the Studies of *Chinese Ancient Classics* (國學基本叢書), Commercial Press, p. 58). Clearly here the Spanish *Ma* sound was transcribed as *Mao* sound in the Southern Fujian dialect pronunciation.

(54)For example, the name 'Marco Polo', in Chinese translation has become 'Ma-'ke Bo-lo'(馬可波羅). The 'r' sound at the end of the word is dropped out in the Chinese translation. 'Mar' often being transcribed as 'ma' in the Chinese translation is one good example.

(55) Often the Southern Fujian dialect tends to mix up the phonics of 'B-' and 'M-' . Like the character 'wu' (無) is pronounced as 'bo'(牟), also pronounced as 'Bo', as in the case of the 'nothing'(無) in "there's 'nothing'"('無有'的'無'). Besides, 'N-' and 'L-' sounds are also mixed up. For example, 'Manila', is called Min-li-la(岷里拉) or M'an-li-la (蠻里拉) in the dialect of Southern Fujian. These are examples. Thus Bo Ni Lao (無呢耄) is called *Bonilao* in the Southern Fujian dialect.

(56)See Horsburgh's *Sailing Direction* (London, A.D.1841) p.361.

(57)*Geographical Description in General*《地理概述》*, The Isles of China's Hainan*《我國海南諸島》Book II, p.22(Guangzhou, 1976).

(58) See Gu Zhuyu(顧祖禹 1631-92), in the Ming dynasty: *Guangdong (III)*(《廣東》(三), *Essentials of Geography for Reading History(*《讀史方輿紀要》*j.*102, p4235, p4239,(Zhonghua bookstores).

(59)See Note (58) above, p.4155.

(60)For example, even until 1930s, Luofwu Mountain Range(羅浮山脈) has still been taken as the Mountain Range with the Main Peaks commencing from the five mountain ridges in northern Guangdong, with its body meandering through Qu Jiang(曲江) and Yingde (英德, or ancient Hengzhou 昔衡州), and down south ended in Zengchen(增城) and Boluo(博羅) by the Map 23 of Guangdong province in the *Latest Physical Maps of China* (《最新中華形勢一覽圖》), published by the Oriental Geographical Society(東方輿地學社). In fact, there is the *Huashishan* Mountain Range(滑石山山脈) blocking in the midst. To join them together and see them as one Luofwu mountain range is to have inherited the mistaken views of the past.

(61)See Note (58), from the same book, p.4240.

(62)Li Daoyuan(酈道元 472-567), in the Northern Wei times(北魏): Kuang Shui (涯水篇, or Kuang Riverlet), *Shui Jing Zu*(水經注 or *Notes to the Book of Rivers*)*q.*39,(*Basic Book Series for the Studies of Chinese Ancient Classics)*《國學基本叢書》, Book VI, p.95, Commercial Press)

(63)Song Le'shi(宋樂史):*Taiping Huangyu Ji*(《太平環宇記》)*j.*157,entry of Southeast route of Guangdong(廣南東路).

(64)"Zhang Yi(張易), the prime minister said in the February(lunar month) of 1280: "The Monk has possessed the mystic power of ordering about the ghosts and making them soldiers.'" See *The Biography of Kublai Khan, the Imperial Biography of Yuan Shizu* (《世祖本紀》) in the *New Yuan History* (《新元史》) *j.*10, p.6619 Kai Ming edition.

(65) "Yaoshan(堯山, or Yao Mountain)" of Yinde County(英德縣) in Guangdong, is 40 Chinese miles west of the county." [Gu Zuyu(顧祖禹), Ming dynasty: *Essentials of Geography for Reading History*(《讀史方輿紀要》) *j.*102, Zhonghua bookstore edition p.4240.] Here, "west of the county" should be "south west of the county", where present-day Daluo Mountain(大羅山) in the southwest of Yinde County is located.

(66)Explanation of YuTai(嶽台) in *C'i Yuan* (《辭源》*The Dictionary of the Sources of Chinese Characters and Phrases*), *Divison Yin*(寅, or the third of the twelve Earthly Branches)p.139.

(67)"*Wushan*(吳山) was also named *Yueshan*(嶽山) in ancient times" *Er Ya*(《爾雅》) explaining the character 'Shan' (山, or mountiain), takes it

as one of the five *yu* (嶽, or supreme mountains).” in the *Geography division (Historical Geopgraphy)*[地理分冊(歷史地理)], p.116, *C'i Hai*《辭海》or the *Encyclopedic Dictionary of Chinese Characters,* (Shanghai Dictionary Publisher, 1978).

(68) The *Silibu tu* (《司隸部圖》) of Western Han dynasty, map 15-16 in book 2 of *the Atlas of China's Historical Maps* shows that there is 嶽山 or Yue Mountain in the southeast of the present-day city of Baoji(寶雞市). (Compiled by the Editorial Group of the Collection of China Historical Maps 中國歷史地圖集編輯組編輯, and published by Zhong Hwa Cartological Society 中華地圖學出版社出版, 1975, First Edition).

(69) See *Chuo Geng lu* (《輟耕錄》) by Tao Zongyi (陶宗儀) 1376 in the late Yuan dynasty.

(70) Horin *Lu*(和寧路 Karakhorin circuit), *Treatises on the Geography*(I)(《地理志》), the *New Yuan History (*《新元史》) *j.*46, (Kai Ming edition, p.6716)

(71) See *The Imperial Biography of Yuan Taizu*,(1277 spring) in *The New Yuan History*, *j.*3 (Kai Ming edition, p. 6608)

(72) *Changchun zhenren xiyou ji* (or *Travels of the Master of Eternal Spring in the West,*《長春真人西遊記》), *juan.* I. [It is one of the most famous Chinese travel descriptions of all times. The 2 juan book was translated by Arthur Waley in the series, *The Broadway Travellers.* The author Li Zhichang 1193-1256, came from Guancheng, Kaizhou (today's Fancheng of Sahgndong province). —by *Translator*.]

(73)See Note (71).

(74)In *the Secret History of the Mongols*(《元秘史》), the Mongolian word, 'ordu', has been transcribed in Chinese as “w'o-e'r-duo”(斡兒朵), and in *the Yuan History* (《元史》), as “w'o-er-duo”(斡耳朵) or “w'o-lu-duo”(斡魯朵). However, the origin of this word is 'orda' in the language of the Gok Turks', meaning, “ the palace hall, palace tent, movable palace, or camping palace”. (See “A Study on Woherduo in the Yuan Dynasty*”* 《元朝斡耳朵考》by a Japanese scholar 箭內互, in *The Study of the Mongolian History*《蒙古史研究》)

(75) *The Tables of Queens and Concubines* (《后妃表》) *in the Yuan History* (《元史》), *j.*106, says that Kublai Khan had four ordos [or huge tent palaces of yellow felt supported by gilded wooden columns —by *Translator*], namely, the first ordo, the second ordo, the third ordo, and the fourth ordo. And his queens and concubines could be called by names totaled 37. (Kai Ming edition, p. 6405)

(76)Joachim Barkhausen : *L'Empire Jaune de Genghis Khan* (《成吉思汗帝國史》), translated by Lin Mengong(林孟工), says in p.179 : "(in 1229) He held a conference to discuss the successor issue at Karakhorin". In the Note (3) On p.203, "*The Yuan History"* 《元史》says: "The place of conference was in Karakorum (闊迭額阿剌勒) by the Kerulen River(怯綠連河). That was Genghis Khan's first tented site or ordo."

(77) See Note (76) above.

(78) *The Imperial Biography of Yuan Taizhong (Ogedei Khan)*(《太宗本紀》) in
The New Yuan History (《新元史》) *j.* 4, says: " After the installation of Ogedei as the Great Khan, he also decided to live by the Kerulen River(怯綠連河) and the Orkhon River(盧朐河)" (Kai Ming edition, p.6610).

(79) It was during 1236 January spring or the 7th year in the reign of Ogedie Khan(1229-1241). See the *Imperial Biography of Yuan Taizhong (Ogedei Khan)* (《太宗本紀》), *The Yuan History* (《元史》) *j.* 2 (Kai Ming edition, p. 6136).

(80) The original name of the city of 和林城, or Kharakhorin was Ordu-balik, meaning a city of palace (a city of movable palace). See *Encyclopedia of Islam*, Vol. II, old edition p.785, s.v. Karakorum. [Ordu Balik(also spelt as *Ordu Balykh, Ordu-Baliq, Ordu-Balig, Ordu-Baligh,* meaning city of the court, also known as Mubalik, was the capital of the first Uyghur Empire. Built on the site of the former Gokturk imperial capital, 17 km north-to-northeast of the later Mongol capital, Karakorum. Ordu-Balig is situated in a grassy plain called the Talal-Khain-data steppe, on the western bank of the Orkhon River in the Khotont'sum of the Arkhangai Province, Mongolia, 30 km north-to-northeast of Kharakhorin. See *Wikipedia.*)

(81) See *Voyages of Johannes de Plano Carpini*.

(82) *Travels Outside the Northern Boundaries of China*(《塞北紀行》), by Zhang D'ehui (張德輝), carried in the *Local Annals of Chengd'e County* (《承德縣志》).

(83)W.W. Rockhill's *The Journey of William of Rubruk to the Eastern Parts* (London, 1900, ISBN 0-8115-0327-5), p.345-6, also see the Note quoted from Rubruck's *Journey to Horin*(《和林紀行》. See also the entry of Horin *lu* (和寧路 Karakhorin circuit), in *the Treatises on Geography*(I)(《地理志》), *The New Yuan History* (《新元史》),*j.46* (Kai Ming edition, p.6716).[The Hakluyt Society released an updated translation in 1990. See William of Rubruck, *The Mission of Friar William of Rubruck: His Journey to the Court of the Great Khan Mongke, 1253-1255(Works issued by the Hakluyt Society,)* translated by Peter Jackson, David Morgan, 1990, with commentary and

extensive notes by two noted Mongol specialists make it the preferred edition for those who wish to have full scholarly annotation. ISBN 0-904180-29-8. —by *Translator*]

(84) *Travels of Marco Polo,*(《馬可波羅遊記》) by Yule and Cordier, Vol. I, p.227, Note (1).

(85) See *Encyclopedia of Islam*, Vol. II, p. 785 (old edition).

(86) See *the Imperial Biography of Taizhong(Ogedei Khan)* (《太宗本紀》), *The New Yuan History* (《新元史》) *j.* 4, (Kai Ming edition, p. 6610).

(87) See *Horin circuit entry*, *the Treatises on Geography, the New Yuan History* ,*j.*46.[Back then in the Yuan dynasty period, the circuits were the seats of both military units(the Myriarchies, 萬戶府, *wan-hu-fu*) keeping order and civil governments (the Directorates-general, *tsung-kuan-fu*) performing judicial, revenue, educational and welfare functions. —by *Translator*.]

(88) *The Treatises on Geography*(《地理志》) in *The New Yuan History*(《元史》)*j.* 58, the entry of the Directorate-general of Krarakhorin circuit and the Secretariat of other circuits, Lingbei (or North of the Mountain, 嶺北) says : " In 1232, the city of Horin, was made for Wan'ann Palace(萬安宮). And in 1235, Ogedei Khan began construction of the palace called *Jia Jian Tu Han* Palace(迦堅荼寒殿) about 70 Chinese miles or 30 km north of Karakhorum.

(89)Yelu Zhu (耶律鑄 1221-1285) was Yelu Chucai's (耶律楚材 1190-1244) second son, and was Vice Premier during Ogedei Khan's reign. A poet himself, he had a book to his credit entitled *Shuang Qi Zui Ying Ji or A Drunkard Hermit's Works by the Two Streams* (《雙溪醉隱集》), in which there is a chapter entitled *the Conquest of Horin* with a footnote by himself. Here the quotation is cited from his own annotation.

(90) See the entry the Branch Secretariat of Lingbei (嶺北) and other places and the Directorate-general of the Horin circuit, in *the Treatises on Geography*(I)(《地理志》), *The New Yuan History*(《元史》), *j.*58 (Kai Ming edition, p.6273).

(91) Yule & Cordier : *Travels of Marco Polo*, Vol. I, p.229, map of the city of Horin and its surroundings.

(92) For Horin Mountain(和林山), see the text that follows.

(93) *Biography of Ba-er-mu-ah-er-teh-d-jin*(《巴而木阿而忒的斤傳》), the *Yuan History (《元史》),j.*122 (Kai Ming edition, p. 6427).

(94)Wang Guowei(王國維) says: "*Wen kun* (嗢昆, today's Orkhon River 鄂爾坤河), *Xian e'* (仙娥, Today's Selenge River 色愣格河), both rivers have their sources sprung from *Hangayn Nuruu* (Mountain Range), of which the people in the T'ang dynasty called *Wu-d'e-jian* Mountain(烏德鞬山) or *Yi-du-jun* Mountain(鬱督軍山), whereas Horin Mountain(和林山) was called after the name of the place." (See *Guan Tang Ji Lin*《觀堂集林》*j.* 20.) However, F. Hirth takes the *Wu-d'e-jian* Mountain(烏德鞬山) as Horin Mountain. (See F. Hirth : *Nachworte,* p.33). The Japanese scholar Bai-wu-kuji (白烏庫吉) agrees. [See the *Research in the Eastern Hu Nationalities* (《東胡民族考》), Book (Continued), Chinese translation, p.6].

(95) See *Outlines of Water Routes* or *Shuidao Tigang*(《水道提綱》) *j.* 23.

(96)Rene Grousset: *Histoire de l'extreme—Oriente*, (Paris, 1929), Chinese translation by Feng Chengjun(馮承鈞)'s *The Brief History of Mongolia*(《蒙古史略》p.44).

(97)A. Hermann : *Historical and Commercial Atlas of China* (Harvard—Yenching Institute, Cambridge, Mass. 1935), p.49: *Beginnings of the Mongol Empire – Boundaries of 1234A.D.* Here, on the map, Syra Ordu was shown on the southwest of Karakoron(哈剌和林), on its east was the source of Orkhon River(鄂爾坤河), on its south (a little inclined to the east) was the source of the Tui River(推河), and according to the map, its location was about 46°N and about 101°E.

(98) See Fan Wenlan(范文瀾) : *General History of China* (《中國通史》) Book 4 p. 62-67(People's Publishing, 人民出版社 1965), also *Tiehl'e zuan(*《鐵勒傳》) in *The Shui History*(《隋書》)*j.*84, and *The Tujue zuan* (《突厥傳》)in *The Northern Zhou History* (《北周書》), *j.* 50.

(99)Refer to Bretschneider : *Mediaeval Researches*, Vol. II, pp. 25 – 34.

(100) See *Gaoche Zuan*《高車傳》,*The Wei History* (《魏書》), *j.* 103.

(101) See *Bu Hu-mu Zuan* (《不忽木傳》), *The Yuan History* (《元史》), *j.* 130.

(102) The word, 'Kanklis' , see *Place Names of Places in the Western Regions Outside China*(《西域地名》, by Feng C'hengjun (馮承鈞) [North Western field research book series, 1930].

(103)*The Secret History of the Mongols*(《元朝秘史》續集)Vol. I(Continued) (a Collection of Publications 叢書集成本).

(104) See Note (99).

(105) See *Voyages of Johannes de Plano Carpini*, also *The Collected Historical Sources on the Communications Between China and the West* (《中西交通史料匯編》), Book V, p. 322-323, by Zhang Xinglang (張星烺)[Furen University Press 輔仁大學, 1930].

(106) See W.W. Rockhill's *Rubruck and Diary of a Journey*, p.345-6.

(107)The Inscription on the *Yeangyi* (仰儀銘辭), *the Treatises on the Yuan Astronomy*(I), (《天文志》(一), *the Yuan History*(《元史》), *j.*84, (Kai Ming edition, p.6238).

(108) *Guligan Zuan*(《骨利干傳》), *The New Tang History*《新唐書》*j.* 217, Part 2.

(109)*The Historical Sources of Western Tujue* (《西突厥史料 》)by Sawoau, translated by Feng C'engjun(馮承鈞), p.71(Commercial Press, 1934 edition).

(110)*Journey to the West* (《西遊錄》), by Yelu Chucai(耶律楚材), in the *shuzai laoxue congtan*(《庶齋老學叢談》), *j.*1 by Sheng Ru-tsi (盛如梓) of the Yuan dynasty.

(111)*Tutuha Zuan* (《土土哈傳》), *The Yuan History*(《元史》), *j.* 128.

(112)*The Hui Hui' Zuan* (《回迄傳》), *the Old T'ang History*(《舊唐書》, *j.*195

(113)"The greater part of the months in winter, owing to the want of sunshine, darkness and humidity dominated the whole land: as soon as you see the twilight of the sun, you will see nothing immediately," said the *Dark World* of *Travels of Marco Polo*, L'mouseau French version (Journal of the Geology Society 地學會輯). As regards fragments of records about the "Land of Darkness", most publications used to say, "In this country (referring to the country under the rule of King Kuangze of the Tartans), there is a state by the outskirt of the boundaries extended to the far north, called 'Darkness', owing to the fact that the whole year round there's only darkness: perennially, no lights of the stars, moon or sun visible, just like our evenings."[See the translation of Feng C'engjun's(馮承鈞) of *Travels of Marco Polo*, edition with annotations by Sha haian, Book III, p. 816.] However, the Chinese translated version of the *Travels of Marco Polo* by Yule has it thus : "Traveling from the above mentioned country (the kingdom ruled by King Kuangze) further northward for a rather long distance, one will come to a place called, 'Darkness', where one can neither see the sun, moon nor stars, and it is all the time as dark as we're at the time from evening till dawn."

(114)See Marsalak-al-Absar quotation from Yule and Cordier : *Travels of Marco Polo,* Vol. II, p.485, n.1(London, 1926).

(115)Yule and Cordier : *Cathay and the Way Thither*, Vol. IV, p.7 (London, 1916).

(116)Yule and Cordier : *Travels of Marco Polo*, Vol. I p. 227-228, n. 1.(London, 1926).

(117)'Kifcha'(可弗叉) is actually 'Kipcha' (欽察), because there's no 'p' in the Arabics, and 'f' is used instead.

(118)*The General Preface for the Treatises on the Astronomy*(I)[《天文志》(一)], *The Yuan History* (《元史》)*j.*48, (Kai Ming edition, p.6237).