THE CALLIGRAPHY AND PRINTING CULTURAL HERITAGE OF GANSU – THE DEVELOPMENT OF THE ENGRAVED PRINTING PROCESS AND PAPERMAKING: AN ARCHAEOLOGICAL APPROACH

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ABSTRACT

The Gansu Region is one of the birthplaces of Chinese culture, and it is also one of the locations of Chinese book production. In spite of rare evidence in historical documents, the study of archaeology has revealed bamboo strips, Dunhuang posthumous papers, paper from the West Han Dynasty (206–24 B.C.), ancient Chinese calligraphy brushes, etc. All of these provide important evidence for the study of China’s history of calligraphy and printed cultural heritage. However, there is still no complete systematic monographic study on calligraphy and printed culture in the Gansu Region. This paper will emphasize the development and editions of Dunhuang posthumous papers and features of the paper making techniques in the Gansu Region.

KEYWORDS

Wood block printing
Paper making techniques
Formats of book decoration
Writing tools
Gansu province
Dunhuang

Gansu is among the areas with the longest history of book development and production. The unique geographical location and natural conditions, together with the unique history of the region, have determined the diversity and distinctness of the ancient calligraphy and printing heritage in this area. The 65,000 pieces of bamboo slips excavated in Gansu, the earliest book objects, have provided us with substantial evidence for research on the history of printing supplementing evidence available in literature. At the latest, at the end of the 9th century or in the beginning of the 10th century – in the time of the late Tang Dynasty and the beginning of the Five Dynasties – Sutra and Buddhist icons were being printed in Gansu, one of the first areas where the engraved printing process was to be found.
in China. The books excavated from the Sutra cave, Mokao Grotto of Tunhuang, have indicated that the method of thread/rope bookbinding was invented in the middle of the Tang Dynasty. The discovery of ancient paper in Gansu proves that paper had been invented in the 2nd century B.C., bringing the time of the invention of paper to 284 years earlier than had been thought. The excavation of calligraphy brushes and ink stones reflects the constant development and evolutionary characteristics of ancient writing tools, which also proves the historical fact of “dabbling bamboo sticks with paints for writing.” The author’s aim is to understand better the academic community of Gansu and its role and value in the history and development of print culture through the substantial materials of calligraphy and printing found in Gansu.

1. BAMBOO SLIPS

Bamboo slips, as the carrier of characters, followed bones or tortoise shells as antecedents to paper, and they were used extensively for writing after the decline of bones and tortoise shells and before the invention of paper. Bamboo slips have a history of nearly 2,000 years from the Shanghai Dynasty (17th century B.C.) to the Jin Dynasty (after 300 A.D.). With the invention of paper and the application of printing, paper gradually became a substitute for the bamboo slip. Bamboo slips, the material for writing, the system for producing books and archives which had been used for 2,000 years, decayed or were buried deeply under ground. The actual circumstances of their decline became unknown to later generations. There is no substantial evidence except for sporadic records, and they have almost become a blank in the history of culture. This was true until the early 19th century when a number of Chinese bamboo slips were discovered along the line of Loulan, Niya and The Tunhuang Great Wall on the northeast border of China, and scholars saw them as substantial examples of literary and information carriers from 2,000 years ago. Now, altogether 65,000 pieces of bamboo slips have been excavated in Gansu, making it the area where the largest number of bamboo slips has been found. In terms of the span of time, those bamboo slips, written in Chinese, Kharosthi, Tibetan, Uigur, and Western Xia characters, cover five dynasties including Qin, Han, Jin, Tang, and the Western Xia dynasties. Bamboo slips from the Qin and Han dynasties account for the majority. The bamboo slips excavated as a part of archaeological studies, as the earliest book objects, have provided us with substantial evidence to support research on the history of the bamboo slip system supplementing the literature on this historical period.

1.1 Proving the Publishing System in the Han Dynasty

The word “book” refers to an object on which characters are written or printed on special material in a certain form which is used by people for reading and commu-
Bamboo slips can be considered the earliest official “books” in China. From the Spring and Autumn Period to the Western Jin Dynasty, most “books” in China were made of wooden or bamboo slips. In the Qin and Han Dynasty, there have been systems for using bamboo slips as books. For example, texts of different content were transcribed on slips of different length. During the Han Dynasty, it was prescribed that classics should be transcribed on slips of 2.4 Chi (about 0.565 meters). According to Mingmingjue Lunheng, The Book of Changes, The Book of Songs, Shang Shu, The Book of Rites, The Book of Music, and The Spring and Autumn Annals should be transcribed on slips of 2.4 Chi, The Book of Filial Piety on 1.2 Chi, and The Analects of Confucius on 0.8 Chi. This is the ancient system. Sheduan Lunheng says that “the classics should be transcribed on 2.4 Chi slips.” According to the Biography of Cao Bao: the History of the Later Han Dynasty, “150 pieces of articles concerning the crowning, wedding and funeral of emperors to common people are written on the slips of 2.4 Chi.” According to the Biography of Zhou Pan: History of the Later Han Dynasty, “the classics of Yao are edited on the 2.4 Chi slips.” In 1959, The Book of Rites, a book written on bamboo slips during the East Han Dynasty (25 A.D. – 220 A.D.) was excavated in Wuwei. This bamboo slips book was published by people living in the Han Dynasty, and it was made from the longest bamboo slips ever discovered in China from this dynasty. Two versions of this book exist. One is inscribed on bamboo slips with the length of 56.5 cm. and a width of 0.9 cm., a dimension equal to 2 Chi and 4 Cun in the Han Dynasty. The other is inscribed on wooden slips with the length of 55.5 cm. and the width of 0.75 cm., a dimension also equal to 2 Chi and 4 Cun in the Han dynasty.\(^1\)

### 1.2 Displaying Book Forms in the Qin and Han Dynasty

The forms named Jian and Du vary with their usage and their method of fabrication. Jiandu excavated in the Gansu Province boasts the forms of Die, Jian, Du, Xi, Zha, Qian, Jian, Gu, Ce, Fu, Chuan, Guosuo, etc. according to the titles of the books. It was recorded in ancient literature that Jian exclusively refers to bamboo slips while Du exclusively stands for the wooden slips. However, as a matter of fact, Jian may also be made of wooden slips and Du are not always wooden. The difference between Jian and Du actually does not consist in their materials but in their forms with the narrow ones called Jian and the broad ones called Du. Bamboo and wood can be made into not only Jian but also Du. Jian and Du were used for distinct purposes in ancient times with Jian used mainly for contents with more characters like book texts, decrees, and important official documents. Du was used primarily for ordinary documents, agreements, and letters. Jian compiled in certain numbers is called Ce. The books published during the period when Ce prevailed possess different forms owing to their contents, usages, and convenience of fabrication. There are mainly three forms of Ce which were discovered in the Gansu Province: Jian, Du, and Gu.
1. Jian in the Qin Dynasty

Jian of the Qin Dynasty was discovered in Fangmatan, Tianshui in Gansu Province in 1986. It was excavated from the tomb of a resident in the country of Qin in the late War Period. The Book of Augury, excavated in Tianshui, is the second book ever discovered on the culture in the Qin Dynasty. The Book of Augury was written on 452 bamboo slips of two types. Type A consists of 73 bamboo slips that are each 27.5 cm. long, 0.7 cm. wide, and 0.2 cm. thick. Type B consists of 379 bamboo slips that are 23 cm. long. There always were three binding ropes around the book with a space of 1 cm. respectively left on both ends. The characters on the bamboo slips were written on the yellowish sides in Lishu (an ancient style of calligraphy) with an ordinary number of 25–40 characters on each slip and the largest number of characters, 49, on one slip. All the characters in The Book of Augury (Type A) were inscribed on the yellowish sides of the bamboo slips and no characters existed on the cyan sides. The characters were laid out in vertical order and covered the whole bamboo slip. There was generally one message in the first column and the rest of the chapter was finished in order. The key parts of the chapter were indicated with a stress symbol “.” as a reminder, and a symbol “I” was used to indicate the chapters.

2. Jian in the Han Dynasty

Let’s examine the Jian discovered in Juyan, Gansu Province. There are seven types of Jian in the Han Dynasty which differ in their dimensions: Jian with a length of 22 cm. and a width of 1–1.3 cm.; Jian with a length of 22.5 cm. and a width of 1.13 cm.; Jian with a length of 23 cm. and a width of 1.1 cm.; Jian with a length of 24 cm. and a width of 1.3 cm.; Jian with a length of 27 cm. and a width of 1.2 cm.; Jian with a length of 30 cm. and a width of 1 cm; Jian with a length of 38.5 cm. and a width of 1.5 cm. Jian with a length of 23 cm. and a width of 1.1 cm prevailed in number, and this type was called Chi Du. Actually, Jian with the length ranging from 22 cm to 24 cm was also called Chi Du. Chi Du was the ordinary Jian used for dealing with routine matters. However, Jian exceeding the length of 30 cm was not referred to as Chi Du and exclusively used for promulgating decrees, regulations, and other important documents which differed from the other ordinary documents. They were made of pine tree, fir, poplar, and willow tree wood and were seldom made of bamboo. The choice of materials for making Jian significantly varied with the times, character, and grade of the official documents. Pine tree wood was popularly used for Jian prior to the reign of Emperor Aidi in the Han Dynasty. All four woods were used before and after the rule of Wan Mang (a ruler during the Han Dynasty from 8 A.D. to 23 A.D.) with pine used primarily for the comparatively more important documents and the other three woods used for ordinary documents. The characters inscribed on the slips made of pine were more standard in form while the characters on the slips made of
the other materials were scribbled, which might account for the advantage of pine in making the slips.

1.2.2 Du

The major characteristic of Du lies in its greater width than that of Jian, while they had similar lengths. Generally, Jian had a width approximating 1 cm. and those exceeding 2 cm. were called Du rather than Jian. Du was often used for the ending of the official documents, the final part of the account book, shopping list, medical prescription, private letters and sealed letters, etc. Du was used for drawings, especially maps. Therefore, in ancient times the expression “Du map” was often used to refer to the territory of a country. There were four Du in the Jian Du which was excavated in Fangmatan, Tianshui. They were similar in size with a length of approximately 23 cm. and a width of about 14 cm. Six maps, current at that time, were drawn on the Du, one for the reigning territory of that time, and five for the mountains and rivers. There were 14 Du in Wuwei Medical Jian in the Han Dynasty, a book excavated in 1972. Their length ranged from 22.7 cm. to 23.9 cm. and their width varied, the widest of which was 3 cm. There were also widths of 1.5 cm. to 2 cm. Each Du held one medical prescription. In 1983, the Underworld Guosuo was excavated, and in the No. 3 Tomb of the Han Dynasty at Wuba Mountain in Wuwei archaeologists found for the first time in China a “pass for the underworld.” This wooden Du was made of cut pine with a length of 5 cm., width of 7 cm., and thickness of 0.5 cm. Characters were inscribed on both sides with 5 columns on the front and 2 columns on the back. There were a total of 124 characters.

1.2.3 Gu

Gu was a kind of multi-faceted prism-shaped Jian made of a cut wood stick. It was used mainly to make character books, textbooks for beginners, or to deliver urgent documents of importance. It was often made of poplar and red willow. This special carrier of educational and official contents seems to have had no fixed length while the number of their facets seems to have been deliberately chosen. A stick was cut into three, four, or eight facets with no less than two facets and no more than eight. Generally, each Gu contained one book or one chapter. Four seven-faceted Gu made in the Han Dynasty were unearthed in the beacon relics in Yumen Huahai. They had a height of about 37 cm. One recorded the emperor’s decree and three transcribed The Passage of Can Jie (Can Jie was the creator of characters in Chinese mythology) with each Gu recording one chapter. Similarly, one three-faceted Gu excavated in Juyan recorded the second chapter of The Can Jie Pian. There were 20 characters on each facet, and the characters were connected in order. In addition, one three-faceted Gu that recorded Ji Jiu Pian was excavated in Tunhuang. It had 20 characters on each side and 63 characters for the whole chapter.
The procedures regarding book construction in the Ce period are scarcely documented in the ancient literature. Liu Xiang remarked in *Bie Lu*, “The books of Sun Wu were recorded on the cyan bamboo slips and bound with ropes.” The Jian Du in complete form was excavated in Gansu Province not only revealing the system of Jian Du at that time, but also bringing to our attention the prototype for books. The process of making Jian Du into a book consisted primarily of three procedures: connecting, transcribing, and proofreading. Bamboo or wood was first cut and processed to make slips or tablets. Then bamboo or wooden slips or tablets were connected to make a whole to receive the transcription. *The Book of Augury* transcribed onto Jian in the country of Qin and excavated at Fangmatan, Tianshui, was bound by three cords, the upper cord, the middle cord and the lower cord. A margin of 1 cm. was left at both ends of the book with the middle cord functioning as the edge to form the upper column and the lower column. Three cords were placed equidistant with a small triangular opening on the right side to facilitate the linking from right to left with thin cords. The margins on both ends were mostly covered with fabric fragments. These fabric fragments might have been added after the slips/tablets were connected. *The Book of Augury* (Type A) was connected first and then inscribed. Judging from the traces left, there were three cords around *Wuwei Medical Jian* which were connected first and then inscribed with 78 slips/tablets connected to form one Ce or volume. There were two binding cords in Du, and they were often inscribed first and then connected. Fourteen Du would form one volume. The pattern of inscribing was often begun with the name of the book on the first slip and the text on the second and the other slips. A margin with a space equivalent to three characters was left in the first line and two points were left from top to bottom of the slips for the cord connection with three parts for transcription.

*The Book of Rites* discovered in Wuwei preserved the title, ending, pages, and order of the original book and, owing to its entirety, was a typical sample of the standard books published in the West Han Dynasty. There was a code at the bottom or each page which had the function similar to pages. The title of each volume was written in the middle part on the back of the slip with the content inscribed on the inner side. If the book was rolled, the the inner side would be covered and the exterior side (i.e. the back side) would be exposed where the title was written. This was similar to the current title page of a book for the sake of convenience when referring to the book. As for the other aspects like cutting, inscribing, the title, modifying, rolling, marking, and characters, *The Book of Rites* discovered in Wuwei provided us with precious evidence for research on the Jian and Ce system in the Han Dynasty.

“Transcriptions” mainly refer to various books after paper is invented but before printing is invented that substitute for bamboo slips and silk scrolls. The period of transcriptions can be dated to when paper is invented. At the end of the Eastern Jin Dynasty (the 4th century), Heng Xu issued an order that “There is no paper in the past, so people use bamboo slips. Use of bamboo slips is not for respect. I hereby
order that bamboo slips be replaced with yellow paper.” This order actually brought to an end the period of bamboo slips and silk scrolls, and the period of transcriptions began. We Emperor of the Sui Dynasty, who emphasized civil administration, in the 3rd year of Kaihuang ordered a “search for rare books in the country.”3 In *The Record of Classics, History of Sui*: “Officers are dispatched to collect rare books. The one who collect (sic) one volume will be rewarded with silk. The original copy will be returned to the owner after being transcribed. Therefore, various kinds of rare books collected by civilians are found.” 4 Until the reign of the Yang Emperor of the Sui Dynasty, “50 copies are required for any book in the Mi Library.” Meanwhile, the copying of sutras is performed. “The re-script (sic) is issued that civilians are allowed to become monks. Taxes are collected from every civilian to build sculptures of Buddha. All sutras are transcribed at the capital (sic) and major cities including Bingzhou, Xiangzhou and Luozhou.” While searching for rare books and summoning transcribers to complete over 30,000 volumes, the government established special institutions for sutra translation, and altogether 130,000 volumes of 46 sutras are transcribed. “Sutras become prevalent in the folk (sic), the number of which is hundreds of times of that of Confucian classics.” The afterword of *The Record of Article, History of Tang* states: “In kaiyuan years...any book in the four sections will be stored at two capitals. (sic) Altogether 125,960 volumes are written with fine jute paper.” 5 From the above description we can see the large scale of transcription in the Sui and Tang Dynasties, which is reflected in the 50,000 volumes of ancient books excavated in the Classics Cave of Tunhuang in 1900. Due to the characteristics of transcriptions, they did not survive for a long time like the slips. Therefore, there are few transcriptions now. The excavation of the Classics Cave of Tunhuang, and the discovery of transcriptions from the Sui and Tang Dynasties have provided us with precious first-hand evidence for the study of transcriptions.

There are about 1,000 Tunhuang books with inscriptions, the earliest of which is the *Khiksu Disciplines* of the 2nd year of Jiancu, the Western Liang Dynasty (406 A.D.) and the latest of which is *To Baoen Temple* by Wang Caozong in the 5th year of Xianaling, the Song Dynasty. Seventy to eighty percent of Chinese transcriptions were produced from the middle of the Tang Dynasty to the early Song Dynasty, which spans almost seven centuries.

### 1.3 Arrangement

The paper edition of Tunhuang stone house (sic) is derived from slips and silk scrolls and invented as their substitutes. It can be said that this paper edition combines the characteristics of slips and silk scrolls in terms of its arrangement. Pieces of paper with equal length and width were pasted into a scroll (sometimes several meters long) and rolled up with a spool, similar to silk scrolls. When used for transcription, lines and columns are divided in advance to facilitate writing. (The grids in black are called “Black Thread Column,” and those in red, “Red Thread Col-
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...unm."") In this way every line is equal to a piece of bamboo slip. 6 A piece of paper is divided into 20 to 31 lines according to the different widths of the paper. The most common division is 28 lines with 17 characters in each line. (For annotation in the text, two lines will be written in smaller calligraphy within the predefined line. Such an arrangement is similar to the contemporary standard French folio, thus one can easily count the words and paper usage of a classic. This indicates that the format of traditional Chinese books that read from top to bottom is very scientific. The first line of each volume begins with the name of the book, which is followed by the name of the volume and the text. The name of the volume was written at the end of the volume, and time, place, and transcriber was written on the second to last line. Sometimes, the names of the reviewer, proofreader and decorator were also included. As for religious classics, such as sutras, the name of the disciple and the purpose of the sacrifice were written at the end of the volume.

1.4 Inscription (Copyright Page)

An inscription is normally included in the standard transcription of classics. Generally, the inscription includes the year, name of transcriber and disciple and votive writings. However, most inscriptions are very simple, sometimes only a name is provided. There is a group of the Vajra Prajna Paramita Sutra and Saddharmapundarika Sutra in the transcribed classics of Tunhuang. This group was transcribed by Chang’an officials from the 2nd year of Xian’he (671 A.D.) to the 2nd year of Fengyi (677 A.D.). The end inscriptions consist of year, name of the transcriber, paper usage, decorator, names of the first proofreader, second proofreader, third proofreader and four detailed proofreaders. The formats of their inscriptions are very strict, which characterizes the standard transcribed classics of the Tang Dynasty. 7 As far as the end inscription is concerned, a record of time, written division of responsibilities, paper usage and signature of the transcriber are all included. At that time, the classics made by the Royal Court were considered to be first rate and were welcomed and trusted by monks and disciples. They not only played an important role in the communication of knowledge, but they also served as the authoritative versions of classics. People could use them as the chief source for copying, maintenance, almsgiving, preaching and reading. The book collecting and administrative institutions could also use them for proofreading and for the examination of folk copies. At the time, people also used those transcribed classics to correct some handwritten and printed copies of classics, and to supplement lost ones.

1.5 Transcribing Institution and Transcriber:

In the Sui and Tang Dynasties, the Archives Department of the Xiuwen/Hongwen Royal Library, Jixian Library, and the Historical Library were responsible for the edition and transcription of national books. The transcription operation of the Royal Court consisted of a lithographer, transcriber, painter, decorator and proofreader. However, there are no records regarding the detailed division of labor and
procedures. The inscriptions in the Tunhuang transcriptions provide us with abundant documentation for the first time.

Over thirty volumes of classics including the Vajra Prajna Paramita Sutra, the Saddharmapundarika Sutra, and the Suvmaprabhasa Sutra, transcribed from the 2nd year of Xian’heng (671 A.D.) to the 2nd year of Fengyi (677 A.D.), found in Tunhuang are parts of the classics transcribed and issued all over the country under the organization of the Archives Department of the Hongwen Royal Library after they were approved as part of a national list of books.

The inscription of Volume 6 of the Saddharmapundarika Sutra collected by the Tunhuang County Museum reads: Transcribed by Transcriber Wang Siqian on Feb. 21st, the 3rd year of the Xianheng; 20 pieces of paper were used; decorated by Xie Shanji; first proofreader: Transcriber Wang Siqian; second proofreader: Guizhen, monk of the Jingxing Temple; third proofreader: Sidao, monk of the Jingxing Temple; reviewed by Shenfu, Noble Man of the Taiyuan Temple, Jiashang, Noble Man of the Taiyuan Temple, Huili, Abbot of the Taiyuan Temple, Daocheng, Honored Monk of the Taiyuan Temple; Xiang Yigan, final Reviewer and Shaofu; supervised by Yu Chang, Duke of Kaiguo, Taizhong Officer, and Assistant Minister of the Construction Ministry.

The transcriber, Wang Siqian, was a student of Yu Shihuan, the famous calligrapher; the four reviewers were four students of Xuanzang; and Yu Chang, the supervisor, was the son of Yu Shihuan. Xie Shanji, the decorator, was responsible for most of the decorative work of these classics sent to Tunhuang from the Royal Court.

What attracts the most attention in the inscription was the system of proofreading and reviewing the transcribed books three times. As for the reviewers themselves, most of them were outstanding students of Xuanzang, were proficient in Confucian classics and sutras, and they not only served as the proofreaders, but they also played an important role in the inheritance of ancient Chinese books and the correct translation of foreign books. “Panguans” may have played a role in the final revision, which are assumed to be knowledgeable governmental officers. These transcribed classics are of great research value in terms of their calligraphy, decoration, transcription procedures and division of responsibilities.

There are no records regarding transcribing by local governmental institutions in Gansu; however, the organizational circumstances of transcribing by the common people may be traced from the existing objects. In the North Wei Dynasty, there was a professional team of transcribers composed of transcribers, proofreaders and reviewers. They were approved by the government to transcribe and sell books with legal identities. From the 4th year of Yongping to the 3rd year of Yanchang (when the Xuanwu Emperor of North Wei ruled), there were 7 or 8 transcribers mentioned in the Tunhuang books, and 3 or 4 proofreaders and reviewers. Those people who made a living by transcribing classics are called “Jingsheng” or “Yongshu.” Their simple and elegant calligraphy is called “Xiejing (transcribing classics).”
The civic team is mainly constituted of transcribers, proofreaders and reviewers. Around 500 A.D., normal inscription and the name of transcribers appeared in the transcribed books. From the 4th year of Yongping, Xuanwu Emperor, North Wei (511 A.D.) to the 2nd year of Renshou, Wen Emperor, Sui Dynasty (602 A.D.), there are more than 10 books indicating that the transcription was completed in Tunhuang, and the name of the transcriber, time and location of transcription, paper used, the names of the proofreader and reviewer are included in the inscription. For example, the end inscription of Vol. 14, *On Honesty* states: “Transcribed by Cao Fashou of Tunhuang Town, proofread by Linghu Zhe, and reviewed by Hong Xie on Aug. 5th, 512, 25 pieces of paper are used.” Another end inscription of *On Honesty* states: “Transcribed by Xiu Guangzhou of Tunhuang Town, proofread by Linghu Zhe, and reviewed by Hong Xie on Aug. 5th, 512, 28 pieces of paper are used.” The first end inscription of *Vaipulya Dharani Sutra* states: “First proofreading is done. Transcribed by Zhang Asheng of Tunhuang Town, and proofread and reviewed by Linghu Zhe on Apr. 12th, 514, 21 pieces of paper are used.” The end inscription of Vol. 16, *Yanhua Sutra* states: “Transcribed by Linghu Litai of Tunhuang Town, and proofread and reviewed by Linghu Congfu Jul. 19th, 514, 24 pieces of paper are used.”

From the above inscriptions we can see that professional transcription was not done by an individual; rather, it was the collective activity of a team. The team members not only enjoyed legal identities, but they also bore definite responsibilities and had strict working procedures. Transcription, proofreading and revision were indispensable for the work. Only after careful proofreading and strict revision could the transcribed classics be allowed to enter the market and be bought by disciples.

2. THE EMERGENCE AND DEVELOPMENT OF PRINTED BOOKS

There are no related historical records covering book printing in Gansu. However, we can judge from the real objects produced with engraved printing that the emergence of this type of printing in Gansu can be dated back to the end of the 9th century or the beginning of the 10th century. During the late Tang Dynasty and the beginning of the Five Dynasties, sutra and Buddha icons were being printed in Gansu, one of the first areas of engraved printing in China. In Tunhuang, an important town in the western region during the Tang Dynasty and one of the areas where Buddhism prevailed, there were a number of merchants and monks. Due to the specific environment and the demand for religious propaganda, printing was developed first at Dunhuang. The Classics Cave of Dunhuang has preserved many precious printed materials of the Tang Dynasty.
2.1 Rubbing

Printing is a method for replication. Before the invention of printing, rubbing was a convenient method for copying text. There are three examples of rubbed texts dating to the early and middle Tang Dynasty from the heritage of Tunhuang, namely: the Paris Cangbozi No. 4508, *Ode to Hot Spring*, (author: Liu Xia) written by Tai Emperor of the Tang Dynasty; No. 4510, *Huada Temple Master Yong’s Safifa Tower Inscription* by the famous calligrapher Ouyang Xun in the early Tang Dynasty, and Paris Cangshihao *Diamond Sutra* by the famous calligrapher Liu Gongquan in 824. The inscription of the rubbed version of the *Ode to Hot Spring* is as follows: “By Guoyier, Weigufu on Aug. of the 4th year of Yonghui (653).” This is the earliest existing rubbed text in the world. This Tunhuang rubbed text has enabled us to see the condition of an original version, which provides us with substantial evidence of the origin and cause of engraved printing.

2.2 Rubbed Printing

Inspired by rubbed inscriptions and stamps, people engraved pictures to be copied on wooden boards to make printing forms, then rubbed them on paper – thus rubbed printing – the transitional form of printing at the initial stage of engraved printing was born.

Most of the surviving xylographs of Tunhuang are single-page works made in the late Tang Dynasty and the Five Dynasties (ca. 10th century). These xylographs are focused on Buddhist stories. Both single and combined figures can be found. The smallest one is 20x13 cm. and the largest is 45x34 cm. Most are 30x20 cm. The most frequently occurring theme is Thousands of Buddha, which were engraved on a wooden board and then rubbed on paper. There are two kinds of engraved rubbings, namely one form for multiple printings and multiple forms. “One form for multiple printings” refers to the method of printing identical Buddha icons by repeated rubbings on paper with the same form. This is mainly used to produce icons of Buddha and Bodhisattva. “Multiple forms” refers to rubbing with different forms in turn to realize the effect of a changing icon.

There are dozens of early prints in the Paris P. 4514, of which there is a single page of rubbed printing of Buddha. This page seems like a picture in the sutra, with the Buddha and flanking bodhi-sativa in the middle, lotus seat at the bottom and Gandharva flying above. This page is not large – of the size of a stamp. There are also a number of “Thousands of Buddha” and “Bodhi-sattva” images, of which some are pasted together after single rubbed printing, and the other are contained in a rectangle. Obviously, those with a rectangle are engraved as a whole. Compared with those made with repeated rubbed printing of a single form, the latter can be considered as a big leap forward, as the former is still of the stamp category and the latter is engraved printing. In terms of the rubbing method, the Tunhuang xylographs can be classified into several categories: temple documents and stamps, Shouchiquian, title pages, Esoteric Buddhism mandala, and colored decora-
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We should pay attention to those Buddha images printed by the rubbing method as they reflect the transition form at the initial stage of engraved printing, and they have exerted direct influence on the development of engraved printing in China.

2.3 Engraved Printing

Among the printing of the Tang Dynasty and the Five Dynasties excavated in the Classics Cave of Tunhuang, the Prajnaparamita Hrdaya Sutra engraved by Wang Jie praying for the blessing of parents in the 9th year of Xianatong (868) is the most precious. It is not only the earliest engraved printed work found in China, but also the most complete ancient print. In addition, it also provides circumstantial evidence for the dating of the invention of engraved printing, determining that the time of the invention of this type of printing was around the middle of the 8th century. The academic community has seen this as substantial evidence to determine the time of the invention of engraved printing. The volume of the Prajnaparamita Hrdaya Sutra is a 16-metre scroll attached to seven pages. On the first page there is an engraved print by Jetavana Vihar, showing the scene of Sakyamuni, sitting on the lotus seat in the middle, expounding Buddhist doctrines to his student, Subbhi. The following six pages are the full text of the “Prajnaparamita Hrdaya Sutra” translated by Jumarajiva; at the end of this volume there is an inscription stating: “Contributed by Wangjie Praying for the Blessing of Parents on Apr. 15th, the 9th Year of Xiantong.” The complete format, printed pictures on the top leaf, imposing text and pictures, delicate engraving, vigorous calligraphy, suitable blackness, and clear printing indicate that this is a piece of work with mature technology instead of those produced in the initial stage. It is also the one and only existing printed work with a definite and complete date of its printing in China. Judging from its mature and delicate nature, we can determine that it is by no means a product of the initial stage of technology. Therefore, the invention of engraved printing can be dated much earlier than the 9th year of Xiantong. Taking into consideration the slow development in feudal society, we may say that it may have taken one century or longer for such achievements. What is most valuable is that the time of printing and the contributor is noted at the end of the volume. The inscription: “Contributed by Wajie Praying for the Blessing of Parents on Apr. 15th, the 9th Year of Xiantong” has made this print different from other prints of the Tang Dynasty. Therefore, the “Prajnaparamita Hrdaya Sutra” is the earliest example of a print with a definite date of the print, and “Wangjie” is the earliest contributor known so far.

In addition, there are two inscriptions saying, “Printed by the Guos of Sichuan” and “Transcribed by an 84-year old man on Mar. 12th, Dingmao” on the remaining volume of the “Prajnaparamita Hrdaya Sutra” collected by the Beijing Library (Youzi No. 9). Dingmao in this inscription refers to the 4th year of Tianyou (907), Ai Emperor of the Tang Dynasty (Li Zhu). The Guos version is a print of the Tang
In addition to prints of the Tang Dynasty, Tunhuang also has three prints of the Five Dynasties: “Icon of Avalokitesvara” and “Icon of Vaisravana” produced in Kaiyun of the Later Jin Dynasty, and the incomplete version of “Prajnaparamita Hrdaya Sutra” produced in the 2nd Year of Qianyou, the Later Han Dynasty. All three are contributed by the Master Cao Yunazhong of the Guiyi Army Governor.

The cheveted wooden board of the “Sitting Statue of Sakyamuni” is 15.4 cm. high, 10.2 cm. wide and 1.0 cm. thick, and is the one and only one from the Tang Dynasty from the Classics Cave of Mokao Grotto of Tunhuang. It is irreplaceable evidence for study of the production materials, origin, development and changes in engraved printing in China.

2.4 Colored Printing

Generally it is considered that colored xylography and chromatographical colored xylography was invented in the Ming Dynasty; however, the origin of colored xylography was earlier than that of chromatographical colored xylography. The earliest existing color-filled xylographs are four works in three categories found in the Classics Cave of Tunhuang. For instance, EO.11218D. S. P.241 and S. P.231.EO.11218D “Icon of Avalokitesvara” was produced with engraved printing and filled with three colors: red, yellow, and green. It is of a rectangular form, which is divided into two parts: the 3/5 part of the top side is the standing Icon of Avalokitesvara, and the other part consists of the prayer and inscription. On the column on the right side it is written “Produced by Master Cao Yuanzhong of Guiyi Army Governor.” S. P.241 “Icon of Avalokitesvara” is filled with three colors. From the prayer and inscription we can see that the contributor of this xylograph was the Governor Cao Yuanzhong of the Guiyi Army at Tunhuang. It was engraved by Lei Yanmei at the 4th year of Kaiyun of the Jin Dynasty, namely 947 A.D. S.P.231 “Holy Icon of Avalokitesvara” is filled with five colors and decorated. It is a work made during Guiyi Army times in the Five Dynasty. P14514.5 “Icon of Ksitigarbha” of the Five Dynasties was produced by engraved printing, and it is decorated and filled with five colors: red, yellow, blue, green and black. The colored xylographs found in the Classics Cave of Tunhuang are mature works of color filling. The several color-filled xylographs found in the Classics Cave of Tunhuang can prove the fact that the colored xylographs of China originated in the Tang Dynasty and Five Dynasties. The Tunhuang xylographs date the history of chromatic xylography in China to several hundred years earlier than was previously thought. As Chinese chromatic xylographs are the direct origin of Japanese Yamato-e which has exerted a great influence on western arts, we may say that ancient Chinese xylography represented by the Tunhuang xylographs is of great importance in the history of world art.
2.5 Movable-type Printing of the Western Xia and Uigur Characters

A number of Western Xia documents were found in the northern area of the Mokao Grotto, Tunhuang, of which there are transcribed versions and printed versions. The latter can be further classified into engraved versions and movable type versions. The “Vimalakiri Sutras” and “Zhumizhouyaoyu” of Western Xia characters made with movable type excavated in Tunhuang are not only the earliest examples of printing done with movable type in the world, but also the only copies. The closing inscription of “Bses-Pahi Sprin-Yig,” the Western Xia document found in the northern area of the Mokao Grotto, Tunhuang, has proved that an engraved version of the 3,600 volume Buddhist Scriptures was kept in Tunhuang during the Yuan Dynasty. It was a part of over 30 collections of Buddhist Scriptures by Master Guanzuba. This incomplete piece is a part of the Buddhist Scriptures in Western Xia characters, which is the only one in China and which is of great importance. Especially, the examples of printing from movable type found in the northern area of Tunhuang are the earliest examples of printing from movable-type in the world. In 1987, the “Vimalakiri Sutras” was excavated at the Haimudong Legacy, Chanshan Village, Xinhua Town, Wuwei City, Gansu Province. This sutra consists of 54 pages with seven lines on each page and seventeen characters in each line. Each page is 28 cm. high and 12 cm. wide. As documents 1224, 1225, and 1226 were excavated at the same time, it can be concluded that the remaining sutra is no later than the Qianding years. Moreover, according to the inscription of the Ren Emperor of the Western Xia Dynasty, this edition was produced in the time when Ren Emperor ruled. It is characterized by uneven blackness on the recto of the page and different ink penetration on the verso of the page. Some type is higher than the level. Some type are stout, thus with thick ink and ink expansion. And ink penetration on the verso of the page is obvious. Some characters are askew, and some characters, due to improper placement, are half clear and half fuzzy. Almost all the pages are askew in the sutra having neither straight lines and columns nor regular row spacing. Comparing this sutra with the “Vimalakiri Sutras” found in Heishui City and collected by Russians, we can see that these two sutras have similar arrangement, format and fonts. Due to their similar characteristics, it has been determined that they are examples of the same kind of printing made using movable type. Taking into consideration the characteristics of the “Vimalakiri Sutras” excavated in Wuwei and the one collected by the Russians, we find the statement that they are soil-made movable type prints reasonable.

This statement is also supported by circumstantial evidence. In the Uigur area which is to the west of Western Xia, printing with wooden movable type came after the use of this type in Western Xia. From the first discovery of wooden movable type of Uigur characters in the No. 464 Cave in the northern area of the Mokao Grotto by a French man, Paul Pelliot, in 1908 to 1995, altogether 1,152 sorts of wooden movable type of Uigur characters have been found in the cave. We can make the presumption that this might be a location where Buddhist scripts were
printed from the 12th to the 13th century. The Buddhist scripts printed with movable type excavated in the northern area of the Mokao Grotto may have been printed in this area as well. Combining the fact that a number of examples of printing using wooden movable type of Uigur characters were excavated in Tunhuang, we can suppose that Tunhuang was a center of movable type printing in Western Xia and the Yuan Dynasties, which has played an important role in the history of printing using movable type.

The 48 examples of printing in Uigur characters produced using wooden movable type excavated in the northern area of Tunhuang are the only ones found in the course of archaeological excavation. All of the wooden movable type of Uigur characters are 1.3 cm. wide, 2.1–1.1 cm. high and of varying thickness. These movable type sorts consist of nouns, stems of verbs, affixes, characters, punctuation, chase lines and gibs (sic).

3. THE EVOLUTION OF BINDING AND LAYOUT

The discovery of the Classics Cave enriches the history of books in China and provides abundant, substantial documents for research on the history of books in China. Research on these substantial documents not only unveils to us the specific forms of document binding and layout from the 4th to the 10th century in China, but also enables us to further realize the forms of binding and layout in the “transcription period.” The main forms of binding and layout of the Tunhuang heritage books are as follows:

3.1 Scroll Binding

The form of the scroll binding was derived from silk scrolls. After the birth of the transcribed paper book, these books inherited and referred to the binding and layout of silk scrolls — scroll binding.

The Tunhuang heritage books have provided us with many real objects in the form of scrolls. The British scholar Stein has written in his *The Thousand Buddhas: ancient Buddhist paintings from the cave-temples of Tung-huang on the western frontier of China*, that “all Chinese translations or ancient books are scrolled, which are 9.5 inches to 10.5 inches high. The smooth and soft yellow scrolls are covered with silk fabric which is very soft. A wooden shaft is inserted in the scroll, sometimes the shaft is decorated with ties at the shaft end. The length of papers is different, so the forms of scrolls are different too. A scroll is about 15 inches to 20 inches long. Those pieces of papers are connected together as a scroll till the end of text, so a scroll may extend very long.” This is the earliest description of the scroll-type books of Tunhuang.

“Dharma Sutra,” item No. 001 in the collection of the Gansu Provincial Museum, is one of the earliest transcribed versions of Tunhuang books in the world. Among the Tunhuang documents collected by Gansu, relatively complete scrolls...
include item No. 328 of the Tunhuang Institute, item No. 004 of the Gansu Provincial Library, No. 003 of the Northwest Normal University, No. 019 of the Gansu Provincial Museum, and Nos. 041, 044, 049, and 050 of the Tunhuang Municipal Museum. These transcribed classics have either complete beginnings or complete endings or both. Sometimes they even retain their rods, ribbons, and wooden shafts. The “Mahaparinirvana-Sutra: the Fifth Volume” in the collection of the Tunhuang Municipal Museum has a complete beginning, and incomplete ending, and an inscription. This scroll is 937 cm. long and 26.8 cm. wide. The “Mahaparinirvana-Sutra: the 33rd and 34th Volumes” collected by the Tunhuang Municipal Museum has an incomplete beginning and a complete end. This scroll is 884.4 cm. long and 26.8 cm. wide. Both of these transcribed classics are on hard yellow papers which seem to be of the 7th century. The “Mahaparinirvana-Sutra: the Fifth Volume,” item No. 041 in the collection of the Tunhuang Municipal Museum, was produced by the Royal Court in the early Tang Dynasty. Judging from the smooth calligraphy and particular decoration, we can say that it is of the highest level among the transcribed classics of Tunhuang. From the beginning and the ending of this piece we may find some characteristics of the volume header, body, and the ending of scrolls in the period when paper transcription prevailed. A number of the heritage books from the 4th to the 10th century found in the Classics Cave of Tunhuang, especially those produced from the 4th to the 8th century when paper transcription prevailed, are of great value for research on scroll binding and binding and layout methods used on the paper transcriptions.

3.2 Indian Binding

Indian binding was originally used for the ancient Indian pattra sutras. The binding method for the pattra sutras, which were written in Sanskrit, was called Indian Binding. This binding method was gradually accepted and used by the Chinese once it was introduced in China. The sutras with Indian Bindings in Tunhuang inherited and kept the basic form, including perforations, clamping, threading and strapping that formed the localized Indian Binding for Chinese paper-made books. Most of the transcribed classics in Tibetan are bound with Indian Bindings.

During the reign of Tubo, the pattra-like transcription with Indian Binding was very popular, the pages of which were strips on which Tibetan was written from top to bottom. Usually there were two holes in the middle of both sides of the strips to facilitate strapping. Among the heritage books of Tunhuang, there are many sutras that were transcribed in Tibetan and bound with Indian Bindings. These amount to about 10,000 pages in Gansu, most of which were collected by the Tunhuang Municipal Museum, the Gansu Provincial Library, the Tunhuang Research Institute, and the Wuwei Municipal Museum. The Tibetan “Watasahasrīka Prajñaparamita Sutra” with an Indian Binding, collected by the Gansu Provincial Library, may be the heritage of the middle Tang Dynasty (about the end of the 8th century and the beginning of the 9th century). This sutra is made of white jute.
papers which are tough and thick. Two pieces of paper are attached, forming a sheet 20.5 cm. wide and 73 cm. long. The sutra is written on both sides of the attached papers. Each page contains 12 lines and the double-sided paper contains 24 lines. The page numbers are written outside of the left border on the recto. To preserve blank space in advance, two 2.5 cm. radius circles are drawn at the 22 cm point from the left slit and 10.2 cm. from the upper slit. A 0.4 radius aperture was made at each center of the circle for threading.

Only a few transcribed Chinese classics are found with Indian Bindings in Tunhuang. Sometimes only one aperture is made, or there is no aperture at all (but the circles are drawn). The “Siyi Sutra: Four Volumes,” Beotuxin No. 1201 in the collection of the Beijing Library, was transcribed at the end of the Tang Dynasty. The papers of this transcription are brown and tough. There are three transcriptions bound with Indian Bindings which were collected by the Oriental Manuscript Department of the British Library. These are namely “Chanmen Sutra,” “Annotation to Sutras,” and “Annotation to Thirty Discussions on Vijnanamatravada,” all of which are the heritage of the late Tang Dynasty and Five Dynasties. “Insights of Mahayana’s Principles,” item P4646 in the collection of the French National Library, is also bound with an Indian Binding.

3.3 Accordion Binding

This binding is made by folding the scroll every four or six lines to form an accordion-like binding which readers may open freely anywhere. This binding was influenced by the pattra-like books of India or Tibet, which appeared in the late Tang Dynasty and the Five Dynasties. There is a piece of an accordion binding book in Tunhuang, namely the “Taisho Tripitaka” made of white jute paper, item No. 354 in the collection of the Tunhuang Institute. Only one section (7.4 cm. wide and 14 cm. long) of this sutra remains. There are three pieces of accordion bindings of transcribed classics in the Tunhuang Municipal Museum, namely Nos. 056, 057, and 071.

The Xuanfeng Binding appeared in the middle of the Tang Dynasty, while the Accordion Binding appeared in the late Tang Dynasty. Both binding methods are transition forms from the scroll binding to the codex binding, or the initial forms of the codex binding.

3.4 Crease Binding

There are four pieces of Tunhuang transcriptions bound with cord or twine in the Tunhuang Collection of the Gansu Province: “Annotation to Prajnaparamita Hrdaya Sutra” with the inscription of the “By Baihe Temple at the First Year of Tianbao, Tang Dynasty (742 A.D.),” No. 096 of the collection of the Tunhuang Research Institute; “Virtues Sutra” with the inscription of “the 19th year of Zhenyuan (803 A.D.),” No. 016 of the collection of the Gansu Provincial Museum; “Prajnaparamita Hrdaya Sutra” with the inscription, Jan. 26th, the 3rd Year
of Tianyou (906 A.D.),” No. 053 of the collection of the Tunhuang Municipal Museum; and the “Collection of Five Sutras including Tan Sutra” made of thick double-sided jute papers in the Song Dynasty, No. 077 in the collection of the Tunhuang Municipal Museum. All of them were considered having been bound with a butterfly-fold binding in the past.

Binding Method: stack five or six pages, fold them in two, make six holes, thread them with cord or twine into a stack along the spine; superimpose the books together, thread the cord or twine through the holes and across the back. The binding of them is much like that of notebooks: cut the upper and lower corners of the bound pages to round the corners to prevent wrinkling. Tung oil or silver powder is applied on the upper, lower and left edges for protection.

In addition, there are four fragments of Crease Binding transcriptions in the Tunhuang thread-binding heritage book collection of the late Tang Dynasty and early Northern Song Dynasty in the Oriental Manuscript Department, the British Library, namely: Nos. S5534 (905 A.D.), S5536 (Five Dynasties), S5646 (969 A.D.) “Prajñāparamita Hṛdaya Sūtra” and S5531 (920 A.D.). In the National Library of France, there is also a pamphlet, including “Modaoyigui,” which is a stack of seven pieces of paper which are 10.5 cm. wide and 15 cm. long. Then the longer edges of the paper are folded into fourteen single pages, which are sewn at the crease. Obviously, it was produced when Tunhuang was ruled by Tibetan kings (781–848 A.D.). The binding form of the above transcription is identical with that of item No. 096 in the collection of the Tunhuang Research Institute.

In January 1972, a copy of “Saddharmapudārīkā Sūtra” in Western Xia characters was discovered in Wuwei. Eight pieces of paper are stacked together and folded twice to form 32 pages. Thin woolen cords are threaded into the center of... Han Nationality but also the minorities, including Tibetans.

As the inscription of the year has indicated, such bindings appeared in the middle Tang Dynasty, and they were still in use in the late Tang Dynasty, the Five Dynasties, and the early Northern Song Dynasty.

In the past, such a binding was considered to be a “butterfly-fold binding” or traditional thread binding. In Tunhuang Heritage and Butterfly-Fold Binding by Bai Yudai, this binding is cited as an example of butterfly-fold binding. However, the crease binding is totally different from the butterfly-fold binding:

1. Both sides of crease-binding pages are written on; only one side of the butterfly-fold binding is written on. The characters appear facing inward when the paper is folded, and the depth of the page is centralized on the spine;
2. The crease binding is realized with cords threading the apertures; there are no apertures on butterfly-fold bound books, nor is the cord used. Paste is used in the butterfly-fold binding;
3. Every page of the crease binding book is written on, while there is one page blank every two pages in butterfly-fold binding books.

Therefore, it is inappropriate to call it a butterfly-fold binding.
Then, is it a thread binding? Mr. Li Zhizhong lists it as an example of thread binding in his *Identification of the Edition of Ancient Books*. Nevertheless, it is different from the thread binding which was very popular from the middle of the Ming Dynasty, and which can not be considered a standard thread binding.

In the early years of the Southern Song Dynasty, Zhang Bangji said in his *Random Notes at Mo Demesne* that “Sticking might be the best way for binding. In case of decay due to long time, it can still be copied in sequence if not lost. I have frequently found some rare books, and thanks to this method of binding, those books are saved. In case that crease binding is used, a broken book will be beyond repair. Once I found several volumes of ‘Fanglu’ by Mr. Dong, the order of page is totally messed. It is after one year’s hard work that book is repaired. And this is the shortcomings of creasing binding.” Mr. Zhang has, while praising the butterfly-fold binding, confirmed for us the fact that there has been a binding method called crease binding. The book heritage of Tunhuang has produced a substantial model for such binding.

As for such binding, Mr. Shao Guoxiu has written his *The Binding Method Lost in the History – Threaded Creasing*, putting forward that such binding, in line with its own characteristics and in order to be differentiated from the thread binding popular since the middle of the Ming Dynasty, can be called “Threaded Creasing.”

4. **NEW DISCOVERIES OF EVIDENCE FOR ANCIENT PRINTING**

With the elapse of time, a number of discoveries concerning printing have been made in Gansu, adding much compelling evidence to support the research on printing history in China.

4.1 **Paper**

*Archaeological Excavation*: in 1942, a piece of “Tsakhortej paper” was excavated at the site of the Tsakhortej Beacon Tower of the Han Dynasty on the eastern side of the Erginar River, Gansu Province, which is now held at the Taipei Institute of History and Language.

In 1973–1974, two pieces of jute paper were discovered at the Jinsuiguan Beacon Tower of the Western Han Dynasty at Juysan, Gansu (now in Inner Mongolia). One of the two has been restored to a 12 by 19 cm. thin and even piece of white and clear colored paper, the texture of which is fine and tough with a trace of ting jute stubs. Micro-examination and chemical analysis have indicated that it contains only marijuana fibers. The most recent bamboo slips excavated at the same location are of the second year of the Xuan Emperor of the Han Dynasty (52 B.C.). All of these clues suggest that there may have been quality paper at the frontier in the middle of the first century B.C. at the latest.
In 1979 five sets and eight pieces of jute paper were excavated at the Maquanwan Beacon Tower of the Han Dynasty in Dunhuang, Gansu, all of which have been tumbled. Item T12: No. 47: 32 by 20 cm. is the largest one. The earliest slips chronologically excavated at the same time were of the Yuankang, Xuan Emperor of the Western Han Dynasty (65–62 B.C.) and the most recent were from the Ganlu years (53–50 B.C.). Items T10:06 and T9:26, altogether four pieces, were excavated chronological slips from the times of the Cheng, Ai and Ping Emperors. Items T9:25 and T12:18, altogether two pieces were chronological slips of the Wang Mang period (9–23 A.D.). The chronological slips have provided exact evidence for the dating of paper. In 1986, a paper map was excavated from a mausoleum of the Han Dynasty at Fangmatan, Tianshui, Gansu. Archaeological study has indicated that it is the map of the Qin Kingdom of the Warring States Period. On this map, mountains, water and roads are drawn with ink. The paper is of khaki, the remaining part of which is 5.6 cm. long and 2.6 cm. wide. This map can be dated to periods of the Wen (187–179 B.C.) and Jin (156–141 B.C.) Emperors at the early stage of the Han Dynasty, and it is of better quality and earlier than the paper excavated at Baqiao, Shanxi [no later than the period of the Wu Emperor of the Han Dynasty (140–87 B.C.)]. "The remaining part of paper map excavated from the mausoleums of Han Dynasty is the earliest object of paper so far. This discovery not only brings the time of paper invention 200 years earlier from the Eastern Han Dynasty to the beginning of Western Han Dynasty, but also provides us with earliest paper with ink in the world." It proves that paper for writing and painting was invented at the beginning of the Western Han Dynasty, which is of great value to the recognition of the origin, manufacturing technology, materials and purpose of paper.

In 1990, a number of silk and jute papers were excavated from the site of the Xuanquanzhi Post, Dunhuang, Gansu. Two pieces of paper contained writing from the Western Han Dynasty, and twenty pieces of paper were found blank. The two pieces with writing were written with Li and Cao fonts, which are of the periods from the Yuan Emperor and the Cheng Emperor of the Han Dynasty. This discovery has provided new and substantial evidence for the academic dispute regarding when paper was invented, and whether it was in the Western Han Dynasty or the Eastern Han Dynasty.

In archaeological excavations from the 1970s to the 1990s, papers of different periods – almost covering all periods of the emperors in the Western Han Dynasty from the Wen and Jing Emperors to the Wang Mang – were excavated. The discovery of ancient paper in Gansu has provided precious, substantial evidence for the study of the materials and techniques of paper making in its early stage, which effectively proves that paper was invented in the Western Han Dynasty (about the second century B.C.), dating the invention of paper two hundred years earlier than had been thought. Archaeological evidence indicates that China is not only the cradle of papermaking, but also the country with the earliest paper samples.
Transcription paper in the stone housings of Tunhuang: ever since the fourth century, there has been a collection of Buddhist sutra transcriptions in the Classics Cave of Tunhuang. Most of these sutras are transcribed on paper. Viewed from the angle of papermaking history in China, the sutras in the stone houses of the Tunhuang have provided us with abundant samples for study of papermaking technology from the diachronic and synchronous approaches. These transcriptions, transcribed by people from the 4th to the 10th century A.D., originated from the Dong Jin Dynasty and Sixteen Kingdoms, became popular in the Sui and Tang Dynasties, and come to an end in the Northern Song Dynasty. Due to the long time these transcriptions were sealed in stone housings to prevent damage from negative factors including light, air, and water, as well as proper materials and handling, the ancient paper is preserved very well. Moreover, the ancient paper is mounted, so most of it has kept its original appearance. Some transcriptions are transcribed with a definite year, and some, though without an inscription of the year, can be dated from the style of the writing. All these have facilitated our research.

The industry of paper making was one of the most important handicrafts of Tunhuang during the Tang Dynasty, and the workers were called “Zhijiang (paper maker).” Most paper produced in the Tang and Five Dynasties in Tunhuang was jute paper. At that time, mulberry and jute were very popular in Tunhuang. The seeds of jute can be used as materials for oil pressing, and jute can be used for paper or cord making. That the planting of jute is prevalent in Tunhuang can be reflected from the various tents in Tunhuang. The development of papermaking in Tunhuang was promoted by various factors: first, the influence of Buddhism. With the development of Buddhism, transcription was very popular. Paper was in demand for accounting, documents and images produced for Buddhist activities. Second, the government also needed a large amount of paper. From the P.4640 record we can see that the paper of all states, counties, and villages was provided by the Military Depot at the time of the Guiyi Army. The paper was mainly used for accounting, land register and various documents. Third, the schools of Tunhuang in the late Tang and Five Dynasties needed paper. There were scores of state schools, county schools, state medical colleges, charity schools, technical schools, private schools and schools held by temples. A number of documents are the heritage of schools. Fourth, paper was in demand for the common people. A large amount of paper was demanded for sacrificial rites and contracts. The large demand promoted the development of the papermaking industry. From the “Guiyi Army Paper and Cloth Use Statements” in the 9th and 10th centuries A.D. (P.4640), we can see that due to a large demand, the use of paper was strictly controlled by the government, let alone the papermaking industry. Therefore, we may conclude that papermaking was a large government controlled industry under the Guiyi Army. The materials for papermaking were also provided by the military administration. P.4640: “On 14th (April), a set of jute cloth is delivered to paper makers.” As for the types of paper: there was fine paper, coarse paper, and painting paper, etc. From the inscription of the No. 196 Cave of the Mokao Grotto, we
can see that He Yuanzhu, the material director, and He Yuanding, the papermaker, were brothers, which indicates that the papermaking industry of Tunhuang may be some kind of home or family industry. And judging from the title of material director, we may suppose the papermaking unit may be a relatively large domestic joint workshop. Papermaking was completed manually at that time: at first the jute was broken and soaked then beaten to pulp to be filtered with screens before becoming pieces of paper. P.4525 bv describes the papermakers, praising their handicraft.

4.2 Writing Tools

4.2.1 Bamboo Pens

In 1991, one Gu of the Han Dynasty, two copper arrowheads and an object made of bamboo were excavated in the site of Gaowang Beacon Tower on the southeastern bank of the Hanachuer Lake northeast of Tunhuang. The object made from bamboo is the earliest bamboo pen found in China thus far. There are many historical records that say, “In the past, people use bamboo sticks as pens,” and the bamboo pen found in the site of the Gaowang Beacon Tower, Tunhuang, is one of such pens. This pen is flat with one obtuse end and one sharp end. The remaining trace of paint at the sharp end indicates that this pen has been used for writing, proving the historical fact, “People dips paint with bamboo sticks to write” in the ancient time of China.

Writing Brush: Writing brushes have been excavated at the Mozuiji Tomb of the Han Dynasty at Wuwei, Gansu; Hantan Slope of Wuwei; and Juyan. In 1986, four pieces of writing brushes and brush covers dating to the Qin Dynasty were found in the Tomb Groups of the Warring States Period, Qin and Han Dynasty at the Fangma Slope, Tianshui, Gansu. As damage was caused by improper storage, there are only two writing brushes and one brush cover that remain. The brush cover is made of two pieces of bamboo stuck together. The middle of each piece of bamboo is hollowed out, and two brushes can be inserted. The surface of it is painted with black paint. The cover is 29 cm. long and 2 cm. wide. The body of the writing brush is made of bamboo, with one end carved into a dome and one end hollowed out to make a cavity to contain the hair of the brush. The hair of the brush measuring 2.5 cm. is inserted 0.7 cm. into the body of the brush that measures 23 cm.26

There is a brush that was excavated from the Mozuizi Tomb from the Middle Eastern Han Dynasty at Wuwei, that is 23.5 cm. long with a 0.6 cm. diameter body and hair 1.6 cm. long. The body of the brush is hollow and made of bamboo. The head of the brush is made of hard black hair covered with tawny hair. It is similar to the brush from the Qin Dynasty in terms of shape and structure. The head of the body is hollow to contain the hair, which is fastened with threads and paint. The body is a light brown with characters written on it that say “Made by Baima” in the Li Font. This brush is one of the best and most properly preserved brushes from the Han Dynasty, which can be called a masterpiece of brushes of
the Han Dynasty. Another brush excavated from another tomb of the East Han Dynasty is inscribed with the characters, “Made by Shi Hu.” This pen is 21.9 cm. which is roughly identical to one Han Chi (or equal to 23 cm.), and that conforms to the record that “a pen is one Chi long,” as stated in On Balance by Wang Chong. The end of the brush was sharpened. This writing brush was found inserted in the hair of the tomb owner. The officers of the Han Dynasty often inserted brushes into their hair or hats for convenience of use; therefore, the end of the writing brush is often sharpened. This method of carrying a brush is known as “Zanbi.” “Bai Ma” and “Shi Hu” were the names of brush makers, and they are the earliest names of ancient writing brush makers discovered so far. This additional evidence verifies the signature system of the handicraft industry administration. This further improves the historical value of the pen.

**Dual-lobe Single Head Writing Brush:** In 1972, archaeologists discovered the dual-lobe single head writing brush at the site of Zhangyibao of the Western Xi Dynasty, Wuwei City, Gansu. As for shape and structure, this brush is made up of finished bamboo, with a shaped head and horse-ear shaped tongue. There is a slit in the middle of the tongue, making a form of two lobes folded into one. This not only provides a channel for the ink to drip slowly, but it also divides the head into two parts to improve the softness and flexibility of the head which is much like the tongue of a modern pen.

### 4.2.2 Ancient Ink-stones

Most ink-stones were excavated at Tunhuang, Gansu. In 1979, an ink-stone excavated at the beacon tower of the Han Dynasty at Maquan Bay, Tunhuang, was found to be a 3.4 cm. diameter round stone with a square base. Its four corners are warped upward. The ink-stone is 1.5 cm. high, and it has a wooden ink-pool. The ink-stone was originally placed in a rectangular wooden case. In 1982, a tri-footed ink-stone which was determined to be heritage of the Han Dynasty was excavated at the South Lake of Tunhuang. It is a 2 cm. thick round stone of 10 cm. diameter with three 1 cm. high bat-shaped feet. The body is decorated with delicate and beautiful lines. A stone (1 cm. by 1 cm. by 1 cm.) in the shape of a tiger is attached. Another 12 cm. by 8 cm. ink-stone was discovered at the same time. The stone of this ink-stone is smooth and fine, and it was determined that the attached stone was of the same period as the ink-stone with the three bat-shaped feet. In 1983, three ink-stones were excavated at the Tunhuang Airport, two of which were quadrates, 8 cm. long and 1 cm. thick. The other one was 13 cm. long, 3 cm. wide and 1 cm. thick of smooth and fine textured stone. They were determined to be writing tools of the Jin Dynasty. The pottery ink-pool excavated from the tombs of Qi Jiawan, Tunhuang, is different from the ink-stones mentioned above. This ink-pool consists of two parts: the round pool in the middle and a sink around the pool. The sink is 2 cm. thick and 0.8 cm. wide. This ink-pool is elaborate and beautiful, the owner of which was a person of the Northern [Han] Dynasty.
Archaeological findings have indicated that natural ink has been used on pottery since the Neolithic age. In the Shang Dynasty over 3,000 years ago, natural carbon ink was used for writing on bones or tortoise shells. In the Qin and Han Dynasties, artificial ink was invented. In the Three Kingdoms, turpentine soot was made into solid ink. In the Han and Jin Dynasties, adhesives were added to ink to form pill-like ink. The ink pill excavated from the Mozuji tomb of the Han Dynasty at Wuwei, Gansu, is 4.5 cm. high with a 4.5 cm. diameter at the bottom. The ink is pitch black, indicating advanced and mature manufacturing technologies. This is the oldest existing ink block, and it is very rare for ink blocks of the Han Dynasty. Furthermore, it pushes back the time of the invention of the ink pill from the Wei Kingdom and Jin Dynasty to the end of the Western Han Dynasty.27

CONCLUSION

The discussion above regarding Jian, Du, lithography, transcription, engraved printing, movable type printing, binding and layout, as well as, writing tools recorded in archaeological studies regarding the Gansu excavation, have provided important substantial evidence for our research on the history of calligraphy and printing in China. However, comprehensive and complete research on the development of the calligraphy and printing culture of Gansu is still somewhat of a void waiting to be filled, and a number of problems remain to be solved.

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