2011 International Conference on Document Analysis and Recognition

Chinese Paleography, Calligraphy, and Pattern Recognition:

Styles and Scripts in Excavated Ancient Chinese Documents

Xing Wen
Dept. of Asian and Middle Eastern Languages and Literatures
Dartmouth College
Hanover, N.H. 03755, U.S.A.
Wen.Xing@Dartmouth.EDU

***Abstract*—Just as the discovery of the Dead Sea Scrolls significantly changed the study of Judeo-Christian biblical tradition, excavated ancient Chinese documents, many of which are unavailable in the transmitted textual tradition, have dramatically changed the study and understanding of almost every aspect of ancient China. As original work of ancient Chinese calligraphy produced in different historical periods and geographic areas, the excavated ancient Chinese documents are vivid demonstrations of stylistic variations, structural complexity and aesthetic principles of ancient Chinese scripts. I argue that an interdisciplinary study of Chinese paleography, calligraphy, and pattern recognition provides an innovative digital approach to the interpretation of excavated ancient Chinese documents and the revolution of traditional Chinese paleography.**

Keywords-Chinese paleography; Chinese calligraphy; pattern recognition; excavated texts; transparent transcription

I. INTRODUCTION

Since the beginning of the 20th century, nearly 300,000 bamboo and wood slips of ancient Chinese historical and intellectual texts have been discovered. Just as the discovery of the Dead Sea Scrolls significantly changed the study of Judeo-Christian biblical tradition, these excavated texts, many of which were unavailable in the transmitted textual tradition, have dramatically changed the study and understanding of almost every aspect of ancient China.

Written in various forms of ancient Chinese script before and after the unification of the Chinese writing system in 221 BCE, many of those excavated manuscripts include rare editions of seminal Chinese classics and long-lost texts that define various aspects of Chinese culture and traditions. Due to the artistic and structural particularities of Chinese calligraphy, many of those excavated ancient inscriptions, in particular, those archaic scripts that have been out of use for over 2,000 years since 3rd century BCE, are difficult to decipher and interpret. I do not include oracle bone and bronze inscriptions in the present study because they had already been developed into independent subjects of study before those important bamboo, wooden, and silk inscriptions were widely discovered in the second half of last century.

In this paper, after a brief survey of the geographic and chronological distributions of the excavated ancient Chinese documents, I propose a new paleographical approach that incorporates pattern recognition. By discussing how ancient Chinese inscriptions are stylistically, structurally and aesthetically presented by Chinese calligraphy, I argue for an interdisciplinary study of Chinese paleography, calligraphy, and pattern recognition, which conjointly examines the stylistic variation and structural complexity of archaic Chinese scripts, to develop an innovative cyber-based holistic Chinese paleography.

II. EXCAVATED CHINESE DOCUMENTS: INTELLECTUAL SIGNIFICANCE, AND GEOGRAPHICAL AND CHRONOLOGICAL DISTRIBUTIONS

Since 1900, over 280,000 government administrative documents inscribed on wooden and bamboo slips have been discovered in Northwest and mid-South China. Starting from the early 1940s, intellectual manuscripts began to be discovered in mid-South, East and North China. Although accurate statistics of the quantity of the excavated documents was never available, it is reasonable to believe that nearly 300,000 wooden and bamboo slips, over 10,000 jade pieces, and nearly 100 various silk manuscripts have been discovered. These excavated ancient Chinese documents cover a wide range of subjects, such as early Chinese administration, divination, economics, geography, history, intellectual history, law, lexicon, literature, mathematics, medicine, meteorology, military theory, music, philosophy, political science, postal system, psychology, religion, ritual, sexology, and zoology.

As a specific example, the published 1,567 Guodian 郭店, Shanghai Museum and Tsinghua University bamboo slips, i.e., 730 bamboo slips excavated from Guodian, Hubei 湖北 Province in 1993 [1], 730 out of 1,200 bamboo slips in the Shanghai Museum collection [2], and 107 out of about 1,800 bamboo slips in the Tsinghua University collection [3], are all the 4th century BCE bamboo slips from Warring States Period (475-221 BCE) tombs. They have been the most frequently discussed textual materials in recent years although other excavated manuscripts, such as those excavated from Mawangdui 馬王堆 in Hunan 湖南 and Yinqueshan 銀雀山 in Shandong 山東 provinces in early 1970s, are neither less famous nor less important. Like those earlier discoveries, the Guodian and Shanghai Museum bamboo texts include both classics such as *Yijing* 易經 (Book of Changes), *Laozi* or *Lao-tzu* 老子, *Liji* 禮記 (Book of Rites) chapters, and the earliest comments by Confucius

1520-5363/11 $26.00 © 2011 IEEE
DOI 10.1109/ICDAR.2011.193

on the *Shijing* 詩經 (Book of Odes), and dozens of invaluable long-lost texts dated between the times of Confucius (551-479 BCE) and Mencius (372-289 BCE), founders of the Chinese philosophical tradition. The Tsinghua University bamboo slips include chapters or textual fragments of both the received and the lost *Shangshu* 尚書 (Book of Documents) classic for which scholars of the Chinese classics have been waiting for millennia. These examples illustrate three characteristics of excavated Chinese texts: they are important, containing seminal Chinese classics and long-lost significant texts; they are difficult, written in archaic forms of script used before the unification of the Chinese writing system; they exist in great quantities, awaiting digital aids with innovative approaches to access and interpret them as a whole.

Geographically, those ancient documents were excavated from many areas in China. These areas include Gansu, Qinghai and Shaanxi provinces as well as Inner Mongolia and Xinjiang regions in Northwest China, Hunan and Hubei provinces in mid-South China, Sichuan province in Southwest China, Guangxi region in South China, Henan, Hebei provinces and Beijing area in North China, and Anhui, Jiangsu, Jiangxi, and Shandong provinces in East China. As shown in Fig. 1, the areas in which ancient Chinese documents were excavated cover more than 2/3 of China [4].

Chronologically, those excavated documents are roughly dated from the 5th century BCE to the 10th century CE, i.e., from the Warring States period of the Zhou 周 dynasty (1046-256 BCE), to Qin 秦 (221-206 BCE), Western Han 漢 (206 BCE-25 CE), Eastern Han (25-220), Three Kingdoms period (220-280), Western and Eastern Jin 晉 (265-420) dynasties, and Tang 唐 dynasty (618-907) [4].

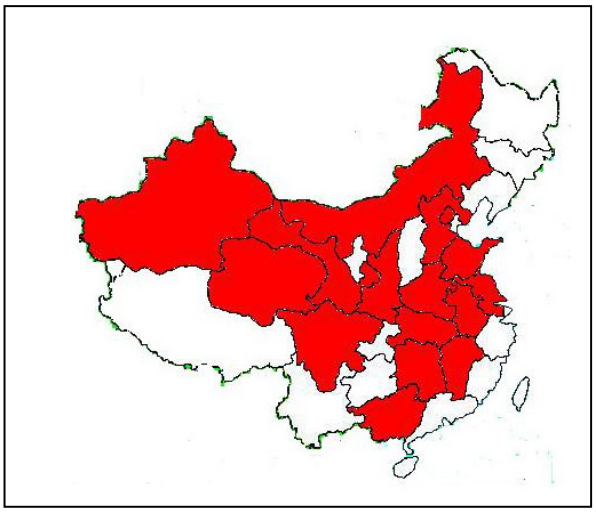

Figure 1. Geographic Distribution of Excavated Ancient Chinese Documents.

III. Pattern Recognition: A Digital Approach to Chinese Paleography

A. *Rethinking Traditional Chinese Paleography*

Most scripts on wooden, bamboo and silk documents dated in and after Han dynasties are modern scripts that do not require any paleographic research before they can be transcribed. However, the most important portion of the excavated documents consists of manuscripts inscribed in archaic scripts dated in and before early Western Han dynasty. The first step to read and interpret the archaic scripts is to decipher and transcribe them. Unfortunately, traditional approach of Chinese paleography is usually highly subjective. In deciphering an archaic graph, a traditionally trained paleographer examines it in terms of its paleographic, phonetic, historical linguistic and textual contexts, and decides what the modern equivalent of the archaic graph is; such work is done with or without adequate notes explaining the paleographic analysis and the transcribing process. The whole process of transcription is thus obscure or perhaps even based on the intuition of the specific paleographer. As a result, the rationale for associating a certain modern character with a certain archaic original is often obscure for a non-paleographic scholar or even to an equally well trained paleographer. This approach, as William G. Boltz said, "deprives every other reader and scholar of the chance to decide for himself what the manuscript actually says" [5], because the transcribing process is not transparent.

I have suggested a Transparent Transcription approach to resolve the problem by directly transcribing archaic scripts stroke by stroke and component by component. This approach usually includes four steps, (1) Tracing Transcription (optional step; used in cases of unknown graphs with no known modern counter parts), (2) Direct Transcription (faithfully transcribing what was written in the original manuscripts), (3) *Liding* 隸定 (clerically transcribing, a term traditionally used to describe the process of transcribing an archaic form graph into a modern form character, such as *Lishu* 隸書, or Clerical Script) Transcription, and (4) Interpretive Transcription (deciphering what was intended to write in the original) [6]. Since components of Chinese characters are usually consistent in their forms, structure, and semantic or phonetic meanings, applying patter recognition technology to match particular graphs in question with recognized components in a related database will no doubt facilitate the transparent process, which is unavailable in the traditional approach to Chinese paleography, of transcribing archaic Chinese scripts.

B. *Database in the Geographical and Chronological Contexts*

In constructing a database for pattern recognition, I propose that both geographic and chronological distributions of excavated manuscripts be carefully considered. For geographical considerations, archaic scripts should be selected from tombs in different states. For chronological considerations, they should cover the most representative

historical periods. For the Warring States period scripts, I include inscription images, both separate components and characters as a whole, from the following tombs in a pattern recognition database:

- Early Warring States period tomb of Marquis Yi 乙 of Zeng 曾 (dated 433 BCE or later)
- The middle Warring States Geling 葛陵 tomb no.1 (dated 377 BCE or so)
- Baoshan 包山 tomb no.2 (316 BCE)
- Guodian tomb no. 1 (around 300 BCE)
- The late Warring States Jiudian 九店 tomb no.56 (around but before 278 BCE)
- The Qin Dynasty Shuihudi 睡虎地 tomb no.11 (around 240s-210s BCE)
- Liye 里耶 site (between 208 to 206 BCE)
- Han Mawangdui 馬王堆 tombs (around 168 BCE)
- Yinqueshan 銀雀山 tombs (between 134-118 BCE)
- Bajiaolang 八角廊 tomb no. 40 (no earlier than 56 BCE)

Geographically, they include five of the seven "warring" states during the Warring States period, i.e., Chu 楚, Qin 秦, Qi 齊, Zhao 趙 and/or Wei 魏 in both the Yellow River and Yangzi River valleys. Chronologically, they cover the three historical periods key to the development of both Chinese calligraphy and intellectual history: the Warring States period, Qin and Western Han dynasties.

C. *Pattern Recognition System*

An algorithmic and recognition system based on the above database is particularly helpful in examining confusing graphs in Chinese paleography. For example, on slip 1 of the Warring States period bamboo-slip text *Hengxian* 恒先, we find the following graph repeated three times  ,  and  [2]. It was transcribed as *zhi* 質, *quan* 全, *pu* 樸, and *su* 素, etc. by different scholars [7]. This is a critical character/word depicting the state of the beginning of the universe in the 4th century BCE excavated text, and a different interpretation of the character will completely change the cosmological view of the text.

Matching algorithms present the matches of the bottom component  of the character as *pu* 業 and *ye* 業. The selected results include:

- *Pu* 業, in  (*pu* 樸 on Guodian *Laozi* A slip 13) [1],  (*pu* 業 on Baoshan slip 145) [8], etc.
- *Ye* 業, in  (*ye* 業 on Shanghai *Kongzi shilun* slip 3) [2],  (*ye* 業 on *Hengxian* slip 4) [2], etc.

Observation 1: The top portions of components *pu* and *ye* are the same as that of component  .

- The bottom of  is either *da* 大 , an abbreviation of *gong*  , or abbreviated as the half, *you*  .

Observation 2: The bottom portions of components *pu* and *ye* are the variations of the same component *gong*.

Discussion and conclusion: The transcription of component  can be either *pu* 業 or *ye* 業. Any other decipherments are not supported by the matching results of pattern recognition. Since *ye* 業 does not make sense but *pu* 樸 (*pu* 業) makes perfect sense in the original text, the interpretation of the character in question should be *pu* 樸.

Verification: Graphs with *pu* 業 component include *pu* 僕,  (found on bronzes Ling *ding* 令鼎, Qitian *ding* 諆田鼎, etc.) with a top that is similar to  or  , the top of the graph in question [7]. *Pu* 僕 was written *pu* 樸 on slip 18 of Guodian *Laozi* A [1]. Since the graph in question has the same structure as character *pu* on the bronzes with a similar top component and the equivalent bottom component, therefore, the above transcription is convincingly confirmed [7].

IV. Chinese Calligraphy: Stylistic Variations, Structural Complexity, and Aesthetic Principles

A. *Stylistic Variations*

From the perspective of stylistic variation, the above example of *pu* is not representative because there is no stylistic variation in either the strokes or the components of the character. In fact, stylistic variation, and structural complexity as well, are the serious issues which a pattern algorithmic and recognition system has to deal with because artistic presentations of Chinese calligraphy usually make one pattern to be matched by different graphs or the same graph to match with various distinct patterns.

For example, *zheng* 正 equals to both  , with a top filled-in stroke as the top horizontal stroke, and  , with the top filled-in stroke as an extra component in addition to the top horizontal stroke. Strokes similar to such filled-in dot-like stroke are commonly used in Warring States period Chu scripts. They present not only stroke variations but also structural complexity. In Table I below, I list some examples of such filled-in stroke components that are identified as different modern forms of their equivalents.

TABLE I. Filled-in Stroke and Its Equivalents

No.	Filled-in Component	Archaic Graph	Trans-cription	Modern Equivalent of the Filled-in Component
1	a:  b: 	a: ; b: 	a: 正; b: 車	一
2			共	廿
3			風	口
4			昆	日
5			屯	凵
6			瓜瓜	厶
7			軝	己

The dot-like filled-in stroke has some variations, such as an independent dot in examples nos. 1a and 2, a decorative dot on another stroke in examples nos. 1b, 3 and 5, a dot attaching to another stroke in examples nos. 4, 5 and 6, and a filled-in of a portion of another stroke in no. 7. Eventually, they evolved into distinct components, i.e., 一, 廿, 口, 日, 凵, 厶, and 己 as shown in Table 1, thus demonstrate the structural complexity of Chinese scripts due to variant semantic implications of the dot-like filled-in strokes.

B. Structual Complexity

Structural complexity of the Chinese writing system has to be examined from various perspectives. Different script usually has different rules to make the form of a character. Chinese paleographers have systematically examined the structural complexity of Oracle Bone Inscription and Bronze Inscription [9], as well as that of the Warring States period archaic scripts [10]. The following perspectives reflect basic issues between the pattern recognition and the structural complexity of Chinese scripts.

1) History of Chinese Calligraphy Perspective: As for the structural complexity, we must realize that many modern forms of certain ancient components do not necessarily reflect the semantic meanings of the originals. In the example below of *bao* 保 (to protect), we see the structual evolution of the character in its different stylistic scripts. Generally speaking, the Chinese writing system derived from the Neolithic period pottery and jade inscriptions, and further developed into Oracle Bone Inscription and Bronze Inscription in Shang 商 Dynasty (1600-1046 BCE), and the Six States Scripts in the Warring States period. Different from conventional believe, both Clerical Script and Cursive Script actually appears in the Warring States period before the Small Seal Script was invented in Qin dynasty to unify the Chinese writing system. However, it is in Han dynasties when both Clerical Script and Cursive Script are fully developed. During the Period of Disunity (220-589 CE) after the Han dynasties, Standard Script and Running Script, the two most commonly used scripts today, are developed. Examples of such script evolution can be observed in Table II.

TABLE II. DIFFERENT SCRIPTS OF *BAO* 保

Script Name	*Script Name in Chinese*	*Scripts*
Oracle Bone Inscription	Jiagu wen 甲骨文	
Bronze Inscription	Jinwen 金文	Early Form:  Later Form:
Six States Scripts (Chu)	Liuguo wenzi (Chu) 六國文字（楚）	
Clerical Inscription	Lishu 隸書	
Small Seal Script	Xiaozhuan 小篆	
Cursive Script	Caoshu 草書	
Standard Script	Kaishu 楷書	保
Running Script	Xingshu 行書	

In this example, *bao* 保 was written as in Oracle Bone Inscription and as in early Bronze Inscription, depicting a person holding/protecting a baby with an arm. In the later stage, this character was written as in the Bronze Inscription with the holding arm turning into an abstract stroke. With an additional stroke added to the center of the bottom, i.e., , to balance the bottom right portion, the original meaning of an arm totally disappears. It is even more difficult to see the original semantic meaning because the original component of an arm have turned into a wood component *mu* 木 in Clerical Script , Small Seal Script , Cursive Script , and Standard Script 保, etc.

2) Evolution of Script Component Perspective: Structural complexity of Chinese script concerning pattern recognition is not a subject that can be properly discussed in a short article. It deserves at least a book of comprehensive study. Some further quick examples may give us some more senses of the complexity. For example, like other writing systems, Chinese script usually evolves into some simpler and simpler forms, such as *zhong* 中 (central) turning from  or  into  . However, it is not unusual for ancient Chinese characters also to turn into more and more complicated forms, such as *wen* 文 (cultural) turning from  into  with a semi-mouth component on the right top or  with a full mouth component at the same location. A pattern recognition system must be aware of such structual complexity.

3) Stylistic Variation Perspective: That a character has variant structures that can be identified as other characters adds further difficulties to pattern recognition. For example, *wei* 唯 (an initial particle) is actually inscribed in the form of *shou* 售 (sale) and its various forms in many excavated ancient manuscripts. A direct transcript of the graph and its pattern recognition will defenitely be misleading. Similar examples can be found in characters  ,  , and , etc., the direct transcriptions of which are 本, (片), and 音, etc., respectively. How a pattern recognition system identifies them as what they originally are, i.e., 爾, 宅, and 其 (期), etc., is clearly a problem that only the study of pattern recognition alone will not be able to resolve.

C. Aesthetic Principles

As for aesthetic principles of Chinese calligraphy, it is an issue that most paleographers neglect. Aesthetic principles in Chinese calligraphy concern not only Chinese cosmology but also the pattern recognition in question because an inappropriate application of certain aesthetic principles may

lead to erroneous components due to improper variation of brush strokes.

1) Cosmological Implication of Chinese Calligraphy: As a cosmology, Chinese calligraphy presents the idea of *yin* 陰 and *yang* 陽 as well as some related principles and images in the cosmos. When black ink is applied on a piece of white paper, the two primordial cosmological forces, i.e., *yin* (black) and *yang* (white), are generated. *Yin* and *yang* interact with each other and give birth to all the living things in the universe. Consequently, each brush stroke of a Chinese character in Chinese calligraphy is not simply a line or a dot, but a cosmological image as well. As Ouyang Xun 歐陽詢 (557-641), one of the four most famous and influential masters of Standard Script in the history of Chinese calligraphy, states, a dot looks like a rock falling from a peak of a mountain, such as ; a horizontal stroke resembles rolling clouds of thousands of miles, such as  ; a graceful hook presents a crescent in the night sky, such as  ; a powerful hook is an old strong branch of a pine tree hanging upside down on a steep cliff, such as  ; etc. [11].

Master Ouyang's theory has been well received because it is not difficult to make similar observations on numerous other works of Chinese calligraphy. For example, *ren* 人 (human) on slip 1 of *Huangmen* 皇門 of the Warring States period bamboo slips in the Tsinghua University collection vividly depicts a profile of a person with a upward straight back, downward arm and supporting hip  [3]; *bing* 并 (parallel), , on slip 3 of *Chengwu* 程寤 in the same catch of the bamboo slips depicts two parallel people with open arms walking or standing hands in hands in parallel:  [3]. In other words, brush strokes in Chinese calligraphy are usually abstract paintings with powerful images.

2) Examples of Aesthetic Principles: The language of Chinese calligraphy is brush strokes in black ink on white paper, which depicts the power and balance of *yin* and *yang*. Each particular script in Chinese calligraphy usually has its particular rules and principles for its artistic presentation. For example, Warring States Chu script usually firmly holds its top or/and right components with a somehow horizontal bottom stroke extending upward towards right, thus the whole graph firmly lands on a solid ground with internal energy always ready to arise upward, such as  and . As for graphs without a horizontal bottom stroke, this principle is still applied by making use of a short horizontal stroke on one side of the graph, such as  , or by using a similar stroke that even extends towards the left, such as  and  , or by simply re-arranging components without any horizontal lines, such as  and  .

Some general rules and principles do apply to all the scripts in Chinese calligraphy. For example, it is a general aesthetic principle of Chinese calligraphy to keep a key brush stroke of a Chinese character aligned with the logical central vertical line of the character, such as the central vertical lines in Chu scripts  , ,  , , and  . However, not every scribe is qualified to properly apply this principle.

3) Improper Application of Aesthetic Principles: Unexpected or erroneous brush stroke variations due to improper applications of aesthetic principles of Chinese calligraphy confuse pattern algorithmic and recognition systems. By using the positive and negative examples below, I illustrate the difficulties which pattern recognition has to deal with when unsuccessful contemporary imitations of excavated ancient documents (the negative examples below) fail to properly present certain aesthetic principles of Chinese calligraphy. The positive and negative examples in Table III below represent two extremes:

TABLE III. ALIGNMENT WITH THE CENTRAL LINE

Positive Example		**Negative Example**	
Charac-ter	***Comments***	***Charac-ter***	***Comments***
C01: *qiong* 窮 	Bottom left component was adjusted to the center to make its vertical line align with the logical central line of the whole graph.	0917: *shou* 受 	Missing the central position, the top central vertical stroke became a part of the top left component thus makes correct pattern recognition impossible.

In graph 0917 *shou* above, the top central vertical stroke shows as the right vertical stroke of the top left component  , but it actually is the left vertical stroke of the top right component  . This kind of stylistic variation will only mislead a pattern recognition system. Similar negative examples also include the bottom components, i.e., *xin* 心 (heart/mind) component, of 0904 *wang*  (忘), 0417 *kong*  (恐), and 0319 *nian*  (念), etc. The correct form of *xin* component is  , depicting a heart in the center as well as blood vessels connecting to it. The variant forms of *xin* in the Chu script include  ,  , and  , etc. Although different, they all include images of a heart in the center and the connecting blood vessels, thus will make sense to a pattern algorithmic and recognition system. In the above examples of graphs 0904, 0417, and 0319, all the *xin* components are scribed as a  ,  and  component with an additional stroke to the right. In this way, not only the images of a heart and blood vessels do not exist any more, but the basic structure and the pattern of the *xin*

component is also altered. Consequently, standard pattern recognition is impracticable.

V. TOWARDS A HOLISTIC CHINESE PALEOGRAPHY

Pattern recognition and cyber-based new technology present unprecedented opportunity for revolutionary progresses of traditional Chinese paleography. The style and script particularities of Chinese calligraphy and paleography found in the excavated ancient Chinese manuscripts require a contextual development of the pattern recognition system. Geographically, different states have different local writing systems before 221 BCE. Chronologically, different historical period has different stylistic scripts in pre-modern China. Stylistic variations and structural complexity could easily confuse one character with another. Improper applications of aesthetic principles of Chinese calligraphy could further complicate component structure and pattern recognition. A comprehensive understanding of geographical, historical, aesthetic, stylistic, and structural characteristics of the Chinese writing system and the script styles is critical for developing the pattern recognition system, including its necessary database, of Chinese paleography. An interdisciplinary study of Chinese paleography, calligraphy, and pattern recognition that incorporates the considerations of stylistic variation, structural complexity, and cosmological implications of Chinese calligraphy, and that is based on the Transparent Transcription approach, is an effective and innovative approach to the study of Chinese paleography. This holistic approach represents an inevitable future of Chinese paleography in the digital era.

REFERENCES

[1] Jingmen City Museum 荊門市博物館, ed., Bamboo Slips Excavated from Chu Tomb at Guodian 郭店楚墓竹簡. Beijing, Wenwu, 1999.

[2] Ma Chengyuan 馬承源, ed., Warring States Period Chu Bamboo Slip Books Collected in the Shanghai Museum, vols. 1-7 上海博物館藏戰國楚竹書（一～七）. Shanghai: Shanghai guji, 2001-2008.

[3] Li Xueqin 李學勤, ed., The Warring States Period Bamboo Slips Collected at Tsinghua University, vol. 1 清華大學藏戰國竹簡（壹）. Shanghai: Zhongxi shuju, 2010.

[4] Pian Yuqian 駢宇騫, and Duan Shu'an 段書安, eds., A Comprehensive Summary of Excavated Bamboo Slips and Silk Documents in the 20th Century 二十世紀出土簡帛綜述. Beijing: Wenwu, 2006, pp. 6-31.

[5] William G. Boltz, "The study of early Chinese manuscript: methodological preliminaries," in Sarah Allan, and Crispin Williams, eds., The Guodian Laozi: Proceedings of the International Conference, Dartmouth College, May 1998. Berkeley: SSEC & IEAS, 2000, p. 40.

[6] Xing Wen, "Towards a transparent transcription," Asiatische Studien, LIX.1.2005, pp. 31-60.

[7] Xing Wen 邢文, "Deciphering pu" (釋樸), in Interpretations of Excavated Texts and Transmitted Texts 出土文獻與傳世典籍的詮釋. Shanghai: Shanghai guji, 2010, pp. 161-164.

[8] Jingsha Railway Archaeological Team of Hubei Province 湖北省荊沙鐵路考古隊, ed., Baoshan Chu bamboo slips 包山楚簡. Beijing, Wenwu, 1991.

[9] Liu Zhao 劉釗, Chinese Structural Paleography 古文字構形學. Fuzhou: Fujian renmin, 2006, pp. 9-221.

[10] He Linyi 何琳儀, A Comprehensive Examination of the Warring States Paleography (Revised version) 戰國文字通論（訂補）. Nanjing: Jiangsu jiaoyu, 2003, pp. 202-265.

[11] Ouyang Xun 歐陽詢, "Eight Laws of Ouyang Xun" 歐陽詢八法, in Gao Ying 高英, ed., Handbook of Calligraphy 寫字手冊. Shanghai, Shanghai guji shudian, 1984, p. 7.