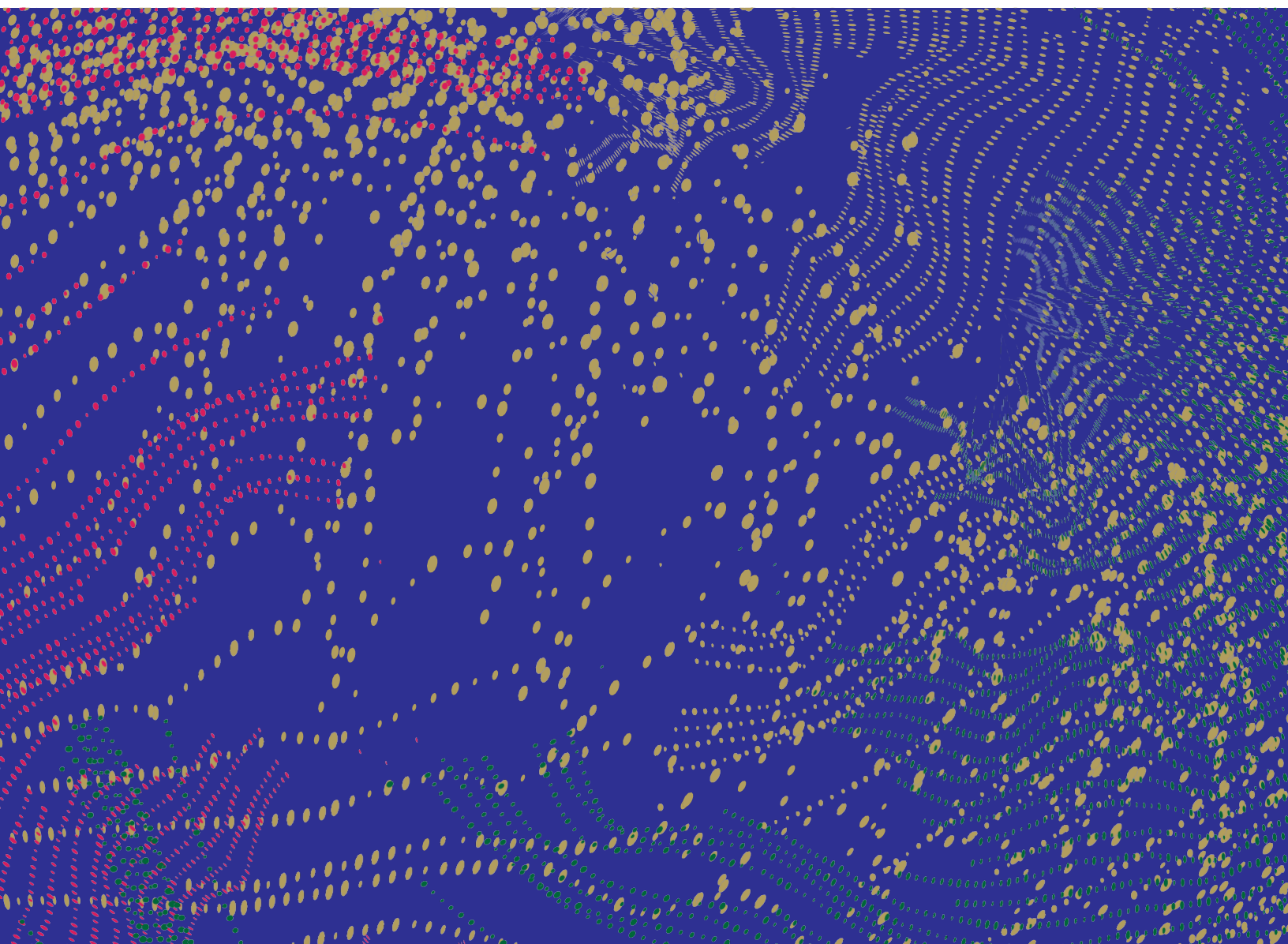


The World Humanities Report

# Research on Chinese Writing Systems

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# Research on Chinese Writing Systems

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## A Renaissance in Paleography

Since the 1990s studies in paleography has ushered in new developments, with the journal *Chutu wenxian* [Excavated texts] edited and published since 2020 by the Tsinghua University Research and Conservation Center for Excavated Texts; *Chutu Wenxian Yanjiu* [Studies of excavated texts]; the journal *Jianbo* [Bamboo and silk manuscripts] edited by the Center for the Study of Bamboo and Silk Manuscripts at Wuhan University; the journal *Chutu wenxian yu gu wenzi yanjiu* [Research on Chinese excavated classics and paleography] edited by the Center for Research on Excavated Texts and Paleography at Fudan University; the volume *Jiagu wen yu Yin-Shang shi* [Oracle bone inscriptions and the history of the Yin-Shang dynasty], edited by Hu Houxuan, Song Zhenhao, and Wang Yuxin of the Institute of History of the Chinese Academy of Social Sciences; the journal *Jianbo yanjiu* [Studies of bamboo and silk manuscripts], edited by the Bamboo and Silk Manuscripts Research Center at the Chinese Academy of Social Sciences; and the journal *Jiandu Xue Yanjiu* [Studies of texts on bamboo slips] jointly published by the Cultural History Institute of Northwest Normal University and the Gansu Bamboo Slips Museum in Lanzhou. These journals guarantee a route to publication that will contribute to the growth of research on paleography and excavated texts.

Currently, developments in the field of paleography have become a composite of the subdisciplines of research into oracle bones, bronze inscriptions, paleographic study focused on the Warring States, and studies of bamboo and silk manuscripts that have each developed independently and now form a system. As the foundation of the discipline of paleography, or the interpretation of ancient writing forms, has been constructed in terms of theory and methodology, and many character forms unidentified have been interpreted, marking a step toward perfecting the first stage of development in analyzing ancient Chinese characters. In the area of oracle bones research, we have tried to lay a solid foundation for textual criticism and interpretation of the inscriptions on oracle

bones and Shang dynasty history by delineating categories and a periodization of oracle bone inscriptions. As for studies of bronze inscriptions, research on the inscriptions on bronze vessels belonging to the various marquis and states has intensified people's knowledge of the state structure and regional culture of the Zhou dynasty. Studies of regionalism in writing forms during the Warring States period achieved a breakthrough, both in theory and in practice, to reveal the complexity and interaction of the languages and writing systems of the various states. Study of texts on bamboo and silk developed swiftly and promises important findings in the future. Gradually, two subfields have taken shape for research on writings and texts of the classical canon, and the objects of research and methodology have followed separate paths, each with a distinct emphasis.

### Studies of Early Modern Philology and Comparative and Applied Philology

Tang Lan proposed the idea of a subfield of early modern philology to complement archaic paleography. With the support and advocacy of Zhu Dexi, Li Rong,<sup>1</sup> Jiang Lihong, Guo Zaiyi, Zhang Yongquan, and Yang Baozhong, the study of early modern writing forms is now considered a major component of the study of Chinese grammatology. The study of *su zi* [popular character forms] is an anchor for branches of study in early modern Chinese paleography, and the task of deciphering and interpreting problematic or knotty characters of this kind is a subject of intense scholarly debate. Paleographic materials dating after the Han dynasty are extremely rich, and the core materials are characters inscribed on stone steles and hand-written manuscripts on paper. Research on the inscriptions on stele mainly centers on the Wei, Jin, and Northern and Southern dynasties (roughly 220–589 CE), while hand-written or copied texts on paper include documents from Dunhuang and Turfan, as well as documents from Khara-Khoto (Harahot in Mongolian, written *Heishui cheng* in Chinese).<sup>2</sup>

<sup>1</sup> Li Rong wrote under the pen names Li Changhou, Dong Shaowen, and Song Wenjia. He presided over the dialects study group at the Institute of Linguistics of the Chinese Academy of Social Sciences until his death.

<sup>2</sup> Documents excavated from the ruins at Khara-Khoto are written in Tangut (*Xixia wen*, the logographic script of the Tangut dynasty, 1038–1227). Pyotr Kozlov discovered the ruined city and took some 2,000 Tangut manuscripts to Russia. The British explorer Sir Aurel Stein went there on his third expedition to Central Asia in 1913–16, and many of the Tangut documents he retrieved are in the British Library.

In the 1990s Wang Yuanlu's *Bijiao wenzi xue* [Comparative philology] followed the publication of *Bijiao wenzi xue chutan* [A preliminary study of comparative philology] by the economist and linguist Zhou Youguang, who was known as the “father of pinyin.”<sup>3</sup> As the discipline continued to expand, comparative philology scholars gradually became familiar with it. Yu Suisheng and his students have carried out a sustained comparative study of archaic Chinese writing forms and the Naxi (also rendered as Na or Naish in studies in Western languages) pictographic symbols Tomba (also written Dongba in Chinese, Tompo, or Mo-so) over many years.<sup>4</sup> Huang Yaping and his students have taken up comparative study of ancient Chinese characters and ancient Egyptian and Biblical writing forms, Sumerian cuneiform logographic symbols, and Mayan pictograms, and are highly productive.

The level of detail in a dictionary reflects the level of research on writing forms. Dictionaries of varying scopes, such as the *Xinhua zidian* [New China character dictionary], the *Xiandai Hanyu cidian* [The contemporary Chinese dictionary], the *Gu Hanyu changyong zi zidian* [A dictionary of commonly used characters in ancient Chinese],<sup>5</sup> the *Hanyu da zidian* [Great compendium of Chinese characters],<sup>6</sup> and the *Hanyu da cidian* [Chinese dictionary]<sup>7</sup> have been widely distributed and are well received. Teaching and research on Chinese characters and the rapid progress in the study of writing forms have reinforced each other. In regard to teaching Chinese writing, most Chinese language and literature departments in institutions of higher education require courses in writing systems designed for the needs of each discipline, and they also teach courses on the fundamentals of study of Chinese writing; certain universities and advanced schools also have specialized courses on paleography or philology

<sup>3</sup> Zhou Youguang, *Bijiao wenzi xue chutan* (Beijing: Yuwen chubanshe, 1998); Wang Yuanlu, *Bijiao wenzi xue* (Nanning: Guangxi jiaoyu chubanshe, 2001).

<sup>4</sup> See, for example, Yu Suisheng, *Naxi Dongba wen yanjiu congkao* [Miscellaneous studies on the Naxi people's Dongba writing system] (Chengdu: Bashu shushe, 2003).

<sup>5</sup> Wei Jianguo, ed., *Xinhua zidian* (Beijing: Shangwu yinshuguan, 1953); Ding Shengshu, ed., *Xiandai Hanyu cidian* (Beijing: 1978; revised ed. Beijing: Shangwu yinshuguan, 2008); Wang Li, Cen Qixiang, and Lin Tao, eds., *Gu Hanyu changyong zi zidian* (Beijing: Shangwu yinshuguan, 1979).

<sup>6</sup> Xu Zhongshu, ed., *Hanyu da zidian*, 8 vols. (Chongqing: Sichuan cishu chubanshe, 1986–89; second ed. in 10 vols., 1996). In addition, there are a three-volume edition and pocket dictionary. The dictionary gives the logographic form of each character in oracle bone script, bronzeware script, and seal script, as well as pronunciations of the character in archaic Chinese, Middle Period Chinese, and Mandarin.

<sup>7</sup> Luo Zhufeng, ed., *Hanyu da cidian*, 12 vols. (Shanghai: Hanyu da cidian chubanshe, 1986–93).

and nonstandardized abbreviations of Chinese characters to train experts in that area.

### Studies of Chinese Writing from the Perspective of Linguistics

The field of study of writing systems is broad in scope and difficult, since it requires comprehensive knowledge of the major writing forms in the world or a grasp of major types of written materials in the world.<sup>8</sup> Research findings by European and American scholars have always dominated the field, while scholars in China have mainly introduced these findings and offered little original insight into this area. In comparison to ordinary grammarology, Chinese scholars have achieved more in the area of comparative philology. Some scholars have had significant findings through comparative studies of the Tomba pictographic script of the Naxi in southwestern China (which is still in use today) and oracle bone inscriptions, bronze inscriptions, and other archaic Chinese character forms. The most important contributions to the field of philology in the past thirty years are actually in studies of Chinese writing systems, which have had brilliant success.

Studies of the nature of Chinese characters must first determine the type of writing to which characters belong. There are basically two methods to define Chinese characters. One method is based on the ability of the character form to express meaning and express phonology and defines its nature based on these functions. The other method defines the nature of the Chinese character form based on its ability to express the level of language structure (or, in other words, the size of the language unit). The first approach primarily explains the nature of characters as an expression of meaning or an expression of sound. The other method primarily explains characters as logograms that express either words or morphemes. Analyses of the structure of Chinese characters have not discarded the formulation of “six principles” (*liu shu*, also translated “six graphs”)<sup>9</sup> defined

<sup>8</sup> The study of writing systems is quite varied, and there is overlap among fields. Grammarology refers to study of the origin and development, nature, and system of writing forms, as well as the relation between sound and meaning, orthographic writing, and evolution of characters. Paleography refers to study of inscriptions that address graphemic, lexicographical, semasiological, syntactical, and phonological aspects. Philology is the area specializing in the form, sound, meaning, and evolution of Chinese characters, and philological analysis is a tool used in interpretation of literary and historical texts as well as contextual and thematic analysis.—Trans.

<sup>9</sup> The “six principles” classify the various ways Chinese characters express meaning into indicatives [*zhishi*], logograms [*xiangxing*], phono-semantic compounds [*xingsheng*], graphic



in the Han dynasty dictionary *Shuo wen* (an abbreviation of the title *Shuowen jiezi*, [Discussion of writing and explanation of characters]).<sup>10</sup> From the 1930s to the 1980s, the historian Tang Lan, the scholar and poet Chen Mengjia, and Qiu Xigui separately proposed analyzing the nature and structure of Chinese characters based on *san shu*, or three principles. Since the start of the new millennium, Huang Tianshu proposed using *er shu* (two principles) to analyze the nature of Chinese characters as either nonphonetic symbolic writing or phonosymbolic writing, in his article “Lun Hanzi jiegou zhi xin kuangjia” [On the new framework for the structure of Chinese characters].<sup>11</sup> To a certain extent, in fact, his proposal revives the broad distinction between viewing Chinese characters as expressions of morphemes or phonemes.

### Studies Combining Philology with Interdisciplinary Research

In 1984 the renowned historian Lin Zhichun founded the Institute for the History of Ancient Civilizations at Northeast Normal University and filled the lacuna that existed in Chinese universities in the disciplines of Assyriology, Egyptology, and Hittitology. In keeping with the understanding that “you have to recognize the letters before you can read,” the institute took ancient languages and writing systems as its starting point to learn, training students to read and interpret classics in the original Sumerian, Akkadian, Egyptian, Hittite language (also known as Nesite, from the region of Anatolia), ancient Greek, Latin, and other languages so that they can be employed by institutes of higher education and research.

In China, there is a rich array of writing forms of China’s ethnic nationalities in addition to Chinese characters. Currently, of the fifty-five minority nationalities, except for the Hui (sometimes called Chinese Muslims or Sino-Muslims) and Manchu who no longer use their own ethnic writing forms and directly write in Chinese characters, twenty-nine minority nationalities have forms of writing accommodated to their own languages. Additionally, historically some of the ethnic nationalities in China once had their own writing forms but no

compounds that acquire meaning through interaction [*huiyi*], borrowed characters [*jiajie*], and derived forms [*zhuanzhu*].—Trans.

<sup>10</sup> Xu Shen, comp., *Shuowen jiezi*. The edition in common use is the annotated *Shuowen*: Duan Yucai, ed., *Shuowen jiezi zhu* (Shanghai: Shanghai guji chubanshe, 1996; earlier published in *Guoxue jiben congshu* [National studies basic books series], Shanghai: Shangwu yinshuguan, 1930).

<sup>11</sup> Huang Tianshu, “Lun Hanzi jiegou zhi xin kuangjia,” *Nanchang daxue xuebao*, no. 1 (2009): 131–36.

longer use them; these scripts or pictograms are referred to as the ancient writing forms of the minority nationalities. We can analyze these ancient writing forms into various types: One type of writing form originates in a given minority nationality, such as Naxi people's Tomba pictogram script; the writing of the Sui language, a Kam-Sui language spoken by the Sui people of Guizhou Province in southwest China; and the Yi script used by the Nuosu Yi people in Sichuan Province. Another type of script imitates existing writing forms, such as various kinds of modular scripts that borrow or adapt elements of Chinese characters, for example, the Bai (also written Pai or Baip) minority nationality of the Dali autonomous region of Yunnan use *bo* script that is modeled on Chinese characters; the Zhuang script (also called Sawndip) is a logogram derived from Chinese characters and has been used by the Zhuang people of Guangxi and Yunnan for more than a thousand years; and the Dong minority nationality (also called Dong-chia in Chinese, Kam or Gam) used a logographic script modeled on Chinese. Yet another type of script was invented later on, primarily developed by linguists and experts recruited by the state to collaborate with intellectuals of a given ethnic nationality in developing new scripts using the Roman alphabet to spell out the nationality language, as is the case with the Zhuang nationality, the Buyi (also spelled Puyi or Bouyei; self-called Buxqyaix) in southwestern China, the Nuosu Yi, the Miao people (called Hmong in Vietnamese),<sup>12</sup> the Hani (also written Ho, or spelled Haqniq) nationality of Yunnan in southern China as well as northern Laos and Vietnam, the Lisu people of southwestern China and Myanmar, the Naxi ethnic nationality, the Dongchia (Kam), the Wa (Ba Roag) people of Yunnan and Southeast Asia, and the Li (also called Lizu, or Hlal, a Kra-Dai speaking ethnic group) in Guangxi, Guangdong, Zhejiang, and Yunnan Provinces.

Before 1949 only a handful of scholars engaged in the study of ancient Chinese writing, so the field was called a “dying form of learning.” There has been unprecedented growth in the discipline over the past thirty years, and research teams have gradually expanded to shape a field of learning that is informed by archeology, historical study, and linguistics. Presently, there are four branches within the study of archaic Chinese writing: the study of oracle bone inscriptions, research inscriptions on bronzes, studies of writing forms from the Warring States period, and the study of texts written on bamboo slips and silk. The

<sup>12</sup> The Miao category was devised in the 1920s by Chinese ethnologists and linguists, who invented Miao-Yao as a language family at the same time. Hmong is one of the several groups lumped into the Miao category.—Trans.



rapid expansion of paleographic research is closely related to the flourishing field of archeology. The work of assembling and publishing specimens of ancient writing and unearthed texts has swiftly advanced with China's continued rise in power, and publication of these materials has provided a constant flow of source materials for research.

Furthermore, large-scale compendia of ancient writing forms have been published one after another, including Song Zhenhao's *Jiagu wenxian jicheng* [Compendium of oracle bone textual materials] in forty volumes; Liu Qingzhu's forty-six-volume *Jinwen wenxian jicheng* [Compendium of bronze inscription textual materials]; *Chutu Zhan'guo wenxian zici jishi* [Glossary of vocabulary in unearthed textual sources from the Warring States], in seventeen volumes, edited by Zeng Xiantong and Chen Weiwu; *Zhongguo jiandu jicheng* [Compendium of writings on bamboo slips from China], in twenty volumes; and Dong Lianchi's edited volumes *Shuowen jiezu yanjiu wenxian jicheng* (Gudai juan) [Compendium of textual sources for the study of the "Discussion of texts and explanation of characters" (Classical sources)], in fourteen volumes, and *Shuo wen jiezi yanjiu wenxian jicheng* (Dang xiandai juan) [Compendium of textual sources for study of the "Discussion of writings and explanation of characters" (Contemporary and modern sources)], in twelve volumes.<sup>13</sup> The series publication makes richly varied materials accessible for studies of writing forms. Works concerned with Dunhuang and Turfan manuscripts include a series of volumes published by the Shanghai Classics Press that reprint textual materials found in Dunhuang and Turfan, including *Faguo Guojia Tushuguan cang Dunhuang Xi Xia wen wenxian* [Tangut-language materials from Dunhuang in the Bibliothèque Nationale de France], *Faguo Guojia Tushuguan cang Dunhuang Zangwen wenxian* [Tibetan-language materials from Dunhuang in the Bibliothèque Nationale de France], and *Yingguo guojia tushuguan cang Dunhuang Xiyu Zangwen wenxian* [Tibetan-language materials from Dunhuang and Central

<sup>13</sup> Song Zhenhao et al., eds., *Jiagu wenxian jicheng*, 40 vols. (Chengdu: Sichuan daxue chubanshe, 2001); Liu Qingzhu et al., eds., *Jinwen wenxian jicheng*, 46 vols. (N.p.: Wenxian shuju, 2005; Electronic version distributed by Hong Kong: Mingshi wenhua Publishing International Limited, 2011); Zeng Xiantong and Chen Weiwu, eds., *Chutu Zhan'guo wenxian zici jishi*, 17 vols. (Beijing: Zhonghua, 2018); Zhongguo jiandu jicheng editorial group, eds., *Zhongguo jiandu jicheng*, 20 vols. (Lanzhou: Dunhuang wenyi chubanshe, 2001–5); Dong Lianchi, ed., *Shuowen jiezu yanjiu wenxian jicheng*, 14 vol. (Gudai juan) (Beijing: Zuoja chubanshe, 2007); Dong Lianchi, ed., *Shuo wen jiezi yanjiu wenxian jicheng* (Danxiandai juan), 12 vols. (Beijing: Zuoja chubanshe, 2006).

Asia in the British Library].<sup>14</sup> Additionally, Sichuan People's Press has published *Yingguo Guojia Tushuguan cang Dunhuang wenxian* [Dunhuang text materials in the British Library], and Tangut sources excavated from Khara-Khoto that are held in collections abroad and in China have been published by several presses, with *E cang Heishui cheng wenxian* [Textual materials from Khara-Khoto in the Far Eastern Studies Institute of the Russian Academy of Science in Saint Petersburg], *Zhongguo cang Heishui cheng Hanwen wenxian* [Chinese-language materials from Khara-Khoto in Chinese collections], and *Yingguo guojia tushuguan cang Heishui cheng wenxian* [Textual materials from Khara-Khoto in the British Library] among these publications.<sup>15</sup>

Chinese characters are a cultural form, and, at the same time, they are a medium for transmitting other cultures. Wang Ning's monograph *Shuowen jiezi yu Hanzi xue* [The dictionary *Discussing characters and explaining writing and Chinese writing*] defines study of the culture of Chinese characters as a branch of the study of Chinese writing.<sup>16</sup> Several works that systematically address and interpret theoretical issues bearing on the study of Chinese writing, including Wang Ning's article "Hanzi yu wenhua" [Chinese writing and culture], He Jiuying's *Jianlun Hanzi wenhua xue* [A brief excursus on the culture of Chinese writing], and Liu Zhiji's *Hanzi wenhua xue jianlun* [The culture of Chinese writing: A short introduction] actively contributed to the construction of the discipline.<sup>17</sup> Since the start of the new millennium scholars have begun

<sup>14</sup> Bibliothèque Nationale de France and Shanghai Classics Press, eds., *Faguo Guojia Tushuguan cang Dunhuang Xi Xia wen wenxian* (Shanghai: Shanghai guji chubanshe, 1994–2005); Jin Yasheng et al., eds., *Faguo Guojia Tushuguan cang Dunhuang Zangwen wenxian*, 26 vols. (Shanghai: Shanghai guji chubanshe, 1999–2019); Jin Yasheng et al., eds., *Yingguo guojia tushuguan cang Dunhuang xiyu Zangwen wenxian* (Shanghai: Shanghai guji chubanshe, 2011–).

<sup>15</sup> British Library; School of Oriental and African Studies, University of London; History Institute, Chinese Academy of Social Sciences, eds., *Ying cang Dunhuang wenxian* (Chengdu: Sichuan renmin chubanshe, 1990–2010); Far Eastern Studies Institute, Shanghai Classics Press, Ethnology Institute of the Chinese Academy of Social Science, eds., *E cang Heishui cheng wenxian*, 21 vols. (Shanghai: Shanghai guji chubanshe, 1996–2019); Ta La, Du Jianlu, Gao Guoxiang, Nei Menggu wenwu kaogu yanjiu suo (Institute of Cultural Relics and Archeology of Inner Mongolia), and Gansu Province Ancient Texts Editorial Office, eds., *Zhongguo cang Heishui cheng Hanwen wenxian*, 5 vols. (Beijing: Guojia tushuguan 2008); Li Wei, Wu Fangsi, Beifang minzu daxue (Northern Nationalities University), British Library, and Shanghai Classics Press, eds., *Yingguo guojia tushuguan cang Heishui cheng wenxian*, 5 vols. (Shanghai: Shanghai guji chubanshe, 2005–10).

<sup>16</sup> Wang Ning, *Shuowen jiezi yu Hanzi xue* (Zhengzhou: Henan renmin chubanshe, 1994).

<sup>17</sup> Wang Ning, "Hanzi yu wenhua," *Beijing Shifan daxue xuebao*, no. 6 (1981): 78–82; He Jiuying, Hu Shuangbao, and Zhang Meng, "Jianlun Hanzi wenhua xue," *Beijing daxue xuebao*,

to apply theory arising from cognitive psychology to the study of Chinese writing. The monograph *Hanzi xinli xue* [The psychology of Chinese writing] by Yao Ganming is a pathbreaking study that constructs a new system around the notion of the psychology of Chinese writing.<sup>18</sup>

## Impact of Information Systems and Digitization on Studies of Chinese Writing

Systems for arranging information about Chinese characters generally include an index number, and for input entry, storage, editing, output, and transmission index numbers have key importance. The GB18030–2005 compendium of character fonts records a total of 70,244 Chinese characters; the extra large Chinese character fonts contain 64,395 Chinese characters; ISO/IEC 10646/Unicode Chinese character fonts is a globally accessible indexed collection of Chinese fonts that contains fonts for spelling out the major languages in the world and includes 68,818 Chinese characters. Additionally, progress has been made on ancient character forms that can be input and retrieved by computer. East China Normal University and Beijing Normal University have taken on the task of generating four systems of characters: Oracle bone inscriptions; small clerical script from the *Shuowen* [Discussion of characters]; bronze inscriptions; and Chu script from the Warring States period, in a text proposal to be presented to the IRG (International Research Group), and are already included in the Unicode character fonts Ancient Writing Systems [*gu wenzi*] index unit.<sup>19</sup> Qiu Xigui served as chief expert for the Chinese Character Data Bank project, with the goal of building code for all Chinese characters and writing forms of the ethnic nationalities, as well as major styles of calligraphy and characters, to create a system for a numeric index of Chinese writing.

The “Longyu Hantang guji shujuku” [Dragon speech and pavilion of letters classics database], jointly developed by Beijing Long Dai te xinxi keji gongsi [Long Dai Special Information Technologies Company] and the Shidai Hantang keji gongsi [Times Beijing Hantang Technology Company] in Beijing is a comprehensive database that is fairly representative and includes both

no. 6 (1990): 91–98; Liu Zhiji, *Hanzi wenhua xue jianlun* (Guiyang: Guizhou jiaoyu chubanshe, 1994).

<sup>18</sup> Yao Ganming, *Hanzi xinli xue* (Nanning: Guangxi jiaoyu chubanshe, 2001).

<sup>19</sup> A total of 70,000 characters in CJK (Chinese, Japanese, and Korean) code had been developed by 2011 and were usable for text restoration and text input. This number may seem large, but 200,000 are needed to retrieve and/or input many classical texts.—Trans.

archeological and philological material.<sup>20</sup> In 2019 two digital research projects developed by teams working with Wang Ning at Beijing Normal University went online: Hanzi quanxi ziyuan yunyong xitong [Chinese character holistic resource application system] and the Shuzi hua *Shuowen jiezi* yanjiu yu yunyong pingtai [Digitized research and application platform for the dictionary *Shuowen jiezi*], which are important tools for research on Chinese writing and modern applications that have been endorsed at all levels of society.

Recently there have been new studies and developments using computer technology to carry out comparison and join together oracle bones. Wang Yuanmin set up a team to pursue “Jiagu wen jisuanji buzhu” [Oracle bone script computer support] to make a state-of-the-art database where they could make the system automatically produce text resembling the target oracle bone fragments, and to recombine and join oracle bone inscriptions through human interface with the computer. In October 2020 the first prototype of an AI oracle bone reconfiguration was formally released—a product they called Zhui duoduo [Link more and more], developed in a collaborative effort between Henan University and Capitol Normal University. This is the first time AI has been adopted in the ancient writing research field, using artificial intelligence to automatically join oracle bones. In 2018 at Jilin University, Li Chunfeng began a research project to research and develop software system using artificial intelligence to recognize the shapes of archaic writing forms that will build on existing editions and interpretive glosses of pre-Qin archaic writing materials to sample a large volume of clear and legible writing specimens, and then make use of computer technology to digitize these forms and then combine human and artificial intelligence technology to develop software that can differentiate the shapes of ancient writings. In May 2019 the Center for the Study and Application of Chinese Characters at East China Normal University announced the findings of their major database for AI + expressive writing, the Shang Zhou jinwen zhineng jing [Intelligent mirror for Shang and Zhou bronze inscriptions] smart system for recognizing and interpreting unearthed textual materials—called the Wenjing Wanxiang [Text mirror with myriad images]—introducing a new way to utilize smart technology to learn, read and interpret, and research.

There have been some new breakthroughs in the study of the ancient writing forms of the ethnic nationalities. In 1997 the Chinese scholar Li Fanwen

<sup>20</sup> *The Longyu Hantang guji shujuku* was released in Beta form in 2007.

and Japanese scholar Motoki Nakajima used the database of Tangut (written Xi Xia, in Chinese) writing forms and a composition program that the National School of Asian and African Studies in Japan had completed the year before to cowrite *Diannao chuli Xi Xia wen “za zi” yanjiu* [Research on using computer software to configure Tangut “miscellaneous characters”].<sup>21</sup> In September 2017 Ningxia University drew on the scholarly strength of related research institutes to use optical character recognition (OCR) and succeeded in automatically differentiating Tangut writings using artificial intelligence. In doing so, they filled a gap in the technology, using OCR to recognize writing forms that are not widely used in archeological text materials.

Additionally, there is technology for 3D scanning and 3D printing, techniques to identify handwriting, and DNA-sensitive technology that has been successively applied to arranging and research on ancient written materials, and these technological means offer significant improvements in the way we assemble ancient writings.

*Translated from the Chinese by Kathryn Lowry*

<sup>21</sup> Li Fanwen, “Diannao chuli Xi Xia wen [Za zi] yanjiu” (Tokyo: Fuji shuppan, 1997). See Nakajima Motoki, “Preface to studies of computer processing of zazi from Tangut texts,” *Ningxia shehui kexue*, no. 1 (1998): 62–64.

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