

# MINISTERS OF YOUXUAN AND THE SURVEYING AND MAPPING IN ZHOU AND QING DYNASTIES

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[Abstract]

It is well known that China is an ancient civilized country with long history, so is its surveying technique. A number of records about surveying and mapping were found in archaeological studies. However, how the surveying and mapping were performed during Zhou and Qing Dynasties (841B.C - 206 B.C.) is still a problem. "Ding Nan" (a carriage for orientation determination) and "Ji Li Gu" (a drum to measure mileage) were invented in ancient China. In <Science and civilisation in China>, Dr. Joseph Needham, a British scholar, pointed out that "Ding Nan" and "Ji Li Gu" obviously were of great value in mapping. Unfortunately, the records showing relation between them and surveying cannot be found.

After years' studies in history of surveying and detailed analysis of precious historical documents, the author concluded that Ministers of Youxuan was the special ministers who mastered surveying and mapping knowledge. They were sent by central government in every August of slack season of lunar calendar in Qing Dynasty, to make a survey of various places using "Ding Nan" and "Ji Li Gu". They measured the azimuth, recorded placenames and distances, and then drew on a geographic sketch. After coming back the capital, they arranged the documents and plotted maps. These materials were prepared for the emperor to control the information of boundaries, population, taxes and fortresses etc. The precious historical records of Ministers of Youxuan are the best answer to the conjectures made by Dr. Joseph Needham.

[Key Words]: Ministers of Youxuan, Ding Nan, Ji Li Gu, surveying, record, mapping

## 1. Review of mapping and surveying techniques before Zhou and Qing

### 1.1. Differences between maps and paintings

Both of maps and paintings possess symbols and colors. However, a map must include the azimuth, be mathematically accurate, to some extent (even it is approximate), have text records (including annotations of toponyms and numbers, the map names and the explaining texts. ) Therefore, it is impossible that maps with geographic figures and literal annotations existed before the occurrence of any characters. The most original map probably was no difference from the painting. In other words, maps were born out of paintings.

### 1.2. Occurrence of characters

According to the cultural relics found in archaeological studies, hieroglyph also came from paintings. During Xia and Shang dynasties, there appeared Jia Gu Wen, but it still belonged to the primary stage of literal development as the writing

format was not unified and canonical. In Zhou, the Zhong and Ding characters were developed. Not until the first emperor of Qing Dynasty unified the six countries, Chinese characters gradually become uniform.

### 1.3. Numbering before Zhou and Qing

Since the appearance of the literal records, the numbering system used in our country (China) has been algorism. The Jia Gu character and Zhong Ding character appeared in Yin made use of the combined characters of one, two, three, four, five, six, seven, eight, nine, ten, hundred, thousand and ten thousand to count the natural numbers less than one hundred thousand. [1]

### 1.4. Surveying instrument and maps before Zhou and Qing.

Based on the related legends, there were already compasses and squares during the time of Fu Xi. When the Great Yu performed the task of water-control, he used the surveying instrument such as compasses, squares, rules, ropes and metering wood. Although they were relatively original and the accuracy was not as good, they showed the quantifying trend. Once to be a Si Kong (an official responsible for construction),

the Great Yu made use of "established laws and measurement standards", "set up the gauge when walking over the mountains [3], then surveyed the topography". He also "exploited nine states (means China), dredged nine roads, explored nine dams, surveyed nine mountains"[4], "collected taxes based on the glebe areas"[5], and "expropriated metals from nine cantons, casted Jiu Ding to symbolize the nine states." [6] It indicated that in the Xia dynasty people began to survey and measure the terrains of China and they also made a solid map: Jiu Ding.

In the Ming dynasty, Yang Cheng pointed out in the introduction of <Shan Hai Jing Bu Zhu> that both <Shan Hai Jing> and <Shan Hai Tu> originated from the Jiu Ding, "all of those can be characterized were collected in <Yu Gong>, and what were rare and abnormal were shown on the Jiu Ding, the Jiu Ding Map, distributed by some ones named Zhong Gu and Kong Jia, was called <Shan Hai Tu>, the text then was named <Shan Hai Jing>. In the Qing dynasty, the Jiu Ding vanished, but <Shan Hai Jing> and <Shan Hai Tu> were kept." [7] The history before the Zhou and the Qing dynasties was too old, what remain currently are some tortoise shells and pottery pieces. The history record only documented some legends about the surveying and mapping. Although the legends are not the fictional myths, they are not reliable evidences.

## 2. Surveying and mapping in Zhou and Qing

### 2.1. Recordation about the surveying and mapping in Zhou and Qing

1) In China, the authentic history record about surveying and mapping began from the Zhou Dynasty, for example:the "Zhi Fang Shi" who "managed the maps all over the world" [8];the "Da Si Tu" who "managed the terra maps" [9];the "Si Xian" who " was responsible for the Map of Nine States" [10]; the "Liang Ren" who "recorded and numbered the terra and kept the maps" [11], and

so on.

2) In <Shi Ji>, there was a description that "the Emperor Wu assigned Nangong Shi and Shi Yi to show the Nine Dings, then honored them..." [12]. It showed that the Emperor Wu in the Zhou dynasty awarded the leuds based on the Map of the Jiu Ding (that is <Shan Hai Tu>).

3) In the Zhou dynasty, there were eight utilized directions: east, west, south, north, northeast, northwest, southeast, and southwest developed from the four directions: east, west, south, and north adopted in the Xia and Shang dynasties.

4) <Shi. Zhou Song, Ban>: "Duo Shan Jiao Yue, Yun You Xi He". According to the note from the historian Zheng Xuan in the Dong Han dynasty: "You, is a map, ... that mapped and numbered the mountains and rivers ". [13]

5) <Zhou Li>: "measured the terra using the Xian and Gao" [14]. This demonstrated that the surveying instrument was more precise in the Zhou Dynasty than in the Xia and the Shang dynasties. "Xian" is also called "Xuan", which means gage with vertical drop, "Gao" equals to the horizontal gage used today.

6) <Zhou Bi> has the record that "using square ruler to check the scale of the rope and measure height, depth and distance, plotting circles with compasses, and drawing rectangles with square ruler". "A circle comes from compasses, a square is from

rules"---- various complicated surveying and mapping tools. The finding of Gou Gu Theorem and the appearance of proportional scale [15] indicated that the surveying instrument and computing methods were relatively precise and rigorous in that era. It was a significant advance from the cursory cartography to the quantified cartography.

7) <Xun Zhi> has a record of the <The map of Qing>[16]-----which is a local map

8) <Zhan Guo Ce. Zhao>: "I (Su Qing) personally think that corrodng to <The world map>, the total territory of leuds is five times big as that of Qing"[17]. It demonstrated that in the Zhan Guo period there were not only the maps of various leud countries, but also <The world map> (the map including all leud countries). Su Qing made an area compare using <the Map of Qing> and <The world map>.

9) <Meng Zi>: "Any benevolent government has to start from determining its border. Once the border is fixed, distributing fields and salaries can be completed indoors". [18]----Borders were shown on maps and used in politics.

10) <Guan Zhi. Di Tu>: "Any head of the army must understand and examine maps in advance"[19]---Maps were in military use.

11) Started from Zhou, finished by the Zhan Guo period, <Shan Hai Jing> actually is <Shan Hai Zhi>. It is the rudiment of <Di Li Zhi> (historical geography). It mainly includes the records about the names of mountains, rivers and walled cities, distances between cities, and produce of each city in the Qing period, and so on. It also has records about the related folk-customs and fames (the mythic parts).

12) In the introduction of <Feng Su Tong Yi>, Ying Shao wrote: "(The governements of )Zhou and Qing often dispatched Ministers of Youxuan in every August to search ancient dialects, to record them when coming back, and store the records in secret places". [20]

13) Yang Xiong mentioned in <Da Liu Xin Shu>: "I heard that the recording books edited by Ministers of Youxuan in previous dynasties were all stored in the palaces of Zhou and Qing. When damaged, they no longer existed. Only a Sichuan resident Yan JunPing who was keen of the ancient books had ever seen what Ministers of Youxuan had presented". [21]

14) Chang Ju wrote in <Hua Yang Guo Zhi>: "Ancient emperors had Ministers of Youxuan. But since the rise of Han, ...only the official name was heard, nobody knows its functions. Only Yan Jun Ping knew about it: this official investigated the folk-customs of various locations, the similarities and differences of the Nine States, the sounds and dialects all over the world so that the government knew the information of everywhere". [22]

15) There was a record about the tomb of the First Emperor of Qing in <Shi Ji> by SiMa Qian: "He (the First Emperor of Qing) ordered craftsmen made rivers and oceans using mercury. It showed the astronomy and geography. Woods and grasses were cultivated to emulate mountains".---It was a vivid map model in the tomb of the First Emperor of Qing.

16) <Song Shi. Yu Fu Zhi> showed: "During the period of Emperor Cheng of Zhou, Shang Shi (messenger) from Yue came to pay a formal visit. But the messenger was afraid of losing his way back, Emperor Cheng gave him an orientation carriage to find the direction of south. After that, they (the carriage and the method) all disappeared." [23]---That carriage is Zhi Nan Che, or called Ding Nan Che.

### 3. Discussion on an argument made by Dr. Joseph Needham

2.2 Needham mentioned following problems in his publication <Science and civilization in China>, vol 5, pt1,

1) The time when Ji Li Gu was invented in China

He thought that the first time when Ji Li Gu appeared in Chinese literatures can be traced to the time of the crown Prince of the state of Yan (240 A.D. ~226 A.D.), or the time of Han Yan Shou (140 A.D. ~70 A.D.). [24]

2) surveying and mapping related to Ji Li Gu (a drum to measure mileage) and Ding Nan Che (a carriage for orientation determination) Needham then mentioned that no record

was found in Chinese literatures about the use of Ji Li Gu by Chinese cartographers [25] and no relation was made between the Ding Nan and cartography [26].

Fig.1. Recovered models of Zhi Nan Che and Ji Li Gu by Wang Zhen Duo

Fig.2. Rubbings from a carriage picture in the Han dynasty

3). Conjectures made by Needham

On the other hand, Needham believed that Ji Li Gu was very useful on the prairie or plain fields except those mountain areas [27] and Ding Nan was of great value in cartography in a wide territory [28]. And he also stated that many ancient maps

plotted by the Chinese only relied on the azimuth calculations from the speed and compasses [29].

#### 4) Interpretation of the character "You"

<Bai Hua Jian>:"(Ban)You Zhi Wei Yuan Chuan[30]." Ban You means territory. <Si. Zhou Song. Ban>: "Duo Shan Jiao Yue, Yun You Xi He". Zhen Xuan explained: "You" is a map. [31] They feted according to the map. <Kang Xi Dictionary> and <Jing Ji Xun Gu> also stated that "You" means "Tu". In ancient China, "Tu" specially meansma p. [32]

<Chinese Dictionary>: "You, originally a name of a carriage". Also "You Che, is a light carriage". A light carriage defines the weight of the carriage, but not the function. The author suggests that the "You" in "You Che" has the same pronunciation as the "You" (which is a map). They are "Tong Jia Zhi " (the same character with similar pronunciations but difference writing forms). Plenty of similar examples can be found in ancient Chinese.

Therefore, "You Xuan" or "You Che" can be explained as "Tu Che", which is a light carriage specially for surveying and mapping. It is very possible that this light, tall carriage was equipped some surveying instrument such as Ji Li Gu and Ding Nan. It was easy to observe the landform from the carriage. The umbrella was used to block the intense sunlight and rain. "Ministers of Youxuan" or "Ministers of Youche " were ministers who drove mapping carriage and possessed special surveying knowledge and skills. They were assigned by government to survey the country. Certainly, surveying was just one of their assignments. They also had the important tasks of investigating dialects, customs, traffic, products, military fortresses, populations, and taxes of various locations. But in the beginning period of Han "Ministers of Youche" was only heard and few people knew their duties. Only Yan Jun Ping and Li Lu Weng Ru in Si Chuan province knew their functions.

In following text, the narrations about "Ministers of Youche" or "Ministers of You Xuan" by Ying Shao, Yang Xiong, and Chang Ju are further explained.

"(The governments of )Zhou and Qing often dispatched Ministers of Youxuan in every August"—this means that in the time of Zhou and Qing, every fall, after the harvest the government sent the ministers who were capable of surveying and mapping to drive the mapping carriage to travel around the country.

"This official investigated the folk-customs of various locations," indicates that "Ministers of Youxuan" received the assignments to do research on the nature sights and popular customs at different regions. All of them are important geographic information.

"Comparing the similarities and differences of the Nine States". It is necessary to communicate with other regions because there were lots of similarities and differences between central area and other areas.

"Recording the sounds and dialects all over the world". Language barrier had to be overcome first to master the situations all over the country.

"Presenting and recording them". After coming back with collected the useful information, they needed to report to government to make records, and to plot maps. "Zhou" means reporting. "Ji" could be "Fu Ji" or "Ban Ji". "Fu Ji" includes the information of population, products and taxes. "Ban Ji" means territory( including maps, borders, and areas).

If the task of "Ministers of Youxuan" was only to find out the dialects and customs, what they needed to do after coming back to capital was only presenting a memorial to the emperor instead of making records and storing them. Only because the documents and maps they made were critical for the country and government, those records were stored in secret places. This ensured the government in the capital to control the information from all over the country.

#### 4. Cartography in Zhou and Qing

##### 1) Media and tools for mapping in Zhou and Qing

Archaeological studies revealed that there appeared silk in Zhou. But most words and texts were carved on bamboo pieces, wood boards. There were also drawings on potteries, bone and gunmetal wares. The general Meng Tian of Qing invented brush pen using animal hair. Plotting on silk using brush pen and pigments was much easier than carving on bamboo pieces, wood boards.

##### 2)Excavated <Qing. Di Li Tu> in Gan Su province and "Shi Fu Ban Zhe"

In 1989, <Qing. Di Li Tu> was discovered at Fang Ma Tan of Tian Shui county in Gansu province. It is a local relief map plotted on wooden board by brush pen instead of knife. It indicated that during Qing dynasty the surveying and mapping skilled was

highly developed. This is backed up by the "Shi Fu Ban Zhe" shown in <Lun Yu. Xiang Dang>. Zhen Xuan noted: "Fu Ban Zhe, a person managing the maps of countries".

Fig.3. Excavated <Qing. Di Li Tu> in Gan Su province (In part)

##### 3) Cartography in Zhou and Qing

In periods of Zhou and Qing, although there were simple surveying tools for measuring azimuth and mileage, it was impossible to make an on-site survey like what we are doing using modern instrument. Therefore, the survey in Zhou and Qing could be to record directions, mileages, toponyms and to plot mountains, rivers, walled cities, and passes. The final emendation and mapping were performed in the bases. These work were all accomplished by "Ministers of Youxuan".

This cartographic method is reliable in reflecting the major elements (such as cities) of a map. Because the relative direction and distance among cities were know, they could make a regional triangle control network. The subordinated elements were then filled and mapped according to the related positions. For some remote and unfamiliar geographic elements, such as deserts, origins of the rivers, the records could be not very accurate, even wrong. However, these techniques were good compatible with the need at that time. We should not criticize the accuracy of ancient maps based on the requirement of the modern mapping.

4. Assigning "Ministers of Youxuan" was a particular way for surveying and mapping in Zhou and Qing

1) Author's review on conjectures made by Dr. Needham

In Zhou and Qing, most of people stayed around the central plain near the Wei river and Yellow River. Most terrain in that region is plain. Therefore, Ding Nan and Ji Li Gu could be used in that area.

2) <Xing Cheng Lu> and "Ministers of Youxuan"

Yang Xiong wrote in <Da Liu Xin Shu>, "I heard that the recording books edited by

Ministers of Youxuan in previous dynasties were all stored in the palaces of Zhou and Qing. When damaged, they no longer existed". And Chang Ju mentioned in <Hua Yang Guo Zhi>: "Ancient emperors had Ministers of Youxuan. But since the rise of Han, ... only the official name was heard, nobody knows its functions". These records mean that in the Han period there was no longer "Ministers of Youxuan". However, the method of recording directions and distances and collecting geographic elements used by "Ministers of Youxuan" was kept, because after the Han, new maps had to be generated in addition to the old maps. Based on <Shui Shu. Pei Ju Zhuan>, in the period of emperor Yang, when hosting the visitors and businessmen from western countries, Pei Ju needed to "entice them to tell their country names, and the terrains of the mountains and rivers", then "make maps to indicate the important cities". [34] <Tang Liu Dian. Bin Bu> showed: "When those foreigners came to the capital, a diplomat was assigned to inquire them about terrain and custom maps of their countries, then presented it to the emperor." [35]

Jia Dan, a cartographer in the Tang Dynasty said "All envoys coming from other countries and our returning envoys must be inquired about the details of the terrains over there. Therefore, the dangerous and important geographic locations in China, the customs of various alien people were clearly recorded and easily told." [36] Jia Dan plotted <Map of the Guan Zhong, Long You Ji Shan Nan Jiu Zhou > and <Map of Hai Nei Hua Yi> and composed geographic works: <Huang Hua Si Da Ji> and <Shi Dao Ji>.

At the beginning of Song, cartographer Shen Kuo wrote <Shi Liao Tu Chao> and made a geographic model of Liao using paper and wood scraps based on it. Then he chose wax to make a same model. Shen Kuo also plotted <Shou Ling Tu> (that is, <The map of states and counties>).

In July of the fourth year of Emperor Jing De of Song, the emperor asked "Hanlings and drawers investigated different roads and areas respectively, mapped the mountains and rivers, indicated the geographic distances, then submitted maps to Shu Mi Yuan."

In summary, since Shui, Tang and Song, "all envoys coming from other countries and our returning envoys" must make a <Xing Cheng Lu> to record the azimuth, the distance, the roads, cities, mountains, and rivers they passed. Then "Hanlings and drawers mapped the mountains and rivers, indicated the geographic distances, then submitted maps to Shu Mi Yuan". This mapping method based on <Xing Cheng Lu> is

similar to the way that "Ministers of Youxuan" made maps. Or it even can be seen as a successor of the "Ministers of Youxuan" in Zhou and Qing. However, assigning "Ministers of Youxuan" to make maps using visiting and recording methods is a unique cartographic way invented by ancient Chinese in the periods of Zhou and Qing. It also proved the conjectures made by Dr. Needham that many ancient maps plotted by ancient Chinese only relied on the azimuth calculations from the speed and compasses. [39]

#### References

- [1] Mei Zhaorong, <Scientific and technologic accomplishments in ancient China>, 73, The Youth Press of China, 1978.
- [2]-[5] Sima Qian, <Shi Ji. Xia Ben Ji, No 2>.
- [6] Ban Gu and Ban Zhao, <Qian Han Shu. Jiao Shi Zhi>.
- [7] Yang Shen, <Shan Hai Jing Bu Zhu. Xu>.
- [8]-[11] <Zhou Li>.
- [12] Sima Qian, <Shi Ji. Zhou Ji>.
- [13] <Shi Jing>.
- [14] <Zhou Li>.
- [15] <Zhou Bi>, first chapter.
- [16] <Xun Zi>.
- [17] <Zhan Guo Ce, Zhao Ce>.
- [18] <Meng Zi>.
- [19] <Guan Zi>.
- [20] Ying Shao, <Feng Su Tong Yi. Xu>.
- [21] Yang Xiong, <Da Liu Xin Shu>.
- [22] Chang Ju, <Hua Yang Guo Zhi>.
- [23] Sima Qian, <Shi Ji, Qing Shi Huang Ben Ji Di Liu>.
- [24] <Song Shi, Yu Fu Zhi>.
- [25] Needham Joseph, <Science and civilisation in China> (Chinese version), Vol 5[1], Chapter 22, pp218, Science Press, 1975.
- [26] Needham Joseph, <Science and civilisation in China> (Chinese version), Vol 5[1], Chapter 22, pp218, Science Press, 1975.
- [27] Ying Shao, <Feng Shu Tong Yi, Xu>.
- [28] Needham Joseph, <Science and civilisation in China> (Chinese version), Vol5 [1], Chapter 22, pp219, Science Press, 1975.
- [29] Needham Joseph, <Science and civilisation in China> (Chinese version), Vol5 [1], Chapter 22, pp219, Science Press, 1975.
- [30] Needham Joseph, <Science and civilisation in China> (Chinese version), Vol5 [1], Chapter 22, pp218, Science Press, 1975.
- [31] Needham Joseph, <Science and civilisation in China> (Chinese version), Vol5 [1], Chapter 22, pp218, Science Press, 1975.
- [32] <Ba Hua Jian>.
- [33] <Shi Jing>.
- [34] <Kang Xi Dictionary>, Ruan Yuan <Jing Ji Xun Gu>.

[35]<Sui Shu, Pei Ju Zhuan>.

[36]<Jiu Tang Shu, Jia Dan Zhuan>.

[37] Wang Ying Lin, <Yu Hai>, Vol14, pp270, 1990.

[38}Needham Joseph, <Science and civilisation in China> (Chinese version), Vol5  
[1], Chapter 22, pp272, Science Press, 1975.