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Bindings of Ancient Chinese Bamboo and Wood Scrolls

Abstract: The poor state of preservation of ancient Chinese bamboo and wood scrolls often makes it impossible to study these artefacts in their intact form, allowing us to view the whole only on the basis of its parts. This paper traces typical features of scrolls by gathering the piecemeal information that is available on their production and form, especially their bindings. The topics addressed include the ways in which slips were prepared before tying them together in a scroll, the materials that were used for the binding strings, different techniques by which the strings were applied to the slips, and the relationship between the number of binding strings and visual organisation. Based on a close observation of the traces of binding strings on individual slips, the paper also proposes new lines of research. These might shed further light on largely unknown aspects of early Chinese manuscript culture, such as the direction in which bamboo and wood scrolls were bound, even for specimens that are no longer intact.

1 Introduction

Before paper gradually became the standard writing support during the third and fourth centuries CE, manuscripts in the area we today know as China were produced mainly from bamboo or wood.[1] It had long been known from early textual sources that bamboo and wood were used as a writing support in the first millennium BCE. However, archaeologists only unearthed the first pieces of inscribed wood and bamboo at the beginning of the twentieth century in the

1 Although paper fragments with writing from as early as the second century BCE have been found, scholars generally agree that paper was not widely used as a writing support until several centuries later, because these early examples are few in number. Received historical sources date the 'invention' of paper – in fact, more probably a substantial refinement of papermaking techniques – to 105 CE exactly. See Drège 2017, xi–xlviii; Giele and Peltzer 2015, 684–686; Tomiya Itaru 2010, 8–28; Tsien Tsuen-hsuin 2004, 145–159; Venture 2014b. To the best of my knowledge, there is no evidence of the use of parchment in China, neither for the ancient nor any other period.

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ruins of ancient border fortifications in the desert regions of Northwest China.[2] These early finds are dated to the Han period (206 BCE–220 CE) and are practically all wood manuscripts. Further excavations in central China, especially since the second half of the twentieth century, have brought to light a significant number of bamboo manuscripts, mostly from ancient tombs or wells.[3] The oldest pieces of inscribed bamboo discovered so far were found in the tomb of Marquis Yi of the state of Zeng. These contain lists of objects carried at his funeral procession and date back to the late fifth century BCE.[4] The oldest extant manuscript made of wood is not quite as old, originating from the late fourth century BCE. This individual tablet records a law on the division of agricultural land from the state of Qin.[5] It is very likely that both materials had already served as a writing support much earlier. The writing system was fully developed by the late second millennium BCE, as extant inscriptions on 'oracle bones' and bronze vessels clearly demonstrate.[6] Brush and ink were presumably already being used to write on bamboo and wood at this point, because these materials would no doubt have been both widely available and inexpensive.[7] While other materials, such as stone tablets or silk, were certainly employed to produce manuscripts as well, these only account for a fraction of all extant examples. Admittedly, the dataset available might contain a certain bias, because silk fabrics were probably more prone to rot and decay without leaving a trace than bamboo or wood artefacts. However, recent studies suggest that even the imperial collection of the Western Han period (206 BCE–9 CE) contained mostly works written on bamboo rather than more expensive silk.[8]

2 For the earliest study in a Western language, still based exclusively on descriptions in received literature rather than the actual manuscripts, see Chavannes 1905. The following decade saw the first groundbreaking studies that made use of the manuscripts excavated in the early twentieth century: see Chavannes 1913; Luo Zhenyu and Wang Guowei 1993 [1914]; Wang Guowei, Hu Pingsheng and Ma Yuehua 2004 [1912].

3 For a chronological overview of and introductions to the numerous finds made between the early twentieth and the early twenty-first century, see Pian Yuqian and Duan Shu'an 2006, 379–479; Shaughnessy 2019, 256–375. Among the manuscripts discovered to date, legal and administrative texts figure most prominently.

4 Habberstad 2014.

5 Hulsewé 1985, 211–215.

6 Boltz 1994, 31.

7 On the early development of Chinese ink, see Franke 1962, 6. For traces of the use of 'exemplar manuscripts' on perishable writing supports in the production process of Western Zhou (1045–771 BCE) bronze inscriptions, see Škrabal 2019.

8 Fölster 2016, 87–88.

The standard book form of the time was the 'scroll' (*ce* 冊), which was usually stored as a 'roll' (*juan* 卷).[9] It was produced by combining narrow slips (usually referred to as *jian* 簡 in Chinese scholarship)[10] of bamboo or wood – before or after the writing was applied to them – with the help of two or more binding strings to form a mat-like object. The character 冊, used to write the Chinese word for 'scroll', has been interpreted as a pictographic representation of such an artefact. The similarity is certainly more obvious in the earliest attested forms of this character that are found in 'oracle bone' or bronze inscriptions (compare Figs 1 and 2 below).[11] Units of bound-together slips were also referred to as *bian* 編 'binding; sth. bound', the same word that was used verbally in the sense 'to tie/bind together'.[12]

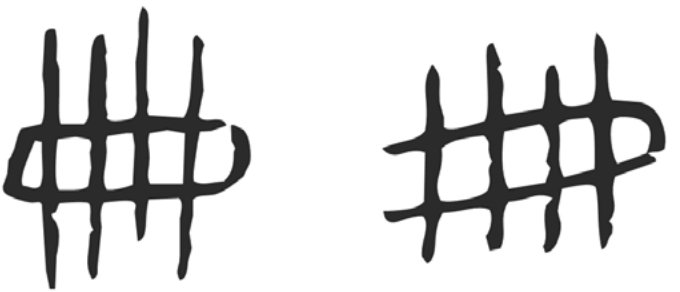

Fig. 1: Early forms of the character 冊 from oracle bone (left) and bronze (right) inscriptions.

9 It has also been shown that scrolls were sometimes folded together rather than rolled up for storage; see Xiao Yunxiao 2017, 241–252. While Xiao suggests that the manuscript in question 'was not in the familiar "scroll" format, but rather a "folded" format' (p. 252), it was clearly a scroll; the only difference to rolled-up scrolls being the way of storage.

10 The term 'slip' will be used throughout this paper to refer to the narrow pieces that are most frequently used to produce scrolls; cf. the wider 'tablets' (usually referred to as *du* 牘 in Chinese scholarship). Note, however, that there is no unified terminology in English. Some scholars, for example, refer to the narrow pieces as 'tablets' and the wider ones as 'boards'; see Tsien Tsuen-hsuin 2004, 120–122. For a discussion of the original Chinese terms for individual pieces of writing support, see Cheng Pengwan 2017, 10–17; cf. Staack 2018, 246–263.

11 For the images in Fig. 1, see the database *Xiao xue tang* 小學堂 'Philological Studies Hall' of Academia Sinica: <https://xiaoxue.iis.sinica.edu.tw/char?fontcode=41.EB63> (left) and <https://xiaoxue.iis.sinica.edu.tw/char?fontcode=31.EA7B> (right) (both accessed on 5 July 2022). Image in Fig. 2 reproduced from Ma Jianhua 2002, 34. On the dating, see Gansu Juyan kaogudui 1978, 9.

12 Cheng Pengwan 2017, 41–42.

Fig. 2: Wood scroll recording a list of items carried by an emissary, 22 CE, excavated at the ruins of the ancient Gold checkpoint of Jianshui company (*Jianshui Jinguan* 肩水金關). Lanzhou, Gansu Jiandu Museum, MS 73EJT21:2–10.

But, of course, not everything was written on scrolls. Especially in the early imperial administration, individual tablets were commonly employed for official correspondence or brief documents that could conveniently be recorded on only one wider piece of writing support.[13] Tablets were also used for maps, personal letters and 'greeting tablets', which served a similar purpose to modern business cards.[14] Due to the natural curvature of its surface, bamboo was less suitable for the production of such pieces than the more versatile wood, although examples of bamboo tablets are known. Another, albeit comparatively rare, form of written artefact involves the use of binding string but differs signif-

13 Sumiya Tsuneko 2003; Sumiya Tsuneko 2012.
14 Venture 2014a. On greeting tablets, see Korolkov 2012.

icantly from the scroll. Several rod-like pieces of wood were planed smooth for inscribing on two or more sides for this written artefact. After the writing had been applied, these pieces – referred to as *gu* 觚/柧 in Chinese sources – were strung on a cord that ran through holes drilled through the top of each piece. This book form was employed mostly for brief literary texts, especially school primers (see Fig. 3).[15]

Fig. 3: Three-sided wood *gu* with the first part of a primer and string hole at the top, excavated near Dunhuang 敦煌. London, British Library, Or. 8211/1, front (left) and back side (right). Courtesy of the British Library Board.

15 Loewe 1967, vol. 1, 30; Martinique 1983, 7. A comparable practice of connecting inscribed pieces of bamboo with one binding string running through drilled holes can be witnessed in Batak manuscript culture. See, for example, the manuscript Hamburg, Museum am Rothenbaum – Kulturen und Künste der Welt, no. 79.8:31, which consists of bundled slips inscribed with a divination text (Zollo 2020, 144–145).

Most scrolls consisted of rather uniform, narrow pieces each measuring between 13 and 75 cm (commonly between 23 and 46 cm, or one and two feet, *chi* 尺) in length, and between 0.5 and 2.5 cm in width.[16] The number of slips in extant scrolls (including reconstructed examples) ranges between less than ten and more than five hundred slips.[17] Based on considerations of usability, it has been argued that it was probably uncommon to have scrolls consisting of more than one hundred slips.[18] In some scrolls, pieces with different widths were purposefully combined. There is evidence of this practice from administrative documents from the early imperial period, where a 'cover letter' was sometimes written on a wider tablet and the 'document proper' (such as a register of convicts) attached on narrow slips.[19] Analogous examples from contemporary funerary culture show letters addressed to otherworld officials (on a tablet) tied together with lists of funerary goods (on slips).[20] There is also evidence suggesting that several wider tablets were occasionally tied together as in a scroll.[21] In contrast to Roman diptychs or triptychs, the connecting strings did not run through holes but were wrapped around the tablets in the same way as would be done

16 Cheng Pengwan 2017, 79–113, and 344–388 (Appendix 2). In contrast to those made of wood, the width of slips produced from bamboo seldom exceeded 1 cm, probably because the material's natural curvature would otherwise have led to problems in the production of a scroll. As far as length is concerned, bamboo seems to have been the more versatile material. While the longest slips discovered to date were produced from bamboo, extant examples of wood slips do not exceed a length of 56 cm.

17 Venture 2014b, 353. An archaeological report on excavations near Dunhuang mentions a scroll consisting of only three slips, see Gansu sheng wenwu kaogu yanjiusuo 2000a, 13. Whether a manuscript consisting of no more than two or three tied-together slips is suitably described as 'scroll' might be a matter of opinion. However, at least structurally it is certainly comparable to manuscripts consisting of a much larger number of slips.

18 Hsing I-tien 2011a, 21–23. This hypothesis has recently received support from a late third-century BCE law which regulates the drafting of official documents. It stipulates: 'In case [a submission concerning] one official matter would exceed 100 slips, divide it up, so that no more than 100 slips are tied together in one unit' (Staack 2018, 269; translation modified).

19 The tablet with the cover letter seems to have normally been placed at the scroll's end (i.e. the far left); see Hou Xudong 2014; Hou Xudong 2019.

20 Guo Jue 2019.

21 Ma Tsang Wing 2020. However, this was probably done for archival purposes only, as the artefact in question consists of three tablets that previously constituted independent documents by themselves. Forming a composite, just like a modern file, it seems to have been folded like a concertina or accordion for storage. In other cases, individual tablets were simply stacked and bound together with string wrapped around the stack as a whole; see Hsing I-tien 2011b; Momiyama Akira 2016, 44–49.

for narrow slips (see Section 4.1 below).[22] In all these cases, at least the length of the tied-together pieces was uniform,[23] but recently excavated manuscripts suggest that even pieces with decidedly different lengths were sometimes bound into scroll-like objects.[24] However, how widespread these practices were is so far unclear.

It must be stressed that current knowledge about bindings of early Chinese bamboo and wood manuscripts is based on a comparatively small number of perhaps a few dozen intact scrolls[25] and a much larger corpus of fragmented scrolls for which only the individual bamboo or wood slips are intact, but not the binding strings that once held them together. Consequently, researchers frequently have to rely on reconstructions. In addition, due to the happenstance of preservation, the intact scrolls all derive from a very specific context, namely, military administration. The original context of production and use regarding the fragmented scrolls is more varied, but examples from outside the administrative sphere normally stem from ancient tombs. To what extent the funerary context may have influenced the physical appearance of these manuscripts is a thorny issue,[26] but there is evidence suggesting that at least some manuscripts were not produced specifically for burial, even though they certainly ended up as burial goods.[27] In the following, this paper reviews the evidence available on

22 At least one diptych-like wood artefact with the two connecting strings running through holes has been excavated in the Han period ruins of the so-called Gold checkpoint (*Jinguan* 金關). The artefact does not bear writing but a drawing of a person and a horse; see Gansu Juyan kaogudui 1978, pl. 3 (top). I am indebted to Ma Tsang Wing 馬增榮 for drawing my attention to this artefact.

23 Chen Mengjia (1964, 59–60) pointed out that the slips appear to have been trimmed in some cases as one of the last steps in the production of a scroll. This is clear from examples where writing at the slips' very bottom is fragmented.

24 Chen Wei and Xiong Beisheng 2019, 53. It should be noted, however, that this statement is not based on intact binding strings but the slips' contents and their position at the time of excavation.

25 Hou Xudong (2019, 120–122) collected information on eleven scrolls with intact binding strings excavated in Northwest China. The excavation report of the Xuanquan relay station (*Xuanquanzhi* 懸泉置) site near Dunhuang mentions 'more than fifty scrolls, some of which have intact binding strings' (Gansu sheng wenwu kaogu yanjiusuo 2000a, 13). Hence, Hou assumes that there might be more intact scrolls among the yet unpublished materials from that site. But this count would certainly be significantly below fifty.

26 Giele 2003, 428–434.

27 See, for example, various examples of corrections in manuscripts recovered from tombs. For an overview of such corrections, see Chen Mengjia 1964, 65–67; Cheng Pengwan 2017, 132–136. Archaeologists have also argued that the placement of manuscripts in tombs itself was a marginal phenomenon and that 'the diversity of texts in the manuscripts indicates their nature

bindings of early Chinese bamboo and wood scrolls and provides an overview of the materials and techniques that were applied during production.

2 Preparations before binding

Before binding pieces of bamboo or wood to form a scroll, the writing support itself, of course, had to be produced. In addition to the manufacture of pieces of a certain shape and size from the raw materials by cutting, splitting or sawing, this also involved polishing and drying, in the air or over fire. The last step was applied especially to bamboo and commonly called 'killing the green' (*shaqing* 殺青).[28] These steps served to make the writing support suitable for the application of ink with a brush and to render the material more durable. However, some preparations commonly undertaken were directly connected with the following procedure of tying pieces of writing support together. On the one hand, these were concerned with determining the slip sequence inside a scroll, on the other, with marking the later position of binding strings on the individual pieces or with securing the strings' proper attachment.

The first of these preparations seems to have been applied exclusively to bamboo. Even before a harvested bamboo culm, or one culm segment of a particular length, was split into multiple pieces – usually narrow slips – a spiral-shaped line was carved around it with the help of a sharp tool.[29] This yielded a line pattern on the slips' back side, which was normally not used for writing due to its smooth surface. As the lines were clearly applied to the bamboo before the binding or even the writing, they primarily marked the sequence the bamboo slips were in as part of the culm segment before it was split lengthwise. It has been argued that the main purpose of this was to suggest the most favourable sequence in which the slips belonging to the same 'set' should be bound as part of a scroll to produce a manuscript which was aesthetically pleasing and convenient to use.[30]

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as personal objects, not the standardized products of a large-scale funerary operation'; see Thote 2017, 38–47 (quote from p. 46). On manuscripts in the context of the whole assembly of burial objects, see Wang Bin 2020.

28 Tsien Tsuen-hsuin 2004, 114; Zhang Xiancheng 2004, 115–116.

29 Han Wei 2012.

30 Jia Lianxiang 2015, 101–102; Staack 2015, 175. Of course, this does not mean that those who later brushed the writing and/or bound the scroll necessarily followed the slip sequence suggested by the lines. This explains cases in which the line pattern on the back side of a scroll

As a side note, whereas the lines just described seem to have rarely been applied to wood in China,[31] wooden codices from fourth-century Roman Egypt show marks that seem to have served a strikingly similar function. Diagonal lines (referred to as 'collational marks' by researchers) were carved in the following way:

> The collational marks [...] were applied by the carpenter to the spine edge of the codex when he completed the boards. Although the notches functioned as a collation guide for the user should the leaves become separated, *they were sawn-in primarily as a guide for maintaining the order as the leaves were cut from the block*. They serve an important purpose, namely, to maintain the original manufactured order of the leaves – more practical physically than as a guide for the reader: when the craftsman sawed the pieces apart, there would be irregularities in the cut, so kept in the order in which they were cut, the whole would lie flat – each irregularity fitting within the irregularities in common with its neighbour.[32]

In contrast to the lines mentioned, numbers marking the slip sequence in a scroll are found in both bamboo and wood manuscripts. Judging from the extant examples, sequence numbers mainly occur on scrolls with literary texts. The sequence numbers were applied to the individual slips with brush and ink, probably directly before or after the writing and before the slips were bound.[33] Extant examples show that numbers could be added on the slips' front or back side, often at the very bottom but sometimes at the top. In case bamboo was used, sequence numbers were sometimes also written at the places on the back

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does not – exactly or at all – match the sequence of the text on the front side. For a recent assessment of the carved lines found on the back of a scroll from Shuihudi 睡虎地 tomb no. 77, which show certain irregularities, see Foster 2021, 421–434.

31 To date, the only mention of lines on the back side of wood slips – in that case applied with ink rather than carved – was made regarding slips of 'group A' of the Qin slips in the possession of Peking University. See Beijing daxue chutu wenxian yanjiusuo 2012b, 66; Staack 2015, 159, n. 12. Complete reproductions of the respective slips still await publication.

32 Sharpe 1992, 132 (emphasis added). I would like to thank Nicholas Pickwoad and Georgios Boudalis for bringing these artefacts and John Lawrence III Sharpe's research to my attention. Another example of a wooden codex with similar marks from seventh-century Egypt is mentioned in He Jin 2013, 468, with Fig. 6.

33 There is no direct evidence regarding the point in time when the sequence numbers were applied. However, it seems most reasonable to do this before the individual slips were bound together. In that case, the numbers could have served the twofold purpose of facilitating not only the original binding process but also a later reconstitution in case the binding strings came apart.

side where the bamboo showed traces of nodes, which were usually scraped smooth.[34]

Most bamboo or wood pieces that were combined into scrolls show small, mostly triangular, notches at the places where binding strings were attached. The notches are commonly positioned on the right side of the slips (seen from the front side with the writing).[35] They probably served a threefold purpose. Firstly, they marked the positions where binding strings were to be attached, which gave the attentive writer the possibility of avoiding these spaces. Otherwise, binding strings might cover writing after the scroll was bound.[36] Secondly, the notches prevented the binding strings from shifting up- or downwards once they had been fastened.[37] Thirdly, they allowed a smaller distance between slips, because the binding string could recede into these cavities, thereby enhancing the appearance of a scroll as a continuous writing surface.[38] Probably, this would also enhance usability.

3 Materials used for binding strings

The binding strings of Chinese bamboo and wood scrolls are referred to as *sheng* 繩 'cord, string' or *bian* 編 'binding' in contemporary sources.[39] Extant administrative documents dating to the time between *c*. 100 BCE and 100 CE frequently mention orders of materials that were necessary for the compilation of official documents, such as writing supports of different shapes and sizes as well as binding strings. The latter are usually measured by length (in *zhang* 丈 'span', *c*. 2.3 m) or weight (in *jin* 斤 'catty', *c*. 220–250 g).[40] The sources reveal a fixed ratio between the number of slips (*zha* 札) and the slightly wider 'two-liners' (*lianghang* 兩行) commonly used for the production of scrolls, on the one hand,

34 Cheng Pengwan 2017, 163–168; He Jin 2013, 452–458.

35 Cheng Pengwan 2017, 37–40; Jia Lianxiang 2015, 79; Zhang Xiancheng 2004, 120–122. Jia argued that this placement of the notches may have to do with the order in which the slips were bound and with most people being right-handed. More research is necessary to substantiate these hypotheses.

36 Li Tianhong 2002, 6–8.

37 Cheng Pengwan 2017, 37.

38 Richter 2013, 27–28.

39 Chen Mengjia 1964, 58. Cf. the use of the term *bian* to refer to an entire scroll above.

40 Chen Mengjia 1964, 60–61; Ji Annuo 2007, 479–483; Ma Zhiquan 2020, 286. For the conversion rates of *zhang* and *jin* into metres and gram, see Qiu Guangming 1992, 520.

and the length of the binding string, on the other: each piece would be allotted around 9 cm of binding string.[41]

Binding strings were produced either from bast fibre plants – mostly hemp (*da ma* 大麻, *Cannabis sativa* L.) and ramie (*zhu ma* 苧麻, *Boehmeria nivea* L.) – or from silk (*si* 糸/絲).[42] Received literature from the time mentions only silk as a binding material.[43] Numerous examples of bamboo and wood slips with remnants of fragmented silk binding strings, which were mostly excavated from ancient tombs in central China, confirm that silk was indeed used. However, both ramie and hemp are similarly attested as commonly used binding materials from excavated manuscripts. In fact, all scrolls with intact binding strings discovered to date show strings made of hemp.[44] Rather than being an indication that hemp is generally a more durable binding material than silk (or ramie), the most probable reason is that these specimens were all excavated in the north-west of present China, where the arid climatic conditions appear to be more favourable for preservation. The binding strings often (partly) decomposed under the more humid or even waterlogged conditions in tombs, especially in central China.

Apart from the function of the manuscript, which probably affected the choice of binding material,[45] this was certainly also influenced by regional

41 Chen Mengjia 1964, 60–61. Calculating with a width between 1 and 1.5 cm per slip, which would be bound at two places (see further below), *c.* 6 cm of string would be needed. Bearing in mind that a certain length of string would be used to cross the gaps between slips and considering that about twice the length of string would be necessary per two-liner, since they are wider than slips, the average number of 9 cm of string per piece (slip or two-liner) seems reasonable.

42 Cheng Pengwan 2017, 51–53. The claim that leather was also used for the binding of scrolls goes back to the occurrence of the phrase *wei bian* 韋編, literally 'leather binding', in received literature. However, to date no examples of leather binding strings have been found. In addition, several other possible readings of the character *wei* 韋 in this phrase have been proposed. For an overview, see Cheng Pengwan 2017, 53–55; Ma Zhiquan 2020, 284–285. Based on a passage in a late third-century BCE law of the state of Qin, scholars have, at times, also argued that grasses or reeds were used to produce binding strings (Cheng Pengwan 2017, 53). However, a comprehensive study that drew on additional textual and archaeological evidence has shown meanwhile that the passage mentioned more probably describes materials that were used for inexpensive wrappings rather than binding strings. See Huang Haobo 2019, 102–103.

43 Chavannes 1905, 21–23, 43; Tsien Tsuen-hsuin 2004, 124.

44 Ma Zhiquan 2020, 285–286. For a material analysis of the ramie binding string traces on the Qin and Han period slips in the collection of Peking University, see Wang Kai and Hu Dongbo 2012.

45 Silk seems to have been used for many scrolls that were placed in tombs, especially during the Warring States period; see Feng Shengjun 2007, 54. Whether this is related to practices

availability and differences in production costs. Hemp and ramie have both been used as fibre plants in certain areas of present China since Neolithic times, however, ramie seems to have spread to the area north of the Yangtze only by the third century CE.[46] In addition, although the properties of ramie are superior to hemp when it comes to the production of textile fibres, hemp fibres are easier to obtain from the stem and the plant also grows in colder regions.[47] Silk is a natural protein fibre produced by the larvae of the mulberry silkworm (*Bombyx mori* L.). The production of silk, which can be traced back at least to the third millennium BCE in China,[48] not only necessitated the cultivation of mulberry trees but also the rearing of silkworms and, therefore, can be expected to involve higher costs.[49] Judging from the processing of the raw materials, it can be assumed that hemp was the most inexpensive and silk the costliest binding material, with ramie ranging somewhere in between.

The binding strings of bamboo or wood scrolls do not appear to have been treated with dye or colour by default, however, a few manuscripts with coloured binding strings have been discovered: some of the Warring States period (453–221 BCE) bamboo slips excavated at Xinyang 信陽 seem to have been bound with a 4 mm wide black silk ribbon.[50] Red binding strings were supposedly used for wood scrolls from the reign of Wang Mang 王莽 (r. 9–23 CE) that were found in Northwest China.[51]

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surrounding burial or reflects common habits of manuscript production in a non-administrative/personal setting remains an open question.

46 The correlation between the use of wood (as a writing support) and hemp (as a binding material) that has been observed by some scholars (e.g. Cheng Pengwan 2017, 53), may, at least in part, be due to the lack of bamboo, ramie or silk in colder areas, especially in Northern China. Similarly, the observation that bamboo manuscripts were mostly bound with silk during the Warring States period, whereas in the following Qin and Han periods silk and hemp (or ramie) were both commonly used (Cheng Pengwan 2017, 53), could reflect more of a regional bias than a diachronic development. After all, most Warring States manuscripts discovered so far come from the ancient state of Chu, which was located in current central China. The finds from the following periods show a greater variety of regional origin.

47 Kuhn 1988, 15–17.

48 Kuhn 1988, 272–273.

49 For details on silk production, see Kuhn 1988, 285–433.

50 Henan sheng wenwu yanjiusuo 1986, 67; Ma Zhiquan 2020, 285. The use of silk ribbons instead of strings is also attested for the Warring States bamboo manuscripts excavated at Yangjiawan 楊家灣 tomb no. 6. See Zhongwenxi gu wenzi yanjiushi Chujian zhengli xiaozu 1978, 65.

51 Cheng Pengwan 2017, 52–53; Gansu Juyan kaogudui 1978, 7. Unfortunately, the authors do not specify the material from which the strings were made. However, as the manuscripts were excavated in Northwest China, hemp is the most likely candidate. For additional examples of

4 Application of the binding strings

4.1 Techniques of binding

As mentioned above, bamboo and wood scrolls were produced by tying together multiple slips with the help of two or more binding strings. In principle, slips could be bound together either before or after writing had been applied to them, and, in fact, both production sequences seem to have been employed.[52] The basic fact that pieces of writing support for bamboo and wood scrolls were somehow connected with binding strings has been common knowledge even before the first specimens of such manuscripts – or rather, fragments of them – were discovered in the early twentieth century.[53] However, the exact techniques employed for tying the strings were seldom discussed. To the best of my knowledge, Aurel Stein was the first to publish a hypothesis about this. Pondering the question of how exactly multiple slips may originally have been connected, he discussed the issue with his colleague Fred Henry Andrews, who made the following proposal:

> Experimenting with a fine raw silk thread, I found that a satisfactory result could be attained by the following method (see illustration) [reproduced as Fig. 4 below].[54] The cord is doubled end to end, the first 'slip' (folio one) is placed in the bend, and an ordinary knot tied with the two ends, care being taken that the encircling cord falls in the notch near one end of the lath, the purpose of which is to prevent the cord slipping. Folio two is then laid with its notch close to the knot, one end of the cord being below the lath and the other on top. The two ends are then half twisted round each other reversing the position of the cords, the upper becoming the lower and the lower the upper. Folio three is next placed between the cords with its notch against the half-twist, and the cords are again half twisted to secure it in position. The process is continued until the last page, after which a knot

coloured binding strings that are mentioned in the received literature as well as the possible connotations of different colours, see Tomiya Itaru 2010, 22–28.

52 Cases in which writing was covered by binding strings suggest that the binding came after the writing (Tsien Tsuen-hsuin 2004, 123), provided the position of the strings did not shift after they had been attached. The reverse circumstance is more difficult to prove since the fact alone that writing is *not* covered is hardly persuasive, at least if the positions of bindings were marked by notches. For a discussion of the issue, see Hsing I-tien 2011a, 23–31, who concludes, based on practical considerations, that it was probably more common to apply the writing before binding the slips together.

53 Chavannes 1905, 40–43.

54 Image reproduced from Stein 1921, 252.

is tied, and the excess length of the two ends is left free to be used as a means of tying the complete record or chapter together.[55]

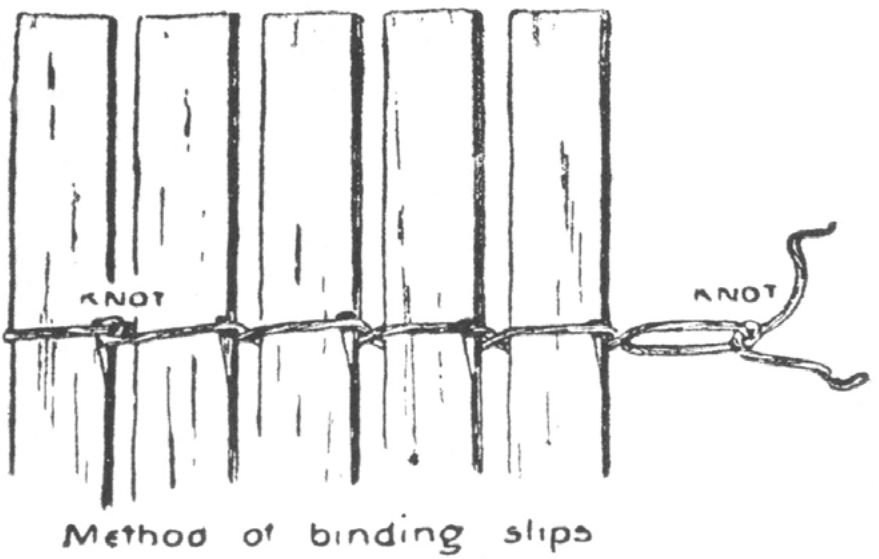

Fig. 4: Reconstructed binding technique employed for the slips excavated by Aurel Stein at Dunhuang (back side of the scroll).

With this method, wherever a binding string is attached to a slip, only one line of string is visible on either side of the slip. While Andrews and Stein do not provide a specific designation for this binding technique, the resulting course of the string visually resembles a basic sewing technique known as 'double running stitch'. Depending on whether the thread of the first passage and the re-

55 Stein 1921, 251–253. It should be noted that Stein and Andrews assumed the scrolls to have been closed for storage like a 'concertina' rather than having been rolled up. This thought was apparently taken up by Tsien Tsuen-hsuin (2004, 123), who stated that '[n]o tablets bound in the accordion form are extant today and no description of this system is found in ancient literature. [...] It seems that the tablets, after being connected by cords, could also be rolled up and stored in that form.' For an example of three comparatively wide (and originally independent) documents on wood from the late third century BCE that were apparently tied together like a scroll but stored in an accordion-like folded rather than rolled-up form, see Ma Tsang Wing 2020.

turning thread turn about each other or not, the double running stitch can be further distinguished into a twined and a plain form (see Fig. 5).[56]

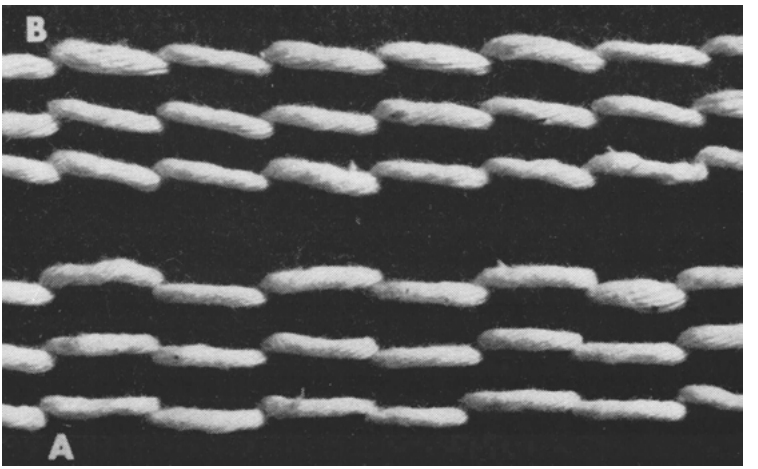

Fig. 5: Plain (A) and twined (B) double running stitch. Courtesy of The Textile Museum, Washington, DC.

In fact, the twined double running stitch seems to come closest to the binding technique reconstructed by Andrews. Actual examples of complete scrolls that have been excavated in Northwest China since the 1930s confirm the use of this technique (see Fig. 6).[57]

56 Emery 1966, 235 and Fig. 353.

57 Hou Xudong 2019, 120–123; Ma Zhiquan 2020, 287–288. Image in Fig. 6 below reproduced from Gansu sheng wenwu kaogu yanjiusuo 2000b, 42.

Fig. 6: Detail of wood scroll with an inventory of carriages and hand carts, 23 BCE, excavated at the ruins of the Xuanquan relay station (*Xuanquanzhi* 懸泉置). Lanzhou, Gansu Jiandu Museum, MS I 90DXT0208[2]:1–10.

It was obviously possible to fix the binding string with only one knot at the very end of the manuscript (left side), while Andrews had assumed that another knot would have been tied after the first slip in the scroll. However, he was right about the general direction of binding. The scrolls with extant binding strings – all administrative documents – were usually bound from the beginning towards the end (right to left, seen from the front), with a certain length of binding string often remaining to the left of the last slip.[58] It has been proposed that, whereas this sequence of binding the slips (from beginning to end) may have been the standard for administrative documents, literary works were more probably bound from left to right (or: the end towards the beginning), yielding leftover string at the scroll's beginning.[59] As no bamboo or wood scrolls with literary works and intact binding strings have been discovered to date, this hypothesis seems difficult to prove or disprove at this point. But, as will be shown below, a closer investigation of the remnants of binding strings, might provide useful evidence in certain cases.

After the proposal by Stein and Andrews, it seems to have taken ninety years before another detailed reconstruction of binding techniques was attempted in the lab report on the Qin manuscripts acquired in 2010 by Peking University. The authors refer to the technique as *suozi kou fangshi* 鎖子扣方式,[60]

58 Cheng Pengwan 2017, 42; Ma Zhiquan 2020, 287–289; Zhang Xiancheng 2004, 123. While it might seem that the scroll in the illustration by Andrews was bound the other way round, from left to right, the direction is in fact identical, since his drawing shows a scroll from the back side.

59 Tomiya Itaru 2003, 72–79. The main basis for this hypothesis is the placement of titles, which most frequently occur on the back side of one of the first few slips in the case of scrolls with literary works. In order not to render these titles invisible once the scroll is stored, it would be most reasonable to roll these scrolls up from the end. This in turn means that additional string to tie the rolled-up manuscript together should be left at the beginning, not the end. Also see Giele and Peltzer 2015, 687–689.

60 Beijing daxue chutu wenxian yanjiusuo 2012a, 37.

literally 'chain-knot method' (cf. the Chinese term *suozi jia* 鎖子甲 for 'chain mail') and provide three drawings for illustration (see Fig. 7).[61]

This technique of applying the binding strings to the slips visually resembles another basic sewing technique commonly called 'chain-stitch' (see Fig. 8).[62]

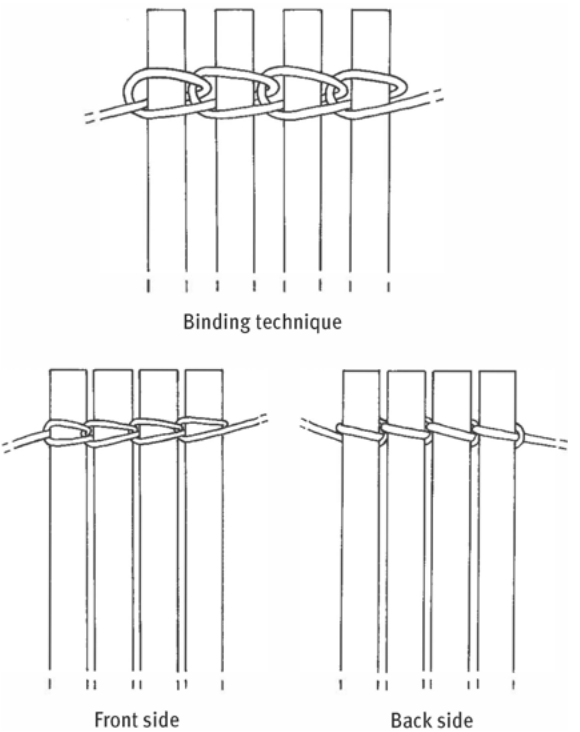

Fig. 7: Reconstructed binding technique employed for the Qin bamboo and wood slips in possession of Peking University.

61 Images in Fig. 7 below reproduced from Beijing daxue chutu wenxian yanjiusuo 2012a, 41 (Fig. 25) (captions translated by author).

62 Emery 1966, 243. I would like to thank Georgios Boudalis for pointing this out to me. As is the case for a particular binding technique of codex manuscripts, which Boudalis discusses in one of his works (Boudalis 2018, 53), the similarity to the chain-stitch sewing technique here is purely visual rather than structural or functional. Chain-stitch in sewing is normally used to decorate already made fabric, whereas, in the case of the binding, it is the very technique through which a structure is created. The same is the case for the double running stitch mentioned above. The images in Fig. 8 were originally published in Boudalis 2018, 53 (Fig. 30).

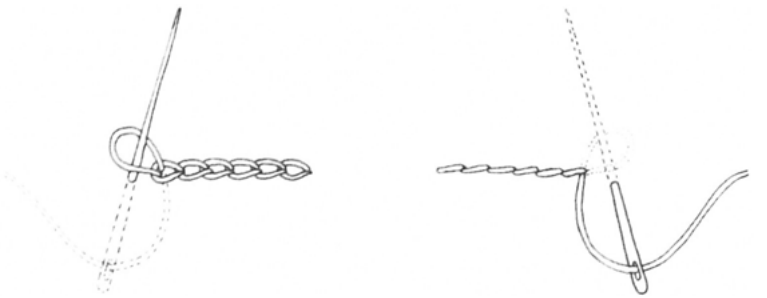

Fig. 8: Chain-stitch. Images courtesy of Georgios Boudalis.

Utilising this method, wherever a binding string is attached to a slip, two lines of the string are visible on one side, but only one line on the other side. In Fig. 7 above, the slips' front side (the side normally carrying writing) shows two lines, the back side one. A survey of bamboo and wood slips that were originally part of scrolls and excavated from various archaeological sites hints towards the possibility that this chain-stitch technique of binding may have been quite common. At least, there are numerous examples of slips that show traces of two lines of string on the front side, at the positions where binding strings were attached to the slips. These include slips excavated from Guodian 郭店 tomb no. 1,[63] Shuihudi 睡虎地 tomb no. 11,[64] Zhoujiatai 周家臺 tomb no. 30,[65] Fenghuangshan 鳳凰山 tombs no. 8 and 168,[66] Zhangjiashan 張家山 tomb no. 247,[67] Kongjiapo 孔家坡 tomb no. 8,[68] and Zoumalou 走馬樓 well no. 22.[69] See Fig. 9 below for an example.[70]

63 See, for example, Jingmen shi bowuguan 1998, 90, slips 19–24 (middle/bottom).

64 See, for example, Shuihudi Qinmu zhujian zhengli xiaozu 1990, 29 (plates section), slips 170–171 (middle) or 124 (plates section), slips 62–63 (top).

65 See, for example, Chen Wei 2014, 129, slips 151–154 (bottom).

66 See, for example, Hubei sheng wenwu kaogu yanjiusuo 2012, 38, slips 97–100 (top/bottom) or 194, slips 48–49 (top/bottom).

67 See, for example, Zhangjiashan er si qi hao Hanmu zhujian zhengli xiaozu 2001, 9, slips 28–33 (middle); 60, slips 94–96 (middle/bottom) or 88, slips 61–65 (top/bottom).

68 See, for example, Hubei sheng wenwu kaogu yanjiusuo and Suizhou shi kaogudui 2006, 85–86, slips 207–213 (top/middle/bottom).

69 See, for example, Changsha jiandu bowuguan, Zoumalou jiandu zhenglizu and Beijing daxue lishixi 2007, 414, slips 4660–4664.

70 Image reproduced from Hubei sheng wenwu kaogu yanjiusuo and Suizhou shi kaogudui 2006, colour plate 6.

Still, it is not entirely certain whether the chain-stitch method was employed in any of the examples above for two reasons. Firstly, we are always dealing with traces of binding strings on individual slips only, as the connections between slips have been lost due to decay. Secondly, photographs of the slips' back sides have not been published for any of the examples mentioned. Hence, it is impossible to verify whether the back sides of these slips show only one line of string, as would be expected for this technique.

Fig. 9: Part of a reconstructed bamboo scroll with hemerological contents, mid-second century BCE, excavated from Kongjiapo tomb no. 8. Wuhan, Hubei Provincial Museum, Hubei Provincial Institute of Cultural Relics and Archaeology, MS *Rishu* 日書 ('Daybook'), slips 205–217, right to left.

A glance at the cache of unprovenanced Qin bamboo and wood slips now in possession of the Yuelu Academy, for which photographs of the back side of all slips have been published, shows that even these will not necessarily yield unambiguous evidence. The front side of many slips shows two lines of string at the positions where binding strings were attached and some of these, in fact, have one line of

binding string on their back.[71] However, the back side of others does not bear any traces of binding strings, although it is clear that strings must have surrounded the slips in some way.[72] There are also slips whose back side shows two lines of binding string – just like the front side.[73] Possible explanations for these phenomena are that lengths of binding string may have been (accidentally) removed from the slips during preservation treatment or that lengths of string stuck to slips other than those to which they had originally been fastened. In sum, the evidence for the chain-stitch method from manuscripts other than those of Peking University is still inconclusive, although it is at least certain that a technique different from the one resembling the double running stitch (see above) must have been employed. This means that at least two different techniques of fastening the binding strings to slips were in use for bamboo or wood scrolls in ancient China.[74] More research, ideally including experiments with scroll replicas, is needed to determine the respective pros and cons of the different binding techniques regarding durability or ease of application and handling.

Before moving on to the discussion of the number of binding strings observable on scrolls, one more note is due on the binding techniques. While checking various publications with reproductions of bamboo and wood manuscripts for evidence of the chain-stitch method, more specifically for slips with the matching two lines of string on the front side, it became clear that the orientation of these two lines of string differs from manuscript to manuscript. The two lines of string usually form an arrow-like shape as they seldom appear entirely parallel. In some cases, this arrow would point to the right (>, as in Fig. 7), in other cases to the left (<, as in Fig. 9). It has been observed regarding chain-stitch that 'the direction of sewing is away from the pointed end of each loop' (also see Fig. 8).[75] Provided that the same can be assumed for the binding technique that closely resembles chain-stitch, this would mean that the orientation

71 See, for example, Zhu Hanmin and Chen Songchang 2010, 95, slip 13 (bottom); 114, slip 13 (bottom); 143, slip 76 (bottom).

72 See, for example, Zhu Hanmin and Chen Songchang 2010, 117, slip 19 (bottom); 122, slip 31 (bottom).

73 See, for example, Zhu Hanmin and Chen Songchang 2010, 47–48, slips 2–3, 5 (bottom); 111, slip 6 (bottom).

74 In some cases, this string binding may have been reinforced by pieces of fabric pasted to the front and/or back side of scrolls. For hints towards this practice in the bamboo manuscripts excavated from Fangmatan 放馬灘 tomb no. 1, see He Shuangquan 1989, 23. Most of the 460 bamboo slips have remains of blue fabric with which the bindings of (one or several of) the scrolls seem to have been reinforced.

75 Boudalis 2018, 53.

of the traces of binding strings allows to determine the sequence in which the slips were bound. Basically, the direction of binding would have been the opposite of the direction in which the arrow shapes are pointing. Following this, it would have to be concluded that the 'Daybook' scroll from Kongjiapo tomb no. 8 (see Fig. 9) was bound from the end towards the beginning (left to right). By contrast, the slips shown in the diagram of the Peking University slips (see Fig. 7) should have been bound from the beginning towards the end (right to left) of the respective scroll.[76] A brief survey of the examples of slips with two lines of string on the front side mentioned above, which were excavated from different tombs, suggests that both directions of binding were about equally common. A more extensive survey of this feature could provide an opportunity to test the hypothesis mentioned above regarding a correlation between the direction of binding and the content of the manuscripts.

While the direction of these arrow-shaped binding traces is often consistent within the same manuscript – or what is deemed to be one manuscript based on reconstruction – this is not always the case. The direction of the binding traces varies, for example, on the 'Daybook' slips from Kongjiapo tomb no. 8, which supposedly originally formed one scroll of nearly five hundred slips.[77] While the arrow-shaped traces point right on slips 141–150, 321–330 and 351–360,[78] they point left on slips 171–180[79] and 205–217 (see Fig. 9). There should not generally be a change in the binding direction for slips that were bound together during the same process and all slips should show identical traces. If that is not the case, the differently oriented traces probably reflect distinct binding processes. This might occur within the same scroll if it was put together as a composite from formerly independent scrolls that had all been bound separately, possibly in different directions, and were joined without replacing the earlier binding strings.[80] Another explanation could be that a scroll, especially if it was to con-

76 These statements presuppose that the writing was applied to the slips *before* the binding, which was probably the case. If not, a prebound scroll could, of course, be turned both ways before the writing would eventually determine where the scroll begins and ends.

77 For the statement that the slips' position in the tomb suggests that they originally formed one scroll, see Hubei sheng wenwu kaogu yanjiusuo and Suizhou shi kaogudui 2006, 29. For images of the reconstructed scroll of 478 slips, see Hubei sheng wenwu kaogu yanjiusuo and Suizhou shi kaogudui 2006, 65–112.

78 See Hubei sheng wenwu kaogu yanjiusuo and Suizhou shi kaogudui 2006, 79, 97, and 100, respectively.

79 See Hubei sheng wenwu kaogu yanjiusuo and Suizhou shi kaogudui 2006, 82.

80 For a prominent case, a wood scroll from the late first century CE that was formed from four originally independent units, see Hou Xudong 2014, 60–61. Such evidence for composite man-

tain a large number of slips, may have been bound in several stages. This would, at least in theory, allow for different directions of binding for the parts.[81]

4.2 Number of binding strings and visual organisation

The number of binding strings that were used to produce a scroll depended mostly on the slip length, which also defined the 'height' of the scroll. Scrolls with originally two to five binding strings have been found to date.[82] As a rule, the longer the slips, the higher the number of binding strings that were employed. Early finds made at the Mozuizi 磨嘴子 (also written 磨咀子) tombs nos 6 and 18 in 1959 provide an illustrative example. The excavations yielded several groups of slips that differed regarding length and the number of bindings strings (see Table 1).

Table 1: Bamboo and wood slips excavated from Mozuizi tombs nos 6 and 18[83]

Group of slips	Material	Length	Number of binding strings
A (*Jia ben* 甲本)	wood	*c.* 55.5–56 cm	4
B (*Yi ben* 乙本)	wood	*c.* 50.5 cm	4
C (*Bing ben* 丙本)	bamboo	*c.* 56 cm	5
Riji zajian 日忌雜簡	wood	*c.* 23 cm	2
Wang zhang shi jian 王杖十簡	wood	*c.* 23 cm	3

uscripts is extremely rare due to the generally poor preservation conditions of bamboo and wood scrolls.

81 Compare the case of the so-called *Xinian* 繫年 'Linked years' scroll from the collection of Tsinghua University, which comprises 138 bamboo slips. Based on small differences regarding the position of the binding strings, Xiao Yunxiao (2015, 75–79) has suggested that it was bound in several stages.

82 Cheng Pengwan 2017, 43–45. Cheng also mentions two examples where a scroll seems to have been formed with the help of only one binding string. However, it has been argued for one of these, the list of funerary goods found in Zhangjiashan tomb no. 247, that the position of the binding string at about one-third of the length from the slips' top suggests that the application of two binding strings had been planned but that the binding was left unfinished for some reason. For the other example, similarly a list of funerary goods (from Fenghuangshan tomb no. 167), conflicting observations – only one vs two binding strings – have been made based on the original manuscripts. See Cheng Pengwan 2017, 45, n. 1; Feng Yicheng 2009, 360, n. 2.

83 Data based on Chen Mengjia 1964, 56, 59.

As can be seen, slips with a length of 23 cm had only two or three strings, whereas slips with a length of more than 50 cm had four or five. At the same time, the slip length was obviously not the only factor that influenced the number of binding strings, as this varied between scrolls produced from slips of the same length. It has been suggested that an additional binding string may have been used for the slips of group C (if compared to groups A and B), because bamboo slips are not as hard as wood slips.[84] Similar to the ratio between the slip length and the number of binding strings, this would certainly concern the stability of a scroll as a material object.

While there are obviously examples of bamboo and wood scrolls with four or five binding strings, it has to be stressed that scrolls with two or three binding strings are *by far* the most commonly encountered form.[85] This is because comparatively few slips exceeded a length of roughly 46 cm/two feet (see above), probably because scrolls would otherwise be too unwieldy. In addition, distances between binding strings of 7 up to 20 cm appear to have been acceptable; the maximum distance between the edges of the slips and the outermost binding strings was usually smaller but could also reach 10 cm or more. Scrolls with an uncommonly low number of binding strings in relation to slip length are most frequently encountered in the form of lists of funerary goods. Such scrolls were certainly produced specifically for the purpose of placing them in tombs rather than for frequent consultation, i.e. rolling and unrolling, or for carrying them around.[86] For these kinds of objects, a less robust design seems unproblematic.

A comparison of scrolls with two and three binding strings shows that the number of binding strings is closely tied to the visual organisation. Scrolls with three binding strings normally had one string running over the middle of the slips and one each over their top and bottom end, respectively. Hence, the writing surface was horizontally divided into two parts of equal size, while the space of 1 to 2 cm above the first and below the third string served as the top and bottom margin (see Fig. 10, right).[87] This area would normally contain only cer-

84 Chen Mengjia 1964, 59.

85 See the specimens collected in Cheng Pengwan 2017, 344–388 (Appendix 2). The three groups of slips cited in Table 1 are, in fact, almost the only examples of scrolls with four or five binding strings. See Cheng Pengwan 2017, 43–44.

86 See, for example, the four lists from Baoshan 包山 tomb no. 2. These scrolls consisted of slips measuring between 65 and 72 cm in length and were bound with only two or three binding strings. See Hubei sheng Jing Sha tielu kaogudui 1991, 3–14.

87 In fact, all known scrolls with more than three binding strings also have a top and bottom margin above the first and below the last binding, respectively. See Cheng Pengwan 2017, 43–45; Venture 2014b, 354; Zhang Xiancheng 2004, 119–120.

tain types of paracontent[88] such as (sub-)titles, marks or collation notes. The presence of bindings near the top and bottom end of the slips not only created a 'natural' margin, it probably also made a scroll sturdier and more suitable for frequent use.[89] In addition, placing two binding strings 'out of the way', also meant that the writing surface would only be interrupted once, which must have seemed preferable especially for recording larger units of continuous text.

By contrast, scrolls with only two binding strings normally had strings running at the positions of about one-third and two-thirds of their length (from the top). This way, the writing surface was horizontally divided into three parts of roughly equal size, without leaving any space designated for an upper or lower margin (see Fig. 10, left). Accordingly, while such margins are present on most scrolls with three binding strings, they are very rare on scrolls with only two binding strings (see Table 2).[90]

88 On 'paracontent' as an extension of the concept of 'paratext', see Ciotti et al. 2018.

89 Richter (2013, 27) states: 'The most frequent type of loss of text occurs in manuscripts that are not bound at the top and bottom ends but only further toward the middle of the slips. The longer the top and bottom ends of slips outside the bindings are, the more easily they can break off.' By contrast, Ma Zhiquan (2020, 287) speculates that the binding might be especially durable if strings are *not* placed so close to the top or bottom end of the slips.

90 Of course, there are exceptions to the rule: it has already been noted that scrolls with three bindings could come either with or without margins (Cheng Pengwan 2017, 44–45; Zhang Xiancheng 2004, 120). In the latter case, the three binding strings divided the writing surface into four parts of roughly equal size, as is the case, for example, with the so-called *Kongzi shilun* 孔子詩論 'Confucius's Discourse on the Odes' scroll from the Shanghai Museum collection. This type of scroll with three binding strings but no margins often consisted of comparatively long slips measuring no less than 46 cm, more commonly above 55 cm. By the same token, there are a few examples of scrolls with two binding strings that, at the same time, have upper/lower margins, none of which are demarcated by binding strings. For an overview that gives an impression of the comparatively low number of these two types of scrolls vis-à-vis the much more common types 'three bindings with margins' and 'two bindings w/o margins', see Cheng Pengwan 2017, 344–388 (Appendix 2).

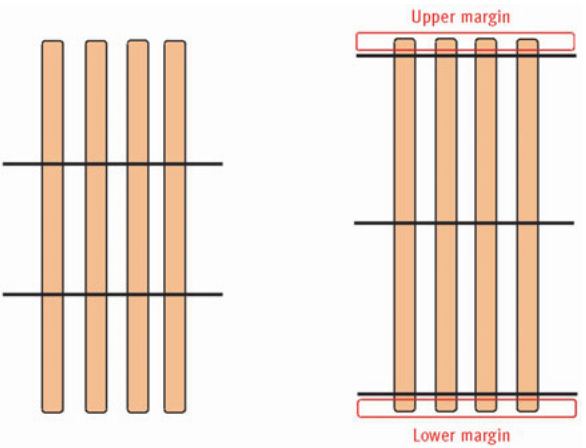

Fig. 10: Typical visual organisation on scrolls with two and three binding strings (illustration by the author).

Table 2: Statistics on the number of binding strings in relation to slip length and occurrence of margins[91]

Number of binding strings	Scrolls (overall)	Slip length (range, cm)	Slip length ≤ 23 cm	Slip length > 23 cm	w/o margins	with margins
2	66	12.8–75	20 (30 %)	46 (70 %)	58 (95 %)	3 (5 %)
3	107	15.1–72.3	10 (9 %)	97 (91 %)	18 (17 %)	87 (83 %)
4	2	50.5–56	-	2 (100 %)	-	2 (100 %)
5	1	56.5	-	1 (100 %)	-	1 (100 %)
Σ	176	N/A	30 (17 %)	146 (83 %)	76 (45 %)	93 (55 %)

Notably, two binding strings (and slips with a length of *c.* 23 cm/one foot) seem to have been the standard for scrolls produced in administrative contexts for most of

91 Data based on Cheng Pengwan 2017, 344–388 (Appendix 2). The table only includes scrolls for which Cheng Pengwan provides data on the number of binding strings. These amount to a total of 176 (the two doubtful examples of scrolls with only one binding string were not taken into consideration, also see note 82 above). For seven of these scrolls, no data on margins is given (five scrolls with two binding strings, two scrolls with three binding strings). Hence, this number was subtracted from the total number of scrolls for the calculation of the percentages in the two columns on margins.

the Han period. This is shown both by extant documents and 'yardsticks' or 'rulers' (referred to as *biao chi* 標尺 in Chinese scholarship) that served as reference materials for determining the position of binding strings (see Fig. 11).[92]

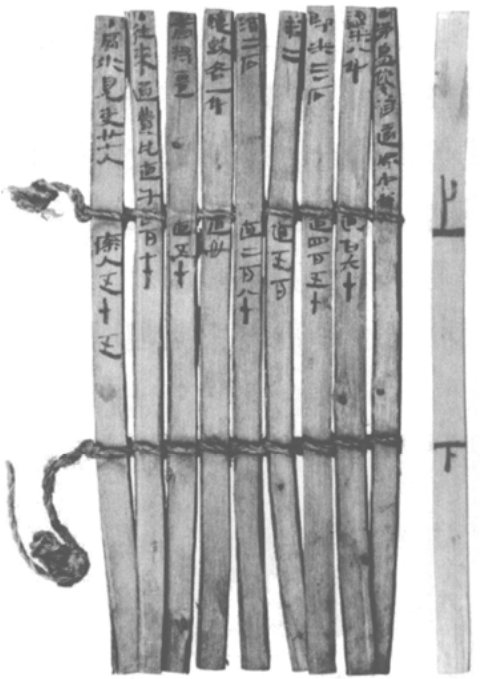

Fig. 11: Wood scroll (Lanzhou, Gansu Jiandu Museum, MS 73EJT21:2–10) with two binding strings and yardstick/ruler (Taipei, Academia Sinica, MS Juyan Hanjian 7.26) placed beside it.

A comparison with scrolls mostly from non-administrative contexts (see Table 2 above) shows that two-thirds (or twenty out of thirty) of the scrolls with slips of

92 Ma Zhiquan 2020, 293. On yardsticks/rulers from the Han period, see Lin Su-ching 1998 who discusses several wood slips on which only the characters 上 and 下 were written (see example in Fig. 11). Apparently, the horizontal strokes of these two characters divided the writing surface into three registers of equal size and possibly also indicated the later position of binding strings. It was more recently discovered that some wood slips that belonged to administrative scrolls have brushed marks on their sides, which may have been done with the help of such objects; see Shih Sheng-shiuan 2017. For bronze, stone, wood, etc., 'rulers' from the Han period, see Qiu Guangming 1992, 12–53. Image in Fig. 11 reproduced from Ma Zhiquan 2020, 287 (Fig. 1).

up to 23 cm length were similarly bound with two binding strings.[93] While a significant group of one-third was bound with three binding strings, even if slips were in some cases only between 15 and 18 cm long, this way of enhancing the stability of scrolls seems to have been unusual for administrative documents.[94] The most likely reason for this is the attempt to economise the material and labour costs of their production. The scrolls produced in the administration were obviously sufficiently stable with only two binding strings. This also suggests that they were neither tailored towards a particularly pleasant visual appearance – margins were certainly not the rule – nor long-term intensive use, apart from potential storage in an archive.

5 Conclusions

The poor state of preservation of ancient Chinese bamboo and wood scrolls often makes it impossible to study these artefacts in their intact form, allowing us to view the whole only on the basis of its parts. By gathering the piecemeal information that is available on their production and form, especially their bindings, the above survey has traced some typical features of scrolls. It addressed the ways in which slips were prepared before tying them together in a scroll, the materials that were used for the binding strings, different techniques by which the strings were applied to the slips, as well as the relationship between the number of the binding strings and visual organisation.

The topic of bamboo and wood scrolls and their bindings certainly warrants further research and could especially benefit from statistical codicology.[95] While this paper has indicated some possible lines of inquiry, a more extensive study would be well beyond the purview of a single article. Further analysis of certain features, such as the exact shape and orientation of the traces of binding strings

93 As has already been noted by Ma Heng (1926, 204), the earliest forms of the character 冊 (see Fig. 1 above) also resemble a scroll with exactly two binding strings.

94 See three of the so-called *Yu cong* 語叢 'Thicket of Sayings' scrolls with collections of aphorisms from Guodian tomb no. 1 (cf. Cheng Pengwan 2017, 369–370). Matthias Richter (2013, 28) argued: 'By using three instead of two binding strings, the producers [...] created narrow margins on the top and bottom ends of the slips, so that even if any of these short ends broke off, no text would be lost. By this method these manuscripts secure their text most effectively.' Loewe (1967, vol. 1, 34) mentions that at least some administrative scrolls seem to have had three binding strings.

95 For a recent example of this approach, focused on European codices, see Maniaci 2022.

on individual slips, might help to shed more light on binding techniques and the direction of binding. However, the relevant data would first have to be collected. This is not only time-consuming but also dependent on the quality of reproductions, which is often too low, especially in publications predating the turn of the century.

Another major caveat is that we often simply cannot judge whether two groups of slips with identical codicological features but perhaps distinct contents were originally part of the same scroll or whether they constituted two separate scrolls.[96] The latter would be the default assumption in most editions and scholarly literature, unless there is evidence suggesting otherwise. Accordingly, the number of 176 'scrolls' for which data on the number of binding strings and slip length is presented in Table 2, is probably too high. However, bearing in mind that this generally applies to all types of scrolls, this will hardly change the basic conclusions drawn in the respective section. It is hoped that future manuscript finds together with the increasing standards in both the archaeological documentation and publication of manuscript facsimiles will bolster this promising line of research.

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96 On this problem, see Liu Chuanbin 2014. This is especially true for manuscripts that were not archaeologically excavated and hence usually lack information on the exact original positions of the slips *in situ*.

Beijing daxue chutu wenxian yanjiusuo 北京大学出土文献研究所 (2012b) 'Beijing daxue cang Qin jiandu gaishu' 北京大学藏秦简牍概述, *Wenwu* 文物, 6: 65–73.
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