

# **A Study of the Ancient Channel of the Yellow River Using Remote Sensing Data: A Comparison of Distinctive Features of the Yellow River during the Former Han and the Yellow River Described in the *Shuijing Zhu***

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## **Introduction**

The Yellow River, China's second-largest river, has, in spite of its great size, repeatedly flooded over the centuries and changed its course. Within Chinese historical geography there is a special field called "History of Changes in the Yellow River," and it has been studied by many researchers down to the present day.<sup>1)</sup> Past research has been centred on textual sources, to which I have added new information in the form of remote sensing (RS) data and the findings of field surveys with a view to reconsidering past theories, and I have already finished reconstructing the course of the Yellow River during the Former Han.<sup>2)</sup> I am also in the process of reconstructing its course during the Later Han as described in the *Shuijing zhu* 水經注.<sup>3)</sup>

In past research on the course of the Yellow River in former times, it has been assumed that the features of the river itself and its topographic features have remained unchanged down through the ages, and research has been premised on this assumption.<sup>4)</sup> But has the Yellow River, which has repeatedly changed its course during several millennia, actually preserved the same features during this time?

In 2004–08 I conducted field surveys focusing on the Yellow River during the Former Han, and in 2013–16 I conducted further field surveys, this time focusing on the Yellow River described in the *Shuijing zhu*. In the course of these field surveys, I ascertained the fact that the topographic features surviving on the surface of the ground vary markedly in different areas. In concrete terms, in the region traversed by the Yellow River during

the Former Han I was able to confirm the presence of an enormous area of slight elevation 20 kilometres wide that had its origins in the Yellow River and the presence of special landforms called “shell ridges” that had formed at the river’s mouth. In investigations of the Yellow River of the *Shuijing zhu*, on the other hand, I was unable to find any evidence of slight elevations, levees, or a delta originating in the Yellow River, and I was only able to identify a levee running parallel to the present-day Jindi 金堤 River from Puyang 濮陽 in Henan province to Dong’e 東阿 county in Shandong province and a levee-like landform 1–2 metres higher than the surrounding area in the Hongtansi 紅壇寺 Forest Park in the town of Linzi 林子 in Linyi 臨邑 county.<sup>5)</sup>

The same applies to the RS data too, and while it was possible to discern vestiges of the greater part of the Yellow River during the Former Han by using SRTM-DEM topographic data, no vestiges in topography could be seen in the SRTM-DEM data in areas where the Yellow River of the *Shuijing zhu* is thought to have flowed. This corroborates the results of my field surveys.

If we look at textual sources such as the *Shiji* 史記 and *Hanshu* 漢書, we find mention of only a few tributaries or distributaries of the Yellow River during the Former Han, such as the Tunshihe 屯氏河 and Tunshibiehe 屯氏別河. The *Shuijing zhu*, on the other hand, mentions a large number of tributaries of the Yellow River, such as the Tashui 漯水 and Jishui 濟水, which all ran parallel to and in the same direction as the main course of the Yellow River. Further, the *Shiji*, *Hanshu*, etc., mention that the Yellow River burst its banks eleven times during the two hundred years of the Former Han.<sup>6)</sup> Meanwhile, according to Wang 1989, several references to the Yellow River “overflowing” (*yi* 溢) are found during the roughly eight hundred years from the Later Han through the Northern and Southern Dynasties to the Tang period, but there are no references to any “breaches, river bank failure” (*jue* 決) of its banks during this time.

Thus, differences can be seen between the Yellow River during the Former Han and the Yellow River of the *Shuijing zhu*, regardless of the method of investigation employed. In order to examine the question of where these differences have their origin, in the following I shall compare distinctive features of both river courses on the basis of reconstructions of their courses and the surrounding topography.

## 1. Past Views on Changes in the Course of the Yellow River

According to Shuili Dianlibu Huanghe Shuili Weiyuanhui 水利電力部黃河水利委員會 [1959], “during the three to four thousand years prior to 1946, the Yellow River broke its banks or flooded 1,597 times and changed its course 26 times.” It is generally considered that during this time there were six or seven major changes in the course of the Yellow River when it took a completely different course.<sup>7)</sup> Here I shall examine the Yellow River of the Former Han, from the first great change in 602 B.C.E. to around the start of the Common Era, and the Yellow River of the *Shuijing zhu*, from 69 C.E.<sup>8)</sup> to the Northern and Southern Dynasties and the Tang.

### 1.1. The Yellow River of the Former Han

The position of the course of the Yellow River of the Former Han has been examined primarily on the basis of accounts of breaches of the river’s banks in the “Gouxu zhi” 溝洫志 and “Dili zhi” 地理志 of the *Hanshu* and accounts in the *Shiji* and *Hanshu* of people crossing the river at the time. Further, judging from the *Shuijing zhu*, the river’s course had already moved by the time of the Northern Wei, but its former course prior to the Northern Wei is referred to as the “old course of the Great River” (*dahe gudu* 大河故瀆), suggesting that vestiges of its course prior to its change in course had survived, and because this coincides with references to breaches of the Yellow River’s banks during the Former Han in the “Gouxu zhi,” this “old course of the Great River” is considered to refer to the course of the Yellow River during the Former Han.

An early example of a map positing the course of the Yellow River of the Former Han on the basis of the above accounts is the *Shuijing zhu tu* 水經注圖 by Yang Shoujing 楊守敬 of the late Qing. As is indicated by its title, this work superimposes descriptions found in the *Shuijing zhu* on contemporary maps. In the maps included in this work, ordinary rivers are drawn in outlined white, with only the “old course of the Great River” being drawn in solid black as if it had been filled in, seemingly indicating that at the time of the composition of the *Shuijing zhu* it no longer formed the course of the Yellow River (fig. 1).

There is also the *Lidai Huanghe bianqian tukao* 歷代黃河變遷圖考 by Liu E 劉鶚, dating from around the same time. Liu E combined his father’s flood-control techniques with Western science and technology that were

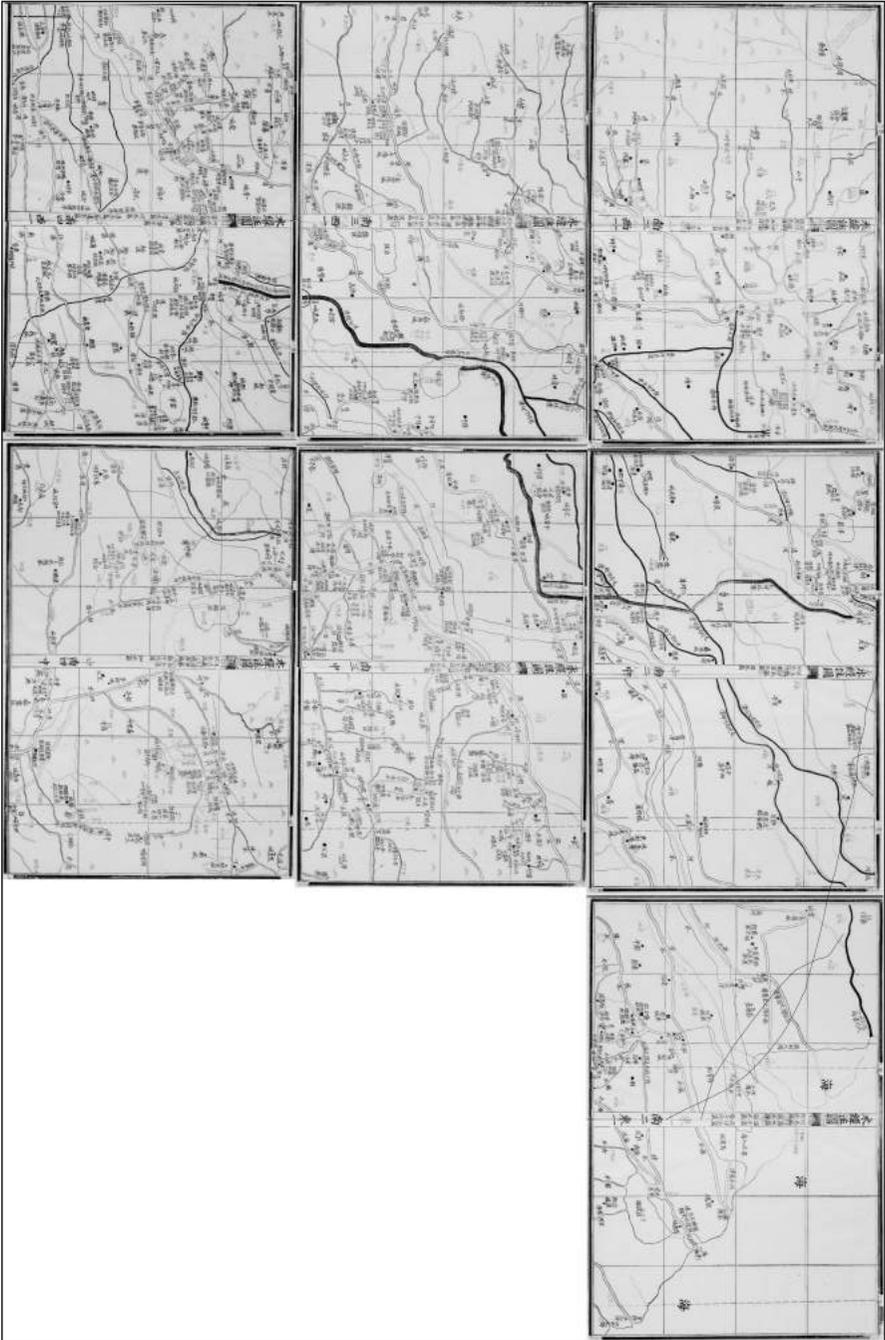


Fig. 1. Lower reaches of the Yellow River in the *Shuijing zhu tu*, stored at the Toyo Bunko (II-11-G-11)

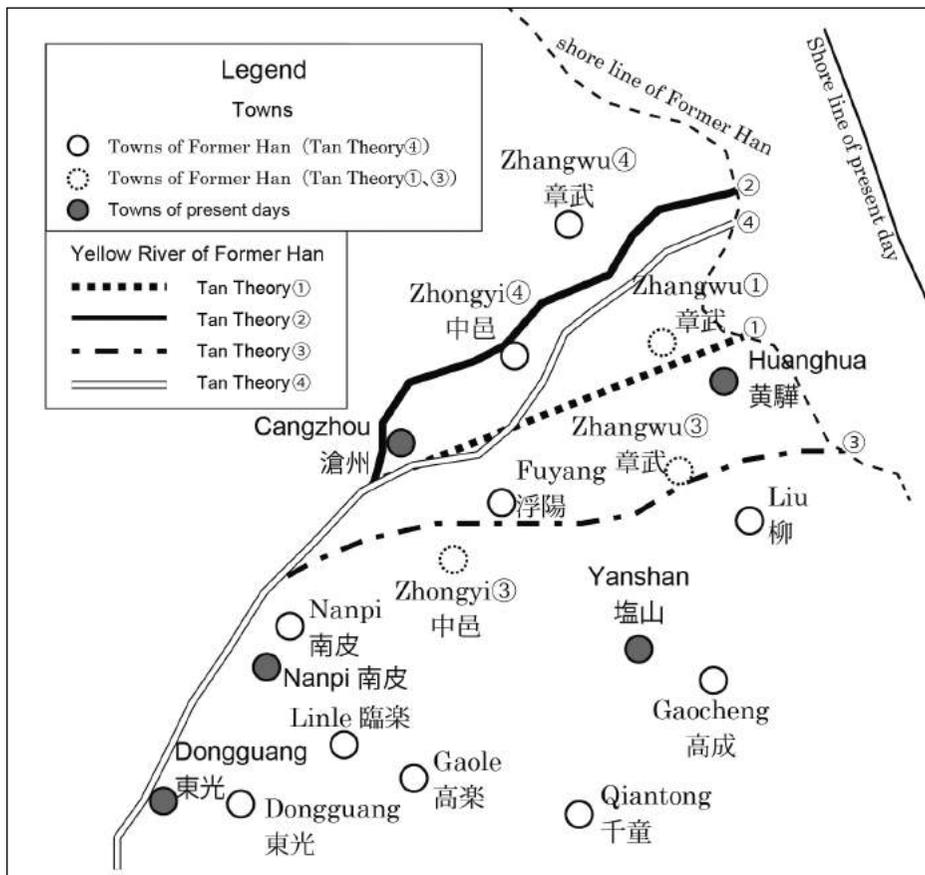
entering China at the time, and in 1888 he carried out investigations of flood control across Henan and Shandong. Then, in 1910 he wrote the *Lidai Huanghe bianqian tukao* on the basis of his experiences during these investigations. This work thus includes maps that were produced after he had seen the actual state of the lower Yellow River Plain and conducted Western-style surveys of the region.<sup>9)</sup>

After the publication of the *Shuijing zhu tu*, Yang Shoujing continued with his researches and produced the *Lidai yudi tu* 歷代輿地圖, which brought together geographical accounts from successive dynasties. The Qing era was a time when the study of historical geography based on evidential textual scholarship made enormous strides, and the *Lidai yudi tu* became widely known as a collection of maps summarizing the fruits of this scholarship. Later, after the founding of the People's Republic of China, Mao Zedong 毛澤東 took an interest in this work and established a Yang Map Committee to superimpose the maps of the *Lidai yudi tu* on contemporary maps. Even with the concerted efforts of Chinese academic circles at the time, this task took thirty years and was finally brought to completion in the 8-volume *Zhongguo lishi dituji* 中國歷史地圖集 under the general editorship of Tan Qixiang.<sup>10)</sup>

Tan Qixiang had himself been engaged in research on the former course of the Yellow River, and in the year prior to the publication of the *Zhongguo lishi dituji* he had published an article entitled “The Course of the Lower Yellow River before the Western Han” (Tan 1981). Shi Nianhai, who was similarly engaged in the study of historical geography at Shaanxi Normal University in Xi'an, had in fact already published a study of the Yellow River from the Warring States period to the Former Han (Shi 1978). But after seeing Tan's article, he acknowledged that Tan's view was correct and retracted his own theory (Shi 1984).

But it was not all plain sailing for Tan when it came to establishing the course of the Yellow River during the Former Han. He published his views on the mouth of the Yellow River during the Former Han on four occasions—“The First Large-scale Coastal Transgression on the West Coast of the Bohai Gulf in the Historic Period” (Tan 1965; Tan Theory 1); an “Internal Version” of the *Zhongguo lishi dituji* that was distributed in advance only to interested parties in 1974 (*Zhongguo Lishi Dituji Bianjizu* 1974; Tan Theory 2); “The Course of the Lower Yellow River before the Western Han” (Tan 1981; Tan Theory 3); and the *Zhongguo lishi dituji* that was made generally available in 1984 (Tan 1984; Tan Theory 4)—and on each of these occasions there were subtle changes in the shape of the river

mouth where the Yellow River entered the Bohai Sea during the Former Han and the locations of cities (fig. 2). For example, in Theory 1 the river ran in a straight line north-northeast from south of Cangzhou 滄州, but in Theory 2 the river flowed north from Cangzhou and at some distance from Zhangwu 章武 and Huanghua 黃驛. In Theory 3, the river makes a gentle bend from Dongguang 東光, but unlike in Theory 1 and 2, it passes to the south of Huanghua. Theory 4 is close to Theory 2, but the river passes south of Cangzhou and Zhongyi 中邑 (which has moved north), and the position of Zhangwu has also moved north. It is thus evident that there were several twists and turns before Tan was finally able to determine the position of the river mouth.



**Fig. 2. Changes in Tan Qixiang's views on the mouth of the Yellow River during the Former Han**

## 1.2. The Yellow River after the Later Han

Research on the course of the Yellow River is considered to have begun with the *Yugong shanchuan dilitu* 禹貢山川地理圖 and *Yugong lun* 禹貢論 by Cheng Dachang 程大昌 of the Southern Song, but at this time theories about changes in the river's course did not cover the course of the Yellow River after the Later Han. It was only with the *Yugong zhuizhi* 禹貢錐指 by Hu Wei 胡渭 of the Qing that its course during the Northern Wei, recorded in the *Shuijing zhu*, began to be included in discussion about changes in the course of the Yellow River.<sup>11)</sup> As can be inferred from the titles of the above works, the study of the Yellow River that began with Cheng Dachang belonged to the current of Confucianism studies (*jingxue* 經學), which included the *Shujing* 書經 and its “Yugong” 禹貢 chapter. The *Shuijing zhu*, on the other hand, was a geographical treatise, and because some outstanding studies by Chen Qiaoyi 陳橋驛 and others have appeared in recent years, research on the *Shuijing zhu* has come to constitute a specialized discipline called Li studies (*Lixue* 麗學), but this forms a separate current from that of Confucianism studies. These two currents merged in Hu Wei's *Yugong zhuizhi*.

But there may have been another reason that the Yellow River of the *Shuijing zhu* was not equated with that of any other period. Today levees have been formed along both banks of the Yellow River, and this was also the case during, for example, the Former Han. The main reason for this is the large amounts of loess, or “yellow soil” (*huangtu* 黃土), that is found in the river's water and gives the Yellow River its name. In the case of rivers carrying large amounts of silt, the silt builds up along both banks to create landforms called “natural levees.” Further, as is indicated by the fact that the Yellow River has since ancient times been likened to a raging dragon, it has frequently breached the levees to cause flooding and has sometimes also changed its course. Consequently, administrators down through the ages have racked their brains for ways of controlling the waters of the Yellow River and constructed banks along its levees. According to a passage in the “Gouxu zhi” of the *Hanshu*, “At the mouth of the Qishui River there is levee, which is 1 *zhang* 丈 high. East of here, the ground is slightly lower and the levee a little higher, and at Zhehaiting it is 4–5 *zhang* high.” (至淇水口，乃有金隄，高一丈。自是東，地稍下，隄稍高，至遮害亭，高四五丈) This suggests that already during the Former Han there existed natural levees that were up to about 5 *zhang* (12 metres) high,<sup>12)</sup> and it is to be surmised that, like the Yellow River today, the river was flanked by

levees. Today, apart from the old tributary called the Jindi River, there are virtually no tributaries that join the Yellow River or branch off it on the lower Yellow River Plain, hemmed in as it is by levees.

The Yellow River described in the *Shuijing zhu*, on the other hand, is completely different. According to the *Shuijing zhu*, at the time a great many tributaries joined and branched off the Yellow River on the lower Yellow River Plain. In particular, the two rivers Tashui and Jishui flowed parallel to the Yellow River right across the lower Yellow River Plain, and all three rivers flowed in this manner to their mouths and into the Bohai Sea. This is completely different from the distinctive features of the present-day Yellow River described above and also from its reconstructed course during the Former Han.

### 1.3. An Outline of the Description of the Yellow River in the *Shuijing Zhu*

In Hasegawa 2016a and 2016b, I have already touched on how the Yellow River during the Northern Wei is described in the *Shuijing zhu*, but in the following I shall recapitulate its description.

The *Shuijing zhu* mentions the Yellow River during the Northern Wei, when the *Shuijing zhu* was composed, and its earlier course, which it calls the “old course of the Great River.” These two rivers forked at Changshou Jin 長壽津 near the present-day city of Puyang in Henan province, with the “old course of the Great River” heading north and the Yellow River of the Northern Wei heading east. It may be supposed, in other words, that the Yellow River of the Former Han flowed eastwards from Changshou Jin. Near Puyang, there was the slight elevation of Huachan 滑澶 formed by the Yellow River of the Former Han,<sup>13)</sup> and this means that the Yellow River broke out of this slight elevation.

According to the *Shuijing zhu*, the Yellow River that headed east during the Northern Wei flowed as far as present-day Dong’e county, where it turned north. Even today, the Jindi River, one of the present-day Yellow River’s few tributaries, flows from Puyang to Dong’e, and both sides of it have been strengthened by the banks called Jindi (“Banks Rigid like Metal”). When viewed with SRTM-DEM, this Jindi combines with the slight elevation of Huachan, and it is evident that it has its origins in a natural levee formed by the Yellow River at the time.<sup>14)</sup>

According to the *Shuijing zhu*, during the Northern Wei the Yellow River displayed some strange behaviour in the vicinity of Dong’e county. To the south of Dong’e county, a distributary called the Dengliqu 鄧里

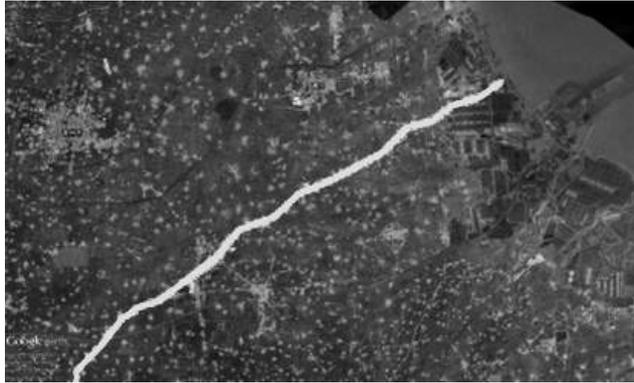
渠 Channel branched off the Yellow River, but after having flowed more than 10 kilometres north, it rejoined the Yellow River. Such behaviour cannot be seen today along the Yellow River, hemmed in as it is by natural levees. During the Former Han, on the other hand, there were medium-scale changes of about 100 kilometres,<sup>15)</sup> but there is no evidence of such small distributaries branching off the Yellow River and then rejoining it.

After having been rejoined by the Dengliqu Channel, the Yellow River of the Northern Wei continued flowing north, passing through present-day Yucheng 禹城, and then turned east once again in the vicinity of Linyi county. Perhaps because there were fewer towns and cities in this area, very few towns and cities are mentioned in the *Shuijing zhu*, but it is noted that near its mouth the Yellow River passed through Yanci 厭次 and Qiancheng 千乘 before entering the Bohai Sea. Further, according to the *Shuijing zhu*, near its mouth the Yellow River flowed parallel to the Tashui and Jishui Rivers on its way to the Bohai Sea. This is a phenomenon seen neither today, when the river mouth forms a delta, nor during the Former Han (fig. 3).

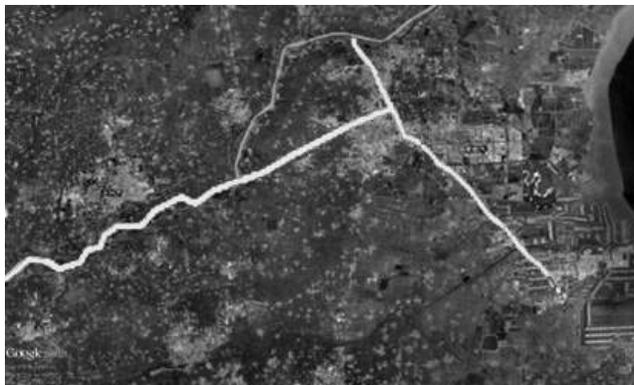
But in the study of the history of changes in the course of the Yellow River, its course as described in the *Shuijing zhu*, centred on the Northern Wei, was for a long time not considered to constitute a distinct period in changes in its course. As was already noted by Hu Wei in his *Yugong zhuizhi*, there are several possible reasons for this.

One reason is that official histories of the period did not include any monographs on water control such as the “Hequ zhi” 河渠志. The greater part of the period in question was a time of division referred to as the Wei, Jin, and Northern and Southern Dynasties, the official histories of which consisted of only basic annals (*benji* 本紀) and biographies (*liezhuan* 列傳), and when compared with the histories of unified dynasties, the histories of this period include very few monographs or treatises (*shu* 書 or *zhi* 志).

There is also the view that the flood-control works carried out by Wang Jing 王景 during the reign of Mingdi 明帝 of the Later Han were extremely effective. According to past research on changes in the course of the Yellow River, the Yellow River, which had begun to change its course towards the end of the Former Han, flowed eastwards from the vicinity of Puyang in Henan province, and during the reign of Mingdi, the second emperor of the Later Han, the engineer Wang Jing was ordered to carry out stabilizing work along the Yellow River and constructed enormous banks about 1,000 *li* 里 long, thereby restoring stability to the river’s course.<sup>16)</sup> Because this course of the Yellow River more or less coincides



**Former Han (Cangzhou, Hebei province)**



**Later Han (Dongying, Shandong province)**



**Today (north of Dongying, Shandong province)**

**Fig. 3. The mouth of the Yellow River in the Former Han, the *Shuijing zhu* (Later Han to late Tang), and today (Google Earth)**

with its course as described in the Northern Wei *Shuijing zhu*, the Tang *Yuanhe junxian zhi* 元和郡縣志, and the *Taiping huanyu ji* 太平寰宇記 of the early Northern Song, the period of about one thousand years from the Later Han to the early Northern Song is regarded as a period of stability during which no major changes occurred in the course of the Yellow River. Wei Yuan 魏源 described this as “one thousand years free from trouble” (千年無患), and this ultimately led to Tan Qixiang’s theory of a period of stability in the flow of the Yellow River from the Later Han to the late Tang.<sup>17)</sup>

## 2. A Comparison of RS Data with Field Surveys

In the previous section we considered the course of the Yellow River during the Former Han and in the *Shuijing zhu*, chiefly on the basis of written accounts. In this section, I wish to examine the Yellow River of the *Shuijing zhu* on the basis of both the results of image analyses of digital data called RS data and topographic information gathered during field surveys conducted on three occasions in Henan and Shandong provinces in April 2013, July 2015, and May 2016.

### 2.1. West of Dong’e County

I have previously undertaken an examination of the course of the Yellow River in the vicinity of Dong’e county on the basis of written sources,<sup>18)</sup> and it has become clear that in this region the river flowed north from the natural levee (the present-day Jindi River) formed by the Yellow River of the *Shuijing zhu* and that several parallel rivers, including the Dengliq Channel, were formed that ran north.

In a field survey conducted in April 2013, I mainly used a bicycle so as to get a real sense of the local topography, especially any subtle undulations in the plain, and I found that apart from the Jindi River (a natural levee) almost the entire area was flat. When one considers the formation of the topography, it is only natural that there are few undulations since it is an alluvial plain in the lower reaches of the river. But in an earlier field survey of the Yellow River of the Former Han it was found that there were slight elevations originating in natural levees, and when I visited the vicinity of Puyang in 2004 there were some hillocks that rose to several metres in height.<sup>19)</sup> When compared with the area around Puyang, the absence of undulations was quite noticeable. Further,

in certain areas there were wide expanses of sandy soil that looked at first sight like ordinary farmland, but sometimes a strong wind would cause minute grains of sand to be blown up into the air, resulting in a sandstorm in next to no time. These characteristics all have their origins in the old course of the Yellow River.

Today's Yellow River boasts mud and sand content that is among the highest in the world, and it is seventeen times greater than that of the Changjiang 長江, China's other major river. As the Yellow River flows towards the sea, it deposits mud and sand on the bottom of the river, and it sometimes flows out the river channel to form natural levees. When the river's course shifts, the mud and sand remain where the river had flowed until then. It is to be surmised, in other words, that the "sand" of the expanses of sandy soil seen in the area and of the sudden sandstorms all has its origins in the Yellow River.<sup>20)</sup>

An examination of the area in question with SRTM topographic data<sup>21)</sup> reveals in the south levee-like landforms extending from Puyang towards Dong'e county and the river's course running parallel to these. This is locally known as the Jindi River, and the levees in the vicinity of Puyang are considered to have originated in the Yellow River. Topographically speaking, these are linked to the slight elevation of Huachan that was ascertained when reconstructing the Yellow River of the Former Han, and this landform may be considered to have its origins in the Yellow River. To the north of these levee-like landforms, on the other hand, almost no undulations can be ascertained. This tallies with the topographic characteristics identified during field surveys.

The course of the river as it heads north from the town of Qiji 七級 and turns east near the village of Huangheya 黃河崖 can be ascertained with ALOS AVNIR-2 data (fig. 4). But in the *Shuijing zhu* ("Heshui zhu" 河水注 5) it is stated that the river "passes to the west of Que'ao 碣磈 castle," and according to the *Yuanhe junxian zhi*, Que'ao castle "stands beside the Yellow River, and its southwest corner has collapsed because of the Yellow River."<sup>22)</sup> According to the revised edition of the *Chiping xianzhi* 荏平縣志, Que'ao castle is located in the present-day village of Gaoyuanqiang 高垣牆. These references do not tally with a river course that flowed eastwards from Huangheya.

In the *Zhongguo lishi dituji* and Yang 1991,<sup>23)</sup> it is posited that the Yellow River changed its course in an easterly direction to the west of Gaoyuanqiang (Que'ao) and flowed north from the west of the castle so as to encircle it. But according to the results of an analysis of the Landsat5

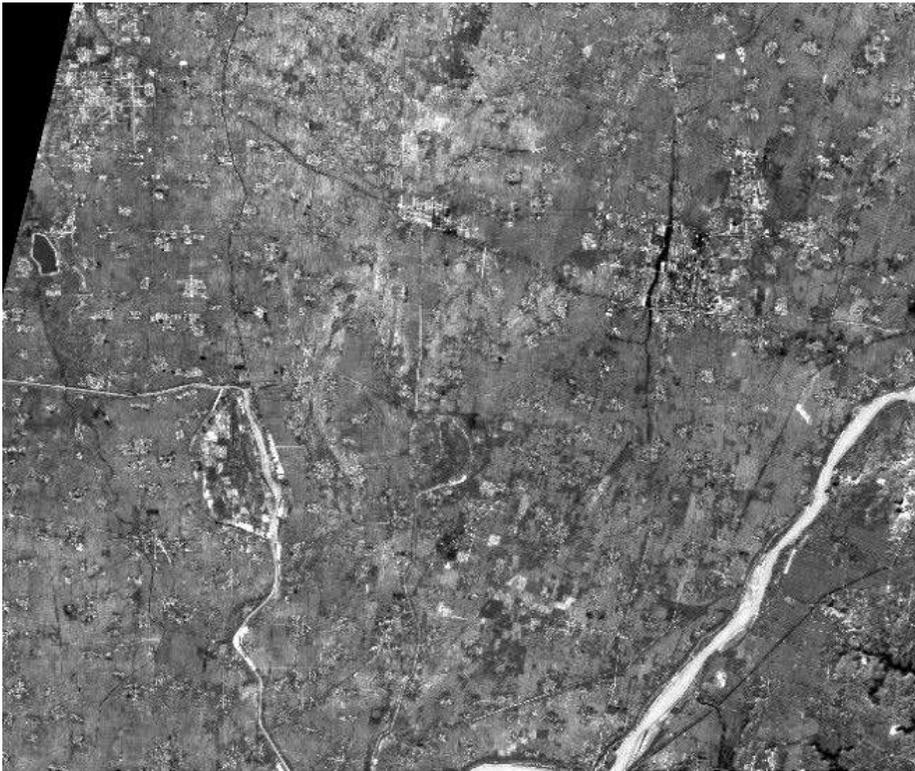


Fig. 4. Vicinity of Dong'e county (ALOS AVNIR-2)

TM data, in the vicinity of Chiping county the old course of the river flowed south-north through an area including wetlands (dotted line in fig. 5), and this does not tally with the river's course posited in the *Zhongguo lishi dituji*, etc.

Wetlands running south-north to the northwest of Gaoyuanqiang can be ascertained in the ALOS AVNIR-2 data. Although there is no evidence of their continuing from the west of Gaoyuanqiang towards Huangheya, if one were to assume that these wetlands correspond to the course of the Yellow River at the time and that it flowed north, then this would coincide with the description of Que'ao in the *Shuijing zhu*. According to the *Shuijing zhu*, there was a tributary called the Dengliqu Channel that branched off towards the east in this vicinity,<sup>24)</sup> and it is conceivable that the vestiges of a river course in the vicinity of Dong'e county are related to this tributary (fig. 5).

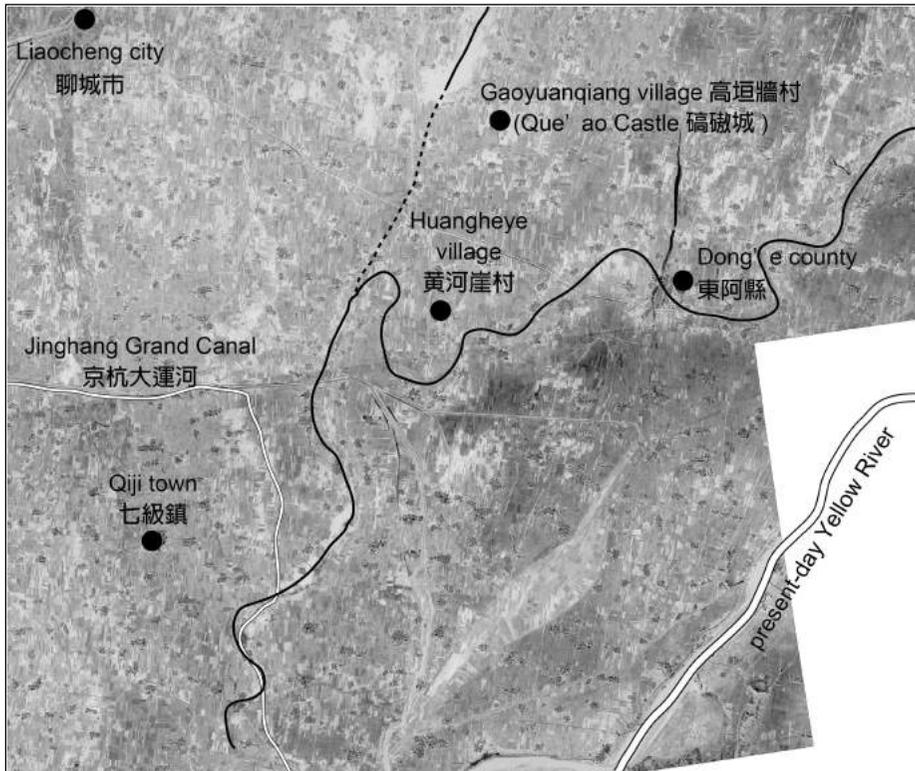


Fig. 5. Vicinity of Dong'e county (CORONA)

## 2.2. The Vicinity of Yucheng

Moving on north from Que'ao castle, one arrives at the present-day city of Yucheng. According to the revised edition of the *Yucheng xianzhi* 禹城縣志, an irrigation canal called the Fengshou 豐收 River was cut in 1969 to the west of Yucheng along the old course of the Yellow River. A straight irrigation canal can be identified in the ALOS AVNIR-2 data, but this shows the situation after the canal had been cut (fig. 6). The situation before the canal was cut, on the other hand, can be ascertained in the CORONA data, photographed prior to 1969 (fig. 7), and it can be confirmed that at the time the canal was not straight, as it is today, but was slightly curved. Further, the old course of the river, as far as can be determined from this data, passes through the village of Panhe 盤河, and this tallies with the statement in the *Dushi fangyu jiyao* that “the former Yellow River passed through Panhedian 盤河店.”<sup>25)</sup>



**Fig. 6. Vicinity of Fangsi 房寺 town, Yucheng (ALOS AVNIR-2)**



**Fig. 7. Vicinity of Fangsi town, Yucheng (CORONA)**

### 2.3. North of Linyi County

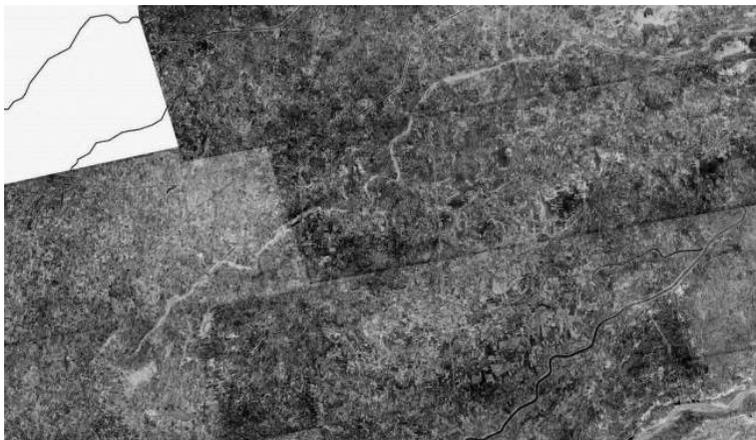
Vestiges of a river channel running from the west to the north of Linyi county can be identified in the ALOS AVNIR-2 data (fig. 8). Fairly clear vestiges of the river's course exist in the wetlands to the north, part of which forms Hongtansi Forest Park, which opened in recent years, and traces of levees can also be ascertained. Vestiges of the river's course can be more clearly identified in the CORONA images (figs. 9 & 10). It is today known as the "Sandy River" (Shahe 沙河), and according to the revised edition of the *Shanghe xianzhi* 商河縣志, it got this name on account

of the fact that mud and sand accumulated here because the Yellow River flowed into the area from the Song period onwards.<sup>26)</sup>

The *Hequ jiwen* by Kang Jitian of the Qing and *Huanghe shuilishi shuyao* mentioned in note 4 deal with this area. According to Kang Jitian, “the area is lowlying and all damp and marshy,” and this has not changed today. The *Huanghe shuilishi shuyao* adds the comment that “the statement that ‘the land is lowlying’ refers not to the old course of the river itself but to the area to its north and south,” thus presenting the view that it is not the old course of the river that is lowlying. It is true that the old course of



**Fig. 8. Linyi and Shanghe counties (ALOS AVNIR-2)**



**Fig. 9. Linyi and Shanghe counties (CORONA)**



**Fig. 10. Vestiges of the course of the Yellow River in Linyi and Shanghe counties (as identified in the ALOS AVNIR-2, Landsat5 TM, and CORONA data)**

the river during the Former Han, the so-called Abandoned Yellow River that flowed south during the Ming-Qing period, and the course of the Yellow River today are all higher than the surrounding land because of the natural levees formed by the river itself. But there are no signs of any natural levees in this area, and a slope analysis using STRM-DEM data also shows that, apart from the vicinity of present-day rivers such as the Majia 馬頰 and Duhai 徒駭 Rivers, almost the entire area is flat without any undulations.

When I visited this area in 2013, I found that, as I had already ascertained with the STRM-DEM data, it was quite flat, and the above-mentioned irrigation canal was a so-called “embankmentless river” that had no levees and had merely been dug slightly lower than the surrounding ground (fig. 11).<sup>27)</sup>



**Fig. 11. North River, Weijia 魏家, Linyi county  
(photograph by author, April 2013)**

#### **2.4. The Vicinity of Dongying (Mouth of Northern Wei Yellow River)**

Where large rivers such as the Yellow River enter the sea, there is created a distinctive landform called a delta. Signs of a delta can be ascertained in the case of today's Yellow River to the north of Kenli 垦利 county in Shandong province, and in the case of the Yellow River of the Former Han one can identify vestiges of a delta with its apex in Mengcun 孟村 Hui Autonomous County, Cangzhou, in Hebei province.<sup>28)</sup> However, not only can the distinctive features of a delta not be found in the Yellow River of the Northern Wei as described in the *Shuijing zhu*, but it can also be inferred that at the river mouth the Yellow River and two other rivers—the Tashui and Jishui Rivers—were flowing parallel to each other.

According to Xue et al. 2004, a delta lobe, where the mouth of a river meets the sea, can be identified in the Bohai Sea near Dongying 东营, where the Yellow River described in the *Shuijing zhu* entered the sea,<sup>29)</sup> and therefore it is more or less certain that the Yellow River entered the sea here from the Later Han to the Tang-Song period. It is to be surmised, in other words, that, unlike in the Former Han and today, during the Northern Wei the Yellow River did not form a delta at its mouth. Furthermore, in field surveys conducted in 2015 and 2016 I was unable to identify in the city of Dongying or its environs any signs of what might have been the mouth of the Yellow River of the *Shuijing zhu*.<sup>30)</sup>

A topographic analysis of Dongying and its environs using SRTM-DEM and Landsat5 TM data reveals vestiges of three parallel rivers near Dongying (fig. 12). According to the *Shuijing zhu*, these three rivers were, from the north, the Yellow River, Tashui River, and Jishui River.

According to Ma et al. 2000, this area around Dongying forms a structural landform called the Dongying Depression. A depression refers to an

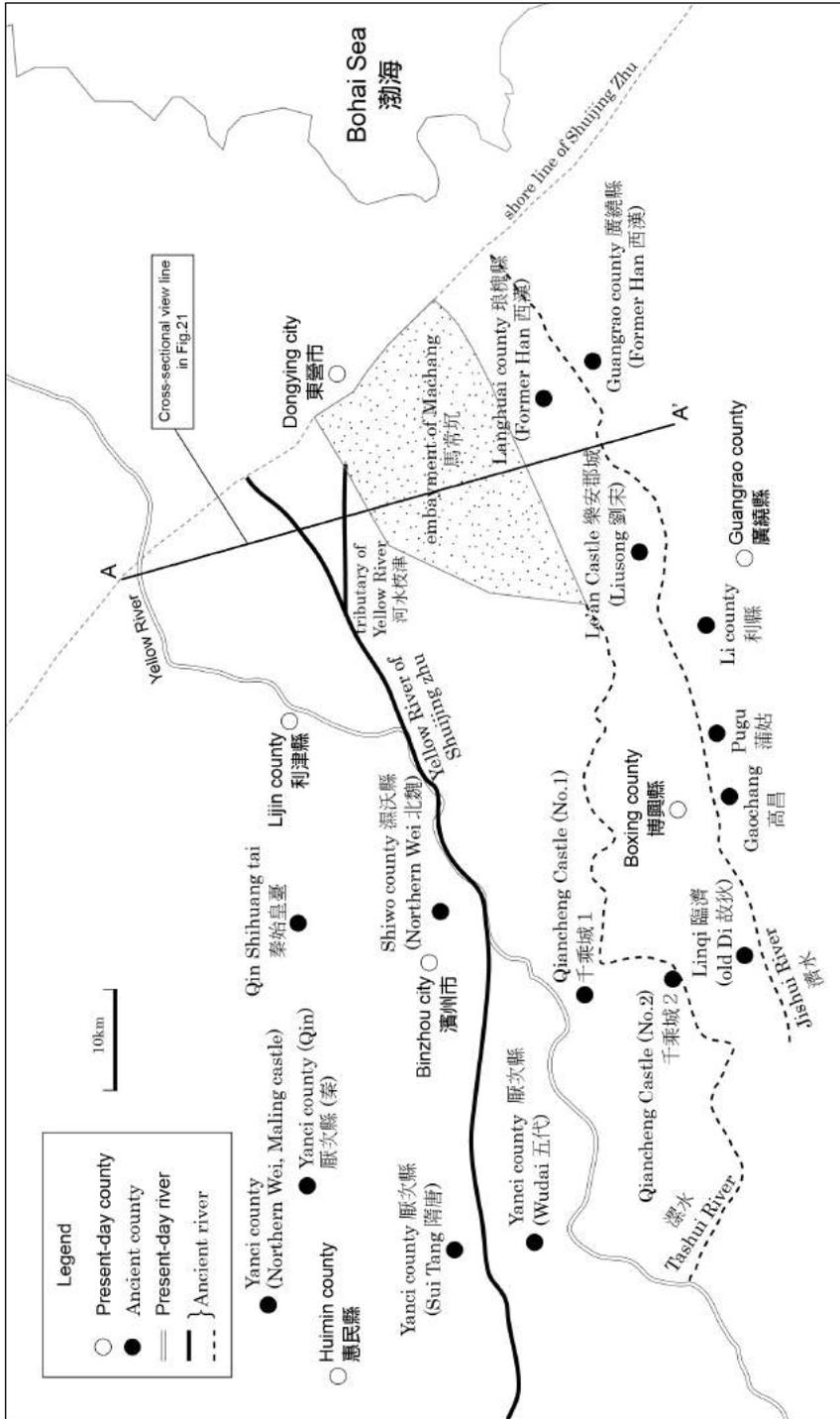


Fig. 12. The old course of the Yellow River in the vicinity of Dongying, based on RS data (SRTM-DEM, Landsat5 TM)

anticline in the geoscience field, and one can ascertain several striated landforms running from east to west. The above-mentioned vestiges of three rivers tally with these striated landforms. The relationship between “a river mouth that does not form a delta” and “striated landforms and three parallel rivers” will be examined below together with the process behind their formation.

### **3. Distinctive Features of the Yellow River to Be Seen in Its Topography and Geology**

Today’s Yellow River is characterized as being very muddy, frequently bursting its banks, and sometimes changing its course (善淤, 善決, 善徙). It is muddy because its waters contain large amounts of loess, which accumulates downstream on the river’s bottom and banks, forming a raised-bed river. Having become a raised-bed river, the Yellow River then bursts its banks, flowing into surrounding areas, and sometimes it will take a new course different from its course before the breach. As a result of repeated changes in its course, there has formed the vast lower Yellow River Plain.

#### **3.1. Topographic Features of the Present-day Yellow River and the Former Han Yellow River**

The Yellow River moves from its middle reaches to its lower reaches around Xingyang 滎陽 in Henan province.<sup>31)</sup> Having passed through the mountainous regions of Shaanxi and Shanxi provinces and then past Sanmenxia 三門峽 and through the Xiaolangdi 小浪底 Dam built in 2001, the Yellow River enters a plain in the vicinity of Xingyang. Banks about 10 kilometres wide have been formed by the river in the vicinity of Zhengzhou 鄭州, and the river has become a raised-bed river, with advancing sedimentation having elevated the riverbed so that it is higher than the surrounding ground in the vicinity of the Iron Pagoda in Kaifeng 開封, which stands beyond the banks. The width of these banks varies, and in the vicinity of Jinan 濟南 in Shandong province they are about 5 kilometres wide. The width of these banks is thought to be roughly proportionate to the length of time that the Yellow River has passed through the area in question.

In the past, it had been considered that these banks on both sides of the Yellow River had been constructed by successive dynasties for the

purpose of flood control, and in former times it was thought that they started from Duke Huan 桓 of Qi 齊 of the Spring and Autumn period. In Japanese research on ancient Chinese history there has long existed the theory of Kimura Masao, who regarded the enormous power required to undertake the large-scale hydraulic works for flood control along the Yellow River as a factor in the formation of unified state power (Kimura 2003). But by reconstructing the course of the Yellow River during the Former Han and its formation on the basis of RS data, I have already demonstrated that these theories are untenable.<sup>32)</sup>

Viewed topographically, the lower Yellow River Plain is an enormous alluvial fan formed by the Yellow River,<sup>33)</sup> and it extends from Tianjin 天津 in the north past Lianyungang 連雲港 on the southern edge of the Shandong Peninsula as far south as the vicinity of Yancheng 鹽城. Generally, rivers that form alluvial fans do not remain on the surface of the alluvial fan and sometimes seep into the ground to form underflows. But the Yellow River has been prevented from seeping underground because of the fine-grained loess that is the principal constituent element of the alluvial fan, and consequently it has become an extremely unstable river that only just manages to flow across the surface of the alluvial fan.

A raised-bed river with natural levees and an alluvial fan are the two main characteristic features of the present-day Yellow River. The present-day Yellow River has formed levees (natural or man-made) on both sides that act as impediments so that, apart from the Jindi River, there are no natural rivers that branch off or join the Yellow River on the lower Yellow River Plain (although there are man-made irrigation canals).<sup>34)</sup>

One point that I noticed when reconstructing the Yellow River of the Former Han was that its vestiges have survived not in a horizontal direction but in a vertical direction. This is also the case with the present-day Yellow River, and the enormous amounts of sediment in the river, which give it its name, have built up to form natural levees on both sides of the river. Because the river meanders across the flat plain in its lower reaches on its way to the sea, the levees continue to grow wider, and even today they have grown to about 1 kilometre in width in the vicinity of Jinan in Shandong province. When surveying the topography of the entire lower Yellow River Plain with SRTM-DEM data, I discovered a slight elevation of considerable length in Shandong province extending from Liaocheng 聊城 to Dezhou 德州 (and which, taking the first character of these two place-names, I have called the slight elevation of Liaode 聊德). Initially I did not consider that this elevation, extending to 20 kilometres in width,

had originated in the levees of the Yellow River, but on comparing the findings of field surveys with written accounts, it became clear that this slight elevation was the final form of a natural levee formed by the Yellow River prior to the Former Han.

Generally speaking, levees form on both sides of a river, and although the width of the body of a man-made levee may exceed 10 metres, it will never be greater than 100 metres. In the case of a natural levee, it is even more difficult for it to grow very large. How, then, was this slight elevation, 20 kilometres wide, formed?

In the lower reaches of today's Yellow River, the riverbed is higher than the surrounding landside area<sup>35)</sup> and forms what is known as a "raised-bed river." This is due to the Yellow River's sedimentary process. It has already been noted that the Yellow River's abundant sediment built up on both sides of the river to form natural levees. But what happens when there already exist man-made banks? The answer is that the sediment accumulates on the riverbed, not at the bottom of the river, resulting in the formation of a raised-bed river that is higher than the surrounding landside area.

In the case of an ordinary raised-riverbed river, the difference in height between the riverbed and the landside area is no more than several metres, and in the vicinity of Zhengzhou in Henan province today's Yellow River too is 5-7 metres higher than the landside area. But what happens if this accumulation of sediment on the riverbed continues over a long period of time? The sediment accumulating on the riverbed will gradually grow higher until it eventually reaches the top of the levees, whereupon there is no longer any difference in height between the levee and the riverbed and they become one. Besides this, there is no other way of explaining rationally the formation of the enormous slight elevation of Liaode, 20 kilometres wide, but a reference to its width of 20 kilometres already appears in the "Gouxu zhi" of the *Hanshu*, written two thousand years ago.<sup>36)</sup>

According to Kimura and others, this passage in the "Gouxu zhi" proves that levees had already been built along the Yellow River during the Warring States period, and the width of 25 *li* (i.e., 10 km) is considered to have represented a buffer zone to prevent excessive clashes between different states. But setting aside the question of whether the idea of a buffer zone already existed in the Warring States period, it is difficult to imagine that it would have continued to be maintained during the several hundred years of the Warring States period. It should be considered

rather than this width represented the width of natural levees created by the Yellow River itself.

### 3.2. Topographic Characteristics of the Yellow River of the *Shuijing zhu*

Meanwhile, there is a strong possibility that the Yellow River of the *Shuijing zhu* possessed characteristics that were at variance with this conventional knowledge about the Yellow River. Three features not seen in other periods and posited on the basis of written accounts centred on the *Shuijing zhu*, field surveys, and RS data may be cited as distinctive features of the Yellow River of the *Shuijing zhu*, namely, the absence of natural levees, the absence of a delta at the river mouth, and the existence of tributaries and distributaries.

With regard to natural levees, I found when reconstructing the course of the Yellow River of the Former Han that levees were mentioned by names such as Jindi in the geographical monographs of various periods, and on the basis of these references I was able to pinpoint the existence of slight elevations. But there are no such references for areas where the Yellow River of the *Shuijing zhu* is thought to have flowed. I was unable to identify any vestiges of levees or slight elevations by means of field surveys or topographic analysis using RS data, discussed in the previous section, and instead I found many instances where the river channel had merely been dug slightly lower than the surrounding ground. In river engineering, this type of river channel is called an “embankmentless river” and is differentiated from an “embankment river” like the Today’s Yellow River (fig. 13).

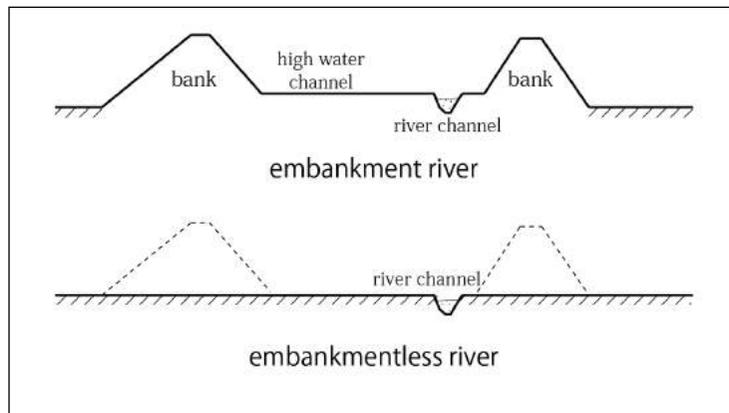


Fig. 13. Rivers with and without embankments

With regard to the absence of a delta at the river mouth, it was difficult to imagine that the Yellow River of the *Shuijing zhu* had no delta when one sees the current river mouth, which extends 100 kilometres in all directions and continues to expand even today. But as far as can be inferred from the results of an analysis with SRTM-DEM data and field surveys, it would seem reasonable to assume that no delta had been formed at the time.

I have already touched on tributaries and distributaries of the Yellow River, about which there are numerous references in the *Shuijing zhu*, and in particular the existence of the Dengliu Channel merits special mention.<sup>37)</sup> At least in the case of today's Yellow River, hemmed in as it is by levees, there are no examples whatsoever of distributaries that rejoin the river after several dozen kilometres.

When these three features are placed side by side, a further feature emerges. Natural levees are formed when the mud and sand contained in the river's water overflow beyond the river channel. Likewise, a delta is formed when the mud and sand flow from the river into the sea. And the presence of tributaries or distributaries is proof that no natural levees had formed. These all indicate that the Yellow River's sedimentary action had grown weaker at the time in question. In other words, there is a strong possibility that at the time of the Yellow River of the *Shuijing zhu* the river had less water or mud and sand than today and during the Former Han and that there was little sedimentation.<sup>38)</sup>

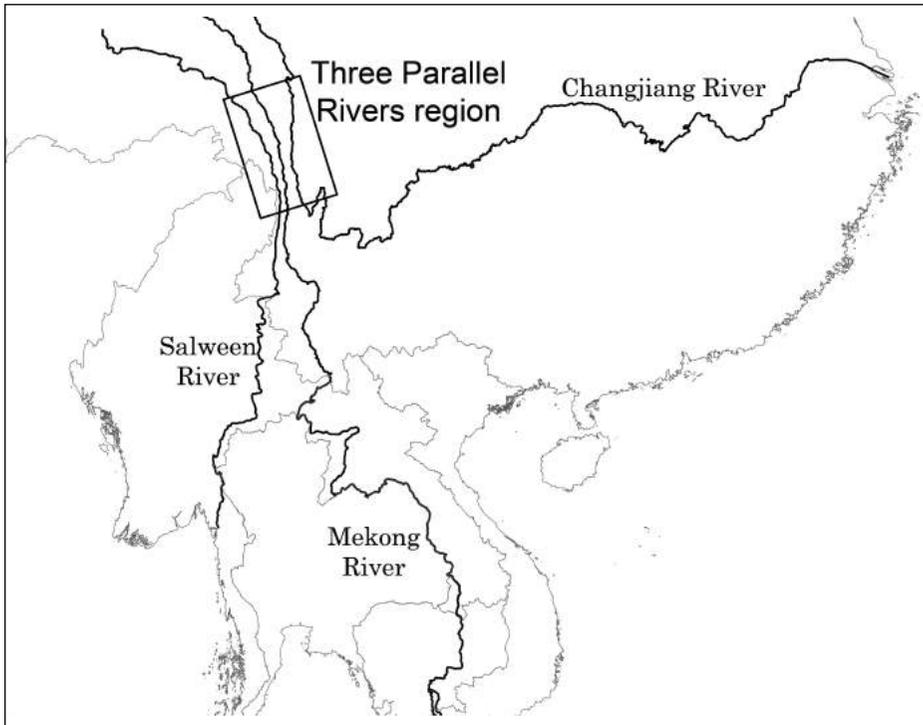
### 3.3. Three Parallel Rivers at the River Mouth

I wish to consider one more landform distinctive of the Yellow River of the *Shuijing zhu*. According to the *Shuijing zhu*, it would appear that during the Northern Wei three rivers—the Yellow River, Tashui River, and Jishui River—flowed into the Bohai Sea at the mouth of the Yellow River, and it is also stated in the *Shuijing zhu tu* that this was the case. But today a delta has formed at the mouth of the Yellow River, and there are no rivers flowing parallel to its main course. In view of the fact that vestiges of a delta with its apex in Mengcun Hui Autonomous County in Cangzhou can be identified in the reconstructed course of the Yellow River of the Former Han,<sup>39)</sup> it is to be surmised that during the Former Han, like today, there were no other rivers flowing parallel to the Yellow River at its mouth. Why did this difference arise? I would like to speculate about the likelihood of the existence of three parallel rivers on the basis of the

process of river formation with reference to examples of similar landforms in China and Japan.

In China's Yunnan province there is an area known as the Three Parallel Rivers region, where the Changjiang, Nujiang 怒江 (Salween), and Lancangjiang 澜沧江 (Mekong) run parallel to each other within quite narrow confines about 40 kilometres wide. According to Ren 1982, this landform has its origins in the mountain-building movements of the Himalayas that occurred 40–50 million years ago. The Indian subcontinent, which was at the time not part of Eurasia, drifted northwards and collided with the Eurasian plate, placing enormous stress on the latter and resulting in the formation of the Himalayas and other fold-mountain ranges. This stress was transmitted as far as present-day Yunnan, where the three rivers were forced into a quite narrow area, thereby creating the rather unusual landform known as the Three Parallel Rivers region (fig. 14).

In Japan too there are the Kiso 木曾, Nagara 長良, and Ibi 揖斐 Rivers, known as the Kiso (or Nōbi 濃尾) Three Rivers, which flow across the



**Fig. 14. Three Parallel Rivers region (China)**

Nōbi Plain in Aichi and Gifu prefectures (fig. 15). They draw closer to each other the further south they flow across the Nōbi Plain, and according to Kuwabara 1968, this close proximity of several rivers on a plain is an example of the phenomenon of tectonic tilting and coseismic subsidence, due to the structure of the Nōbi Plain. The underground structure of the Nōbi Plain is such that it tilts towards the west, and because the ground's surface has over many years slowly moved westwards, the three rivers have drawn closer to each other in such a narrow area.

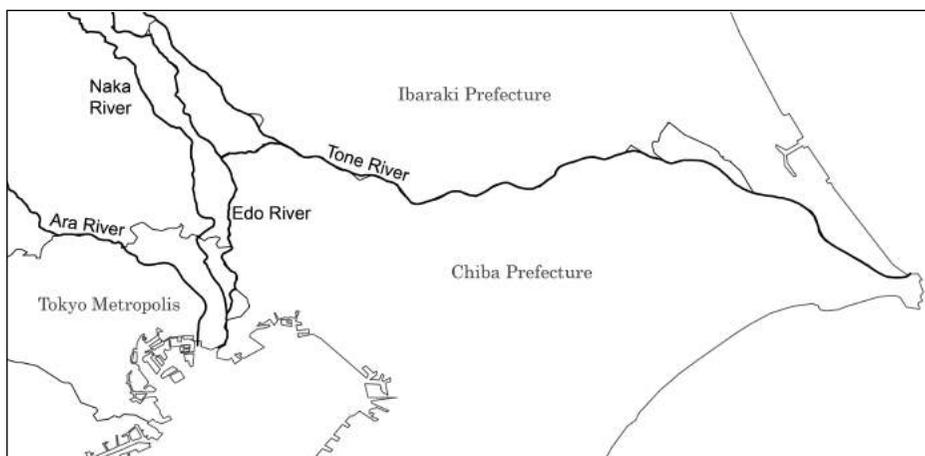
The above two examples demonstrate wide-area factors such as mountain-building movement and geologic structure, but they would not seem to match the situation at the mouth of the Yellow River as described in the *Shuijing zhu*. Accordingly I wish to consider another similar example, this time from eastern Tokyo in Japan. Today at least four rivers—from the west, Sumida 隅田, Ara 荒, Naka 中, and Edo 江戸 Rivers—flow parallel to each other from north to south in eastern Tokyo. The Sumida and Ara



**Fig. 15. Nōbi Three Rivers (Japan)**

Rivers belong to the basin of the Ara River, which rises in Mt. Kobushigatake 甲武信ヶ岳 in westernmost Saitama prefecture, while the Edo River belongs to the basin of the Tone 利根 River, which has its source in the Mikuni 三國 Mountains in Gunma prefecture. This complicated relationship between these rivers has its origins in the work carried out by the Tokugawa 徳川 shogunate in the early Edo period to change the course of the Tone River (fig. 16).

Prior to the Edo period, the Tone River did not flow east through Lake Kasumigaura 霞ヶ浦 and into the Pacific Ocean, as it does today, and instead it flowed along the present-day course of the Edo River into Tokyo Bay. Tokugawa Ieyasu 徳川家康, who arrived in Edo (present-day Tokyo) in 1590 (Tenshō 天正 18), built Edo Castle on the present-day site of the Imperial Palace, and when doing so he set about stabilizing Tokyo Bay. If the Tone River were to continue flowing into Tokyo Bay as it was doing at the time, silt would accumulate and eventually Tokyo Bay would disappear. Plans were made to change the course of the Tone River at a place called Sekiyado 關宿, near where present-day Chiba prefecture borders on Ibaraki and Saitama prefectures, so that the waters of the Tone River would flow east into the Pacific Ocean. Starting in 1594 (Bunroku 文祿 3) with the closing of the Ainokawa 會の川, one of the channels of the Tone River, work continued for about sixty years and was finally completed in 1654 (Jōō 承應 3), with the result that the main course of the Tone River now flowed eastwards. The present-day Edo River represents a remnant of the former course of the Tone River.<sup>40)</sup>



**Fig. 16. Tone River (Japan)**

The above examples seemed to resemble the Yellow River of the *Shuijing zhu* with regard to the configuration of the rivers, but because the process of their formation differed, they could not be used for reference purposes. Lastly, I wish to consider one more example, also from Japan, although it is not near a river mouth.

In the vicinity of Tōkamachi 十日町 in Niigata prefecture, the Shinano River 信濃 River and Uono 魚野 River, one of its tributaries, flow side by side in a northerly direction and meet at Kawaguchi 川口 (part of present-day Nagaoka 長岡) to the north of Tōkamachi, whereafter the Shinano River flows across the Echigo 越後 Plain into the Sea of Japan. An examination of the contour lines reveals that the Uonuma 魚沼 Hills lying between the Shinano and Uono Rivers are slightly elevated, and the area between the two rivers forms an anticlinal structure with the Uonuma Hills as its axis (fig. 17).

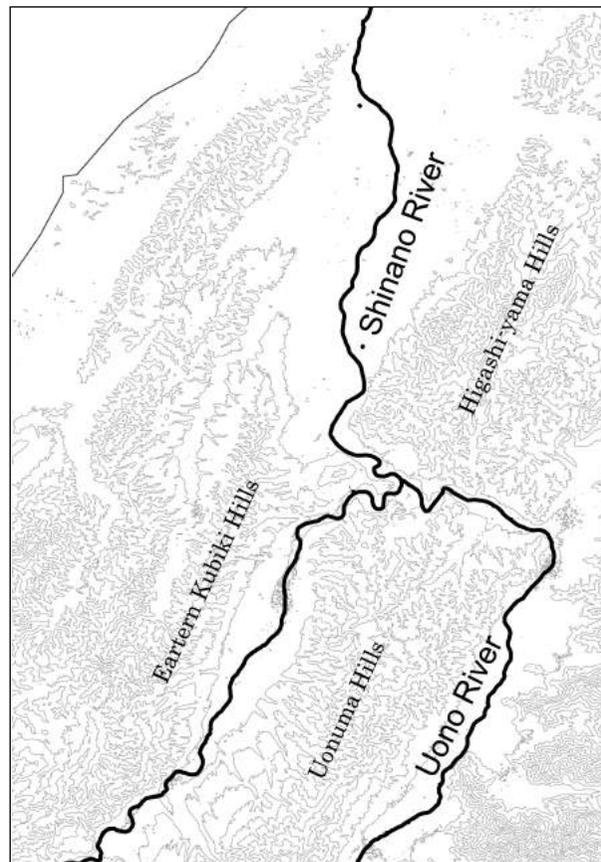


Fig. 17. The Shinano and Uono Rivers and Uonuma Hills

There is one further similarity, namely, the existence of oil fields. Although Niigata has almost no oil fields today, it is recorded in the *Nihon shoki* 日本書紀 and other works that in ancient times it produced petroleum, referred to as “burning water” (kusōzu 燃水).<sup>41)</sup> Meanwhile, during my field surveys in 2013 and 2015 around the mouth of the Yellow River of the *Shuijing zhu* I saw many pumpjacks over a wide area extending from Dongying to Binzhou 濱州 county, Huimin 惠民 county, and Linyi county (fig. 18). According to Sekiyu Gakkai 1984, in the area from Dongying to Linyi county, which I visited in the course of field surveys, there is an oil field called the Shengli oil field, which has been developed since the 1980s.

In the case of the Shinano and Uono Rivers, two rivers run parallel to each other, separated by hills that have an anticlinal structure. Next, taking these examples into account, I wish to examine the relationship between the Yellow River, Tashui River, and Jishui River of the *Shuijing zhu*, using SRTM-DEM and other topographic data.

### 3.4. The Formation of the Yellow River of the *Shuijing Zhu*

It has become clear from field surveys and the results of analyses of RS data that in the lower reaches of the Yellow River of the *Shuijing zhu* there were no natural levees, there was no delta at the river mouth, the Yellow River had tributaries and distributaries, and that at its mouth the Yellow River flowed parallel to the Tashui and Jishui Rivers into the Bo-



Fig. 18. An oil well in Huimin county (photograph by author, 2013)

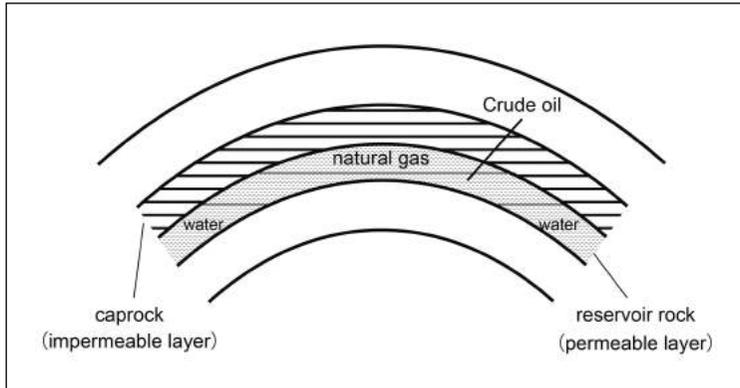
hai Sea. These are all characteristics that cannot be observed in today's Yellow River or in the reconstructed course of the Yellow River of the Former Han. In the following, I shall consider the situation in the lower reaches of the Yellow River during the Northern Wei, when the *Shuijing zhu* was composed.

As has already been noted several times, according to the *Shuijing zhu*, at the time the Yellow River flowed parallel to the Tashui and Jishui Rivers towards its mouth. Further, SRTM-DEM data shows that in the vicinity of present-day Dongying in Shandong province, thought to correspond to the mouth of the Yellow River of the *Shuijing zhu*, there extends only flat land, and there are no signs of any natural levees, let alone a delta such as can be seen in the Yellow River of the Former Han and today. Natural levees can be ascertained along a line coinciding with today's Jindi River, extending eastwards from Puyang in Henan province to Dong'e county in Shandong province, but no signs of any natural levees can be found in the vast expanse extending north from Dong'e county to the river mouth.

Furthermore, in my field surveys I used a bicycle to ascertain undulations in the land at Yucheng and in Gaotang 高唐, Linyi, and Huimin counties, but the land was quite flat, and I was able to identify vestiges of a natural levee at only one site. This tallies with the results of an analysis of the RS data.

Worth noting in this connection is the Shengli oil field, which extends from the river mouth in a westerly (or, strictly speaking, west-southwesterly) direction. Today, when exploring for oil fields, one of the indicators is the anticlinal theory proposed by Israel C. White in 1885 (White 1885). An anticline is a type of fold in which accumulated strata have been thrust upwards by compression from both sides (fig. 19). On the surface it looks convex, but in the lower strata there is what is called an anticlinal trap. According to White's anticlinal theory, petroleum is lighter than water and accumulates in the upper part of the permeable layer, and it therefore tends to accumulate in strata such as anticlinal traps. This means that oil fields are often discovered in localities where the ground possesses the characteristics of an anticlinal structure, and in fact many oil fields have been discovered by applying this theory.

As was noted earlier, according to Ma et al. 2000, the area around Dongying, which I analyzed with RS data, is called the Dongying Depression and forms an anticlinal structure. Further, this Dongying Depression forms part of a larger structural landform called the Jiyang 濟陽 Depres-



**Fig. 19. An anticlinal trap**

sion, which, according to Li 1980, constitutes an enormous geologic structure that ultimately extends as far as Puyang in Henan province.

With respect to the Yellow River during the Northern Wei, described in the *Shuijing zhu*, I have already completed an examination of the river's course from Puyang in Henan province through Dong'e county to the vicinity of Linyi county in Shandong province. This Linyi county lies on the western edge of the above Jiyang Depression, while the eastern side corresponds to the Dongying Depression, that is, the mouth of the Yellow River of the *Shuijing zhu*.

It is to be surmised, in other words, that the section of the Yellow River of the *Shuijing zhu* lying between Linyi county and Dongying more or less coincides with the Jiyang Depression. In point of fact, the Shengli oil field discovered at Dongying in Shandong province, thought to correspond to the mouth of the Yellow River of the *Shuijing zhu*, continues towards Linyi county in the west-southwest, and this tallies with the direction of the course of the Yellow River at the time when it was described in the *Shuijing zhu*.

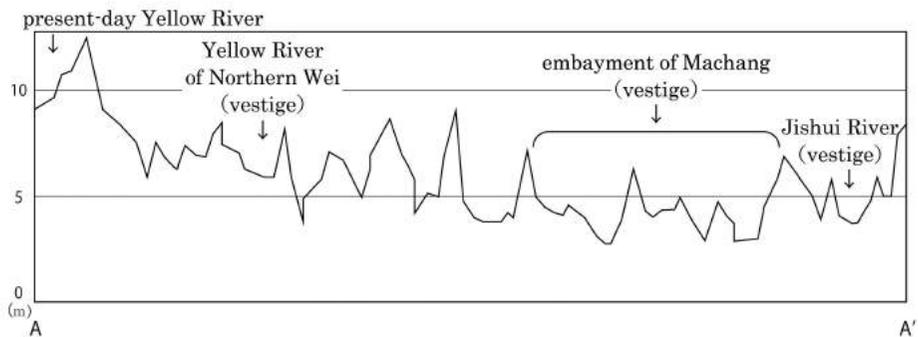
An anticlinal structure has one further topographic characteristic. The sedimentary strata thrust upwards may become exposed as a result of erosive action caused by rain and so on, and if the sedimentary strata include comparatively hard and soft strata, the soft strata will quickly erode while the hard strata remain. As a result, several parallel cleft-like landforms may form along the anticlinal axis. This is the origin of the anticlinal structure and parallel rivers to be seen in the case of the Shinano and Uono Rivers in Tōkamachi in Niigata prefecture.

Thinking that something similar may have occurred at the mouth of the Yellow River of the *Shuijing zhu*, and using SRTM-DEM data, I prepared a cross-sectional diagram of the area around present-day Dongying, thought to correspond to the mouth of the Yellow River during the Northern Wei (fig. 20), whereupon I was able to ascertain several distinctive hollows and protrusions. These coincide with the topographic structure of the Dongying Depression presented in Ma et al. 2000. Further, an examination of this diagram revealed the existence of a hollow wider than the channel of the Tashui River between the Yellow River of the *Shuijing zhu* and the Jishui River. In the *Shuijing zhu*, it is stated that at the mouth of the Tashui River there was an inlet called Machangkeng 馬常坑 that cut into the shoreline at the mouth of the Tashui River, and this coincides with this hollow. From this too it is evident that the vestiges of the three rivers are situated in the order described earlier.

Bringing together all of the above, and combining it with the already completed reconstruction of the course of the river from Puyang to Dong'e and Gaotang counties (Hasegawa 2016b), I have prepared a map of the entire lower Yellow River Plain showing the reconstructed course of the Yellow River of the *Shuijing zhu* (fig. 21).

#### 4. Conclusion

In the above, I have ascertained the state of the Yellow River during the Northern Wei on the basis of the description given in the *Shuijing zhu* and by analyzing RS data and undertaking field surveys. As a result, it has been possible to ascertain the following points.



**Fig. 20. Cross-sectional view of the Dongying Depression (by author, based on SRTM-DEM data)**

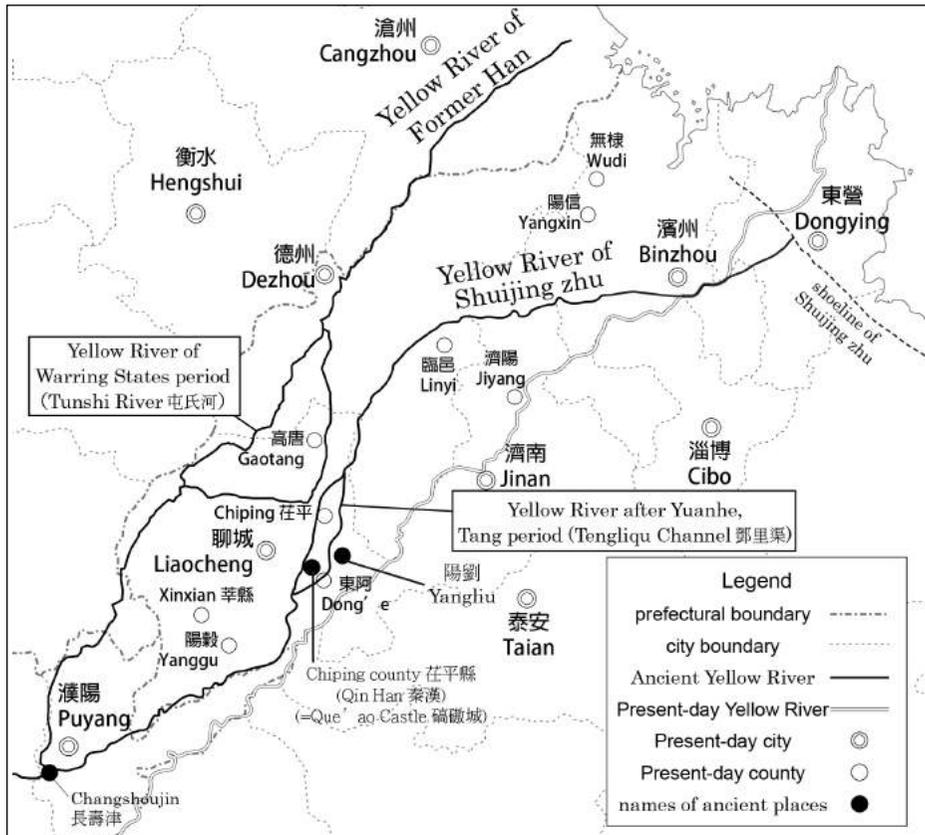


Fig. 21. Reconstruction of the course of the Yellow River of the Shuijing zhu

- (1) In the broad expanse of the Yellow River of the Former Han and the present-day Yellow River, I was unable to ascertain any undulations thought to originate in natural levees, neither in field surveys nor with SRTM-DEM RS data. In other words, the Yellow River at the time when the *Shuijing zhu* was composed did not form any natural levees.
- (2) At its mouth, the Yellow River flowed parallel to the Tashui and Jishui Rivers straight into the Bohai Sea without forming a delta.
- (3) In the lower Yellow River Plain several rivers, including the main course of the Yellow River, flowed parallel to each other or branched off and rejoined the Yellow River.

(1) and (2) are the result of having gained a grasp of the situation on the ground through field surveys and by using RS data. In the case of the

Yellow River of the Former Han, I was able to clearly identify the two slight elevations of Huachan and Liaode and vestiges of a delta with its apex in Mengcun Hui Autonomous County. It has become evident that, when compared with the present-day Yellow River, which has formed banks on both sides and the mouth of which continues to expand to the north of Dongying, the Yellow River of the Northern Wei, described in the *Shuijing zhu*, had completely different fluvial characteristics.

(3) is based on the description found in the *Shuijing zhu*. Today, there are a great many man-made irrigation canals in the lower Yellow River Plain, especially in the area between the Yellow River of the Former Han and the present-day Yellow River, where the Yellow River is thought to have flowed during the Northern Wei, and it is extremely difficult to ascertain the situation in former times. But judging from the *Shuijing zhu*, it would seem conceivable that during the Northern Wei the area may have been crisscrossed by a considerable number of small and medium-sized rivers.

In the areas that I visited in the course of field surveys, many of the rivers had no embankments, and there were no rivers that had formed banks. The many rivers without embankments flowed at a height slightly lower than the surface of the ground.

Wang Shangyi, whose research is mentioned in the “Introduction,” has collected and collated accounts found in official histories and summarized by dynasty the number of occasions when the Yellow River burst its banks or overflowed (fig. 22). In the Former Han and earlier, there are many references to breaches, but from Wang Mang’s 王莽 Xin 新 dynasty and the Later Han through to the Sui period there is not a single reference to a breach and only several overflows are mentioned (Wang 1989). Basing himself on the absence of references to breaches, Tan Qixiang put forward the thesis that from the Later Han through to the Tang period the flow of the Yellow River remained stable (Tan 1962), whereas Wang, placing importance on the references to overflows, rejected this thesis. But a different perspective emerges when one considers the course of the Yellow River of the *Shuijing zhu* reconstructed above and the local topography.

Dynasty	Breach (river bank failure)	Overflow	Changes in course	Total
Xin (Wang Mang)	0	0	1	1
Later Han	0	2	0	2
Three Kingdoms Wei, Shu and Wu	0	1	0	1
Western Jin	0	1	0	1
Eastern Jin and Sixteen Kingdoms	0	3	0	3
Sui	0	0	0	0

**Fig. 22. The number of breaches, overflows, and changes in course of the Yellow River in successive dynasties (Wang 1989)**

#### **4.1. The Yellow River of the *Shuijing Zhu* as Seen in the Local Topography**

First, I wish to ascertain the difference between a “breach” and an “overflow.” A breach means literally that the river breaches its banks and its waters spread beyond the river’s channel to the landside area. In the case of an overflow, on the other hand, the waters of the river similarly spread beyond its banks to the landside area, but the banks are not necessarily breached. It is possible that scribes used the word “overflow” precisely because there had been no breach of the banks.

It has already been pointed out that, based on a comprehensive examination of three sources of information—the *Shuijing zhu* and other written sources, field surveys, and RS data—at the time there were no natural levees along the Yellow River. And if there were no natural levees, it would have been impossible for any “breaches” to have occurred. All that could have occurred was “overflows,” without any bank breaches. Further, as was explained in §3.2, the Yellow River of the *Shuijing zhu* had no embankments, and it would have been easy for “overflows” to occur in the case of a river of this type.

But as far as damage to the surrounding area is concerned, there is no difference between a “breach” and an “overflow.” In the case of a large river such as the Yellow River, when it overflowed, even if there was no bank breach, the impact would have extended over quite a wide area. But as has already been noted by Tan Qixiang, the official histories of this period contain no records of damage caused by the Yellow River in the lower Yellow River Plain. It is another topographic feature—the three parallel rivers—that now assumes importance.

#### 4.2. The Relationship between the Three Parallel Rivers and Flood Damage

The term “three parallel rivers” is my own coinage and refers to the fact that at the time it would seem that the Yellow River was flowing parallel to two other rivers. As was seen in §3.3, it can be confirmed on the basis of the *Shuijing zhu* and an analysis of RS data that during the Northern Wei the two rivers Tashui and Jishui ran parallel to the Yellow River at its mouth.

However, the positions of these three rivers were not fixed. In the vicinity of Puyang, in the upper part of the lower Yellow River Plain, the Tashui River lay to the north of the Yellow River of the *Shuijing zhu* while the Jishui River lay to the south, and the Yellow River thus flowed between them. But in the vicinity of Dongying at the river mouth, the positions of the Yellow River of the *Shuijing zhu* and the Tashui River had been reversed, with the three rivers flowing into the sea in the order, from the north, of Yellow River, Tashui River, and Jishui River.

In §3.4 I touched on the fact that the area around Dongying at the river mouth had its origins in an anticlinal structure called the Dongying Depression and that this extended as far as Linyi county in the form of a larger structural relief called the Jiyang Depression, with the structure running north-south from Linyi county as far as the east side of Puyang. This configuration coincides with the course of the Yellow River described in the *Shuijing zhu*. Further, a geologic analysis using Landsat5 TM data revealed vestiges of landforms running north-south from Dong’e county as far as the vicinity of Liaocheng, and it turned out that one of these was a distributary of the Yellow River called the Dengliqu Channel in the *Shuijing zhu* (Hasegawa 2016b). To sum up, it is to be surmised that at the time there may have existed in the area around the Yellow River many distributaries like the Dengliqu Channel or rivers running parallel to the

Yellow River, all of which may be considered to have been cleft-shaped landforms originating in anticlinal structures. This also tallies with the relative positions of the Yellow River and its distributaries and tributaries as described in the *Shuijing zhu*.

In addition, the existence of small and medium-sized rivers such as the Tashui and Jishui Rivers running parallel to the Yellow River is also connected to the low level of flood damage caused by the Yellow River in the lower Yellow River Plain at the time. Because the Yellow River had no natural levees at this time, when the river flow increased in its upper and middle reaches because of heavy rain and so on, the river would overflow in its lower reaches. But the water overflowing from the Yellow River would flow into nearby parallel rivers such as the Tashui and Jishui Rivers and would not spread any further.<sup>42)</sup> People at the time probably knew from experience the extent of damage caused by such overflows, and so they may not have settled from the outset in such areas prone to flood damage.

#### 4.3. Points at Issue in Past Research on the Yellow River

The final conclusion to be drawn from the above is that the Yellow River of the *Shuijing zhu* possessed distinctive features that were completely different from those of the Yellow River of the Former Han and the present-day Yellow River. As can be seen in the relationship between the *Hequ jiwén* and *Huanghe shuilishi shuyao* mentioned in note 4 and §2.4, there are unfortunately many examples of people failing to recognize the facts before their eyes.

Especially when dealing with natural objects such as rivers, people will often adduce examples of similar natural objects, regions, or periods since there are few references to such natural objects in the official histories. But it is quite conceivable that the features of the object under discussion do not tally with those of what has been adduced. In research on natural objects, there is a need to constantly take into account the actual objects and their location and period.

In the case of the Yellow River, past research has considered the features of the Yellow River of the *Shuijing zhu* to have been identical to those of the Yellow River of the Former Han and the present-day Yellow River, and this has ultimately led to the conclusion that the flow of the Yellow River was stable at the time described in the *Shuijing zhu*. But the conclusion drawn by the present study shows that the assumptions behind this

earlier view were wrong. It is important to examine the issues by extending one's thinking to local conditions that remain today and to the process whereby the river course was formed.

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### Credits for Satellite Data

Fig. 3: Google Earth (for copyright details, see lower left of each image).  
 Figs. 4, 6 & 8 (ALOS AVNIR2): Data distributed by Japan Aerospace Exploration Agency and Remote Sensing Technology Center of Japan.  
 Figs. 5, 7 & 9 (CORONA): United States Geographical Survey.

### Notes

- 1) See Hasegawa 2016a: pt. 1, chap. 1.
- 2) See Hasegawa 2016a.
- 3) According to current theories about changes in the course of the Yellow River, the second change in its course occurred from the late Former Han to the Later Han, as a result of which it moved to a different course from that during the Former Han, and it is considered that there were no major changes thereafter through the Northern and Southern Dynasties until its course changed again in the late Tang. Detailed information about the location of the river's course during this period can be found in the *Shuijing zhu*, dating from the Northern Wei, and I therefore refer to the Yellow River during this period as the “Yellow River of the *Shuijing zhu*.” I have already reconstructed its course from present-day Puyang in Henan province to Dong'e county and Liaocheng in Shandong province; see Hasegawa 2016b.

- 4) For example, Kang Jitian 康基田 of the Qing writes in his *Hequ jiwén* 河渠紀聞 that “there still exist [traces of] the old course of the Great River (i.e., Yellow River) to the north of Pingyuan [county], and the area is lowlying and all damp and marshy” (平原以北、大河故道猶存、地區窪下、皆沮洳之區), on which *Huanghe Shuilishi Shuyao* Bianzhezu 2003 comments as follows: “The statement that ‘the area is lowlying’ refers not to the old course of the river itself but to the area to its north and south” (p. 134). This is examined below in §2.4.
- 5) According to my reconstruction of the course of the Yellow River of the *Shuijing zhu*, this latter locality corresponds to the place where the Yellow River of the *Shuijing zhu* flowing from the south turned eastwards.
- 6) See Hasegawa 2016a: pt.1, chap. 1.
- 7) The period from the Northern Song to the Jin and Yuan is considered to have been a turbulent period for the Yellow River, with its course changing several times. Researchers differ in how they count the number of times the river changed its course during this time.
- 8) For details on the view that the Yellow River of the *Shuijing zhu* starts from 69 C.E., see Hasegawa 2015.
- 9) The Yellow River breached its banks at Zhengzhou 鄭州 in 1887 (Guangxu 光緒 13), and Liu E took part in flood control works that were carried out by Wu Dacheng 吳大澂, who was appointed governor-general of Hedong Hedao 河東河道 the following year, and compiled the *Lidai Huanghe bianqian tukao* on the basis of his investigations conducted at the time. For details, see Hasegawa 2016a: pt. 1, chap. 1.
- 10) For details about Yang Shoujing’s *Lidai yudi tu* and the process that led to the compilation of the *Zhongguo lishi dituji* by the Yang Map Committee, see Yoshikai 2003.
- 11) See Hasegawa 2016a: pt. 1, chap. 1.
- 12) Here, 1 *chi* 尺 = 23.2 cm and 1 *zhang* = 10 *chi* = 2.3 m. On weights and measures during the Former Han, see Hasegawa 2016a: pt. 3, chap. 2, and Qiu 2003.
- 13) See Hasegawa 2016a: pt. 2, chap. 1.
- 14) On the stretch of the Yellow River that flowed during the Northern Wei from Puyang in Henan province via Dong’e county as far as Yucheng 禹城 in Shandong province, see Hasegawa 2016b.
- 15) On partial changes in the course of the Yellow River during the reign of Wudi 武帝 of the Former Han, see Hasegawa 2016a: pt. 2, chap. 5 and pt. 3, chap. 1.
- 16) On changes in the Yellow River during the period of transition between the Former and Later Han and Wang Jing’s hydraulic works, see Hasegawa 2015.
- 17) Wei Yuan was an official and literatus of the Qing who wrote the *Haiguo tuzhi* 海國圖志 and other works. In the *Chouhe pian* 籌河篇 he writes with reference to the flood control works carried out by Wang Jing in the Later Han that “Wang Jing’s river was free from trouble for one thousand years” (王景河、千年无患). Tan Qixiang argued that these “one thousand years free

from trouble” were related to depopulation of the middle reaches of the Yellow River during the Later Han and an increase in stock-farming due to an influx of people from the north, and he put forward the view that for at least eight hundred years from the Later Han until the late Tang the flow of the Yellow River was stable (Tan 1962). Since then there have appeared many arguments for and against this view, on which see Hamakawa 2006.

- 18) See Hasegawa 2016b.
- 19) On my field survey in Puyang in 2004, see Hasegawa 2016a: suppl. chap. 2.
- 20) The distinctive features of the Yellow River and its mud and sand are touched on in Hasegawa 2016a: pt. 1, chap. 2.
- 21) On distinctive features of ALOS AVNIR-2, Landsat5 TM, CORONA, SRTM, and other forms of RS data, see Hasegawa 2016a: pt. 1, chap. 3.
- 22) *Yuanhe junxian zhi* 10, “Henandao” 河南道 6: “Luxian” 盧縣.
- 23) The courses of the Yellow River of the *Shuijing zhu* as presented in the *Zhongguo lishi dituji*, Zhou 1982, Yang 1991, Niu 1994, Wu et al. 2001, etc., are compared in Hasegawa 2016b.
- 24) On the Dengliqiu Channel and distributaries of the Yellow River of the *Shuijing zhu*, see Hasegawa 2016b.
- 25) *Dushi jangyu jiyao* 31, “Shandong” 山東 2, “Linyi xian” 臨邑縣.
- 26) “Shahe: Formerly called Shanghe 商河. From the Song period onwards water from the Yellow River flowed into it, as a result of which sand accumulated in the river channel, and so it was renamed Shahe.” (revised edition of *Shanghe xianzhi* 2, “Natural Environment”)
- 27) On “embankmentless rivers,” see §3 below.
- 28) See Hasegawa 2016a: pt. 2, chap. 4.
- 29) At the point where a large river enters the sea, the soil on the seafloor is churned up by the waters of the river and forms a distinctive landform or stratum, called a “delta lobe,” which can be regarded as evidence of the former presence of a river mouth (Saitō 2007). On the relationship between delta lobes and changes in the course of the Yellow River, see Hasegawa 2016a: pt. 1, chap. 2.
- 30) This may be related to the development of Dongying, which has grown rapidly since the discovery of the Shengli oil field in April 1961. In December 1983 it became a prefecture-level city, and today it has grown into a large city with a population of 1.8 million (Shandongsheng Dongyingshi Difangzhi Bianzuan Weiyuanhui 2000 and Dongyingshi Tongjiju et al. 2014). It is possible that any vestiges of the river mouth may have disappeared during the course of this rapid development.
- 31) A stele marking the point of demarcation between the middle and lower reaches of the Yellow River, erected in 2001, stands in Taohua 桃花 valley, Xingyang, and today this stele is considered to mark the divide between the middle and lower reaches of the river.
- 32) See Hasegawa 2016a: pt. 3, chap. 2.
- 33) See Yun 1995 and Hasegawa 2016a: pt. 1, chap. 2.
- 34) In May 2016, I visited Lankao 蘭考 county in Henan province and observed the point where today’s Yellow River makes a bend towards the northeast.

There survive in this area signs of when the Abandoned Yellow River flowed southeast, and a weir for adjusting the flow of the water had been built in the bank on the southeast side of the Yellow River.

- 35) In river engineering, the “landside area” of a bank refers to the land, generally inhabited, on the opposite side to the riverside of a bank.
- 36) “The construction of levees began recently in the Warring States period, and they protect the rivers, each for their own benefit. Qi, Zhao, and Wei are bordered by the Yellow River. Zhao and Wei are bounded by mountains, while the land of Qi is lowlying, and it has constructed banks that extends 25 *li* from the river.” (蓋隄防之作，近起戰國，雍防百川，各以自利。齊與趙、魏，以河爲竟。趙、魏瀕山，齊地卑下，作隄去河二十五里) Converted into today’s measurements, “25 *li*” corresponds to 10 kilometres, and the banks on both sides of the river would therefore equate to 20 kilometres. For further details, see Hasegawa 2016a: pt. 3, chap. 2.
- 37) On the Dengliqu Channel, see Hasegawa 2016b.
- 38) Generally speaking, the transporting capacity of a river’s waters falls not only when the mud and sand in the river decrease, but also when the volume of water decreases, and the mud and sand are no longer carried as far as the lower reaches of the river.
- 39) See Hasegawa 2016a: pt. 2, chap. 4.
- 40) For details on this work to change the course of the Tone River, see Ōkuma 1981.
- 41) In the *Nihon shoki*, in the entry for the seventh year of the reign of the emperor Tenchi 天智 (668), it is stated that “the province of Koshi (Echigo, or present-day Niigata prefecture) offered burning earth and burning water” (越國獻燃土与燃水). This “burning water” is thought to signify petroleum.
- 42) In the *Zizhi tongjian* 資治通鑑 (“Houzhou ji” 後周紀 3) it is stated: “For 120 *li* from Yangliu to Bozhou the [Yellow] River run out to the east annually, separated into two branches, converged into a large marsh, and inundated several hundred *li*.” (河自楊劉至於博州百二十里，連年東潰，分爲二派，匯爲大澤，瀾漫數百里) When compared with the Yellow River’s greatest expanse of 20 kilometres during the Former Han (i.e., the width of the slight elevation of Liaode), this represents a vast area almost twice the size, and it is to be surmised that this area extending 40 kilometres from east to west between Yangliu 楊劉 (present-day Yangliu in Dong’e county) and Bozhou 博州 (Bopingzhen 博平鎮 in present-day Chiping county) corresponds to the largest area over which the Yellow River (and Tashui and Jishui Rivers) of the *Shuijing zhu* extended.

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