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Gandhāran Scrolls: Rediscovering an Ancient Manuscript Type¹

1 Introduction

Recent discoveries in ancient Gandhāra and its cultural sphere (modern eastern Afghanistan and northern Pakistan) have brought to light a wealth of new material evidence for the oldest indigenous manuscript type of this region: birch-bark scrolls in a range of formats, the large majority of them inscribed with Buddhist texts in the Gandhari language (a Middle Indian dialect descended from Sanskrit and related to Pali and the Prakrits) and Kharosthī script (an adaptation of the Aramaic script for the writing of Indian texts).² Prior to these new discoveries, only one single manuscript of this kind was known to scholarship – a long scroll containing a Gāndhārī version of the *Dharmapada*, found outside the center of Gandhāran culture near Khotan on the Southern Silk Road (Brough 1962) - but stray reports (summarized in Salomon 1999, 57-68) had already made it likely that a substantial number of Gandhāran scroll manuscripts had once existed and might be recovered. This process of recovery is now well underway and shows no signs of abating, new discoveries of Gāndhārī manuscripts and inscriptions being announced at frequent intervals. Restricting ourselves to those manuscripts that at this point have received at least a preliminary description in print, we now know of more than 89 Gandhāran birch-bark scrolls written by more than 51 different scribes and containing approximately 115 distinct texts from a wide range of literary genres (including sūtras, canonical verse texts, vinaya texts, stotras, episodes from the life of the Buddha, accounts of previous and future buddhas, story collections, commentaries on canonical texts, scholastic treatises, Mahāyāna sūtras, magical texts, a verse abecedary, a treatise on statecraft, a letter and a text inventory). One of these sūtras (BL 6, see section 6) is written in Sanskrit

¹ Thanks are due to Ingo Strauch (Lausanne) for access to unpublished material in the Bajaur Collection, to Reinhard Lehmann (Mainz) for information on the Aramaic scribal tradition, and to Jan-Ulrich Sobisch (Copenhagen) for inviting me to present the paper from which this article evolved. It was completed at Bukkyo University in Kyoto, and I would like to thank the Bukkyō Dendō Kyōkai for making this visit possible as well as my colleagues in Kyoto for providing such a friendly and productive environment.

² The following abbreviations are used to refer to this material: BC (Bajaur Collection), BL (British Library Collection), Dhp-G^K (Gāndhārī *Dharmapada* from Khotan), LC (Library of Congress scroll), RS (Robert Senior Collection) and SC ('Split' Collection).

using the Brāhmī script, and the treatise on statecraft is written in Sanskrit using the Kharosthī script. The exact findspots and archeological contexts of the large majority of these scrolls are regrettably unknown because they were not found in archeological excavations, but only reached scholars after being traded on the art market; only the provenience of the Bajaur collection can be established more or less reliably from information provided by the finder. On the basis of palaeographic and linguistic features as well as radiocarbon analysis, the scrolls can be dated to the 1st and 2nd centuries CE, and there are indications that at least some of them are as old as the 1st century BCE (Salomon 1999, 141–155, Allon/ Salomon/Jacobsen/Zoppi 2006, Falk 2011, 19–20). In addition to these more than 89 Gandhāran birch-bark scrolls, discoveries at Bamiyan in central Afghanistan have produced around 275 fragments of palm-leaf manuscripts in Kharosthī script, written by ca. 50 scribes and containing an undetermined number of texts; a few further specimens of such palm-leaf manuscripts were found in Central Asia at the beginning of the 20th century (Salomon 1998, Vorob'eva-Desiatovskaia 2006). Table 1 provides an overview of the scroll and Kharosthī palm-leaf material now at our disposal (updating the table in Salomon 2009, 33).

Sections 3–5 of this article provide a comprehensive description of the construction and use of Gandhāran scrolls, on the basis of a detailed investigation of ten well-preserved published scrolls supplemented by information from the body of unpublished material.³ Section 6 presents a new hypothesis concerning the origin of this format.4

2 Source material

The ten scrolls forming the focus of this study were found in three different manuscript deposits. Six of them (BL 1, BL 5B, BL 9, BL 12 + 14, BL 13 and BL 16 + 25) were among the first new discovery of Gandhari manuscripts, in a clay pot from a Dharmaguptaka monastery (Salomon 1999, pl. 5), and were acquired by the British Library in 1994; they probably date to the 1st century CE. Three more scrolls (RS 5, RS 14, RS 19) belong to the second new discovery, in a clay pot bearing a relic-ded-

³ The following seven scrolls have been published but are too fragmentary to be used as core material for this study: BL 2 (Lenz 2010, 95), BL 3A (Lenz 2010, 105), BL 3B (Baums 2009, 269), BL 5A (Salomon 2000, 218), BL 7 (Baums 2009, 67-69), BL 18 (Baums 2009, 67-69) and BL 21 (Lenz 2010).

⁴ The principal earlier discussions of the Gandhāran scroll format are Senart 1898, 198–200, Kaye 1927, 7–10, Janert 1955/56, 65–74 and Brough 1962, 18 (Khotan Dharmapada), Salomon 1999, 87–109 (Khotan *Dharmapada* and BL Collection) and Strauch 2008, 106–108 (Bajaur Collection).

Tab. 1: Overview of Gandhāran scrolls and Kharoṣṭhī palm-leaf manuscripts

Collection or manuscript	Provenience and date	Contents	Container	References
British Library Collection	unknown 1st c. CE(?)	28 birch-bark scrolls by 21 scribes	clay pot donated to a Dharmagup- taka monastery	Salomon 1999, Salomon 2014, 4–6
Bajaur Collection	Mian Kili, Dir, Pakistan 1st c. CE(?)	18 birch-bark scrolls by 18 scribes	rectangular stone compart- ment in monas- tery	Strauch 2008, Falk/Strauch 2014
Library of Congress scroll	unknown 1st c. CE(?)	one birch-bark scroll by two scribes	unknown	Salomon/Baums 2007, Salomon 2014, 8-9
'New' or 'Split' Collection	unknown 1st – 2nd c. CE	more than 16 birch-bark scrolls by more than seven scribes	unknown	Baums 2009, 38–39, 42, Allon/ Salomon 2010, 11, Falk 2011, Salomon 2014, 9–10, Falk/ Strauch 2014
Senior Collection	unknown 2nd c. CE	24 birch-bark scrolls by one scribe	clay pot with relic-donation inscription	Salomon 2003, Allon 2007, Allon 2014
Khotan Dharmapada	Kohmari Mazar, Xinjiang, China 2nd c. CE(?)	one birch-bark scroll by one scribe	next to clay vessel in cave	Brough 1962
University of Washington scroll	unknown 2nd c. CE(?)	one birch-bark scroll by one scribe	unknown	Glass 2004, 141–142, Cox 2014, 39
Bamiyan fragments	Bamiyan, Afghanistan 2nd – 4th c. CE	ca. 275 palm-leaf fragments by ca. 50 scribes	unknown	Allon/Salomon 2000, Salomon 2014, 6–8
Pelliot and Ol'denburg fragments	Northern Silk Road, Xinjiang, China 2nd – 4th c. CE	nine palm-leaf fragments by four or more scribes	unknown	Salomon 1998, Vorob'eva-Desia- tovskaia 2006

ication formula dated to the year 12 (probably of the Kanişka era, and thus corresponding to 140 CE), and are part of the private collection of Robert Senior. The tenth scroll (Dhp-G^K) was discovered in 1892 near Khotan and is now preserved partly in the Bibliothèque nationale de France in Paris, partly in the Institute for Eastern Manuscripts of the Russian Academy of Sciences in St. Petersburg; it probably dates to the 2nd century CE.

It is apparent at first glance that these scrolls have two different physical formats. Five of them (BL 1, BL 9, BL 12 + 14, BL 13 and Dhp-G^K) are narrow but long, with widths ranging from 14 to 21 cm and original heights of up to 250 and 500 cm (in the two cases where this can be estimated reliably; Figure 1). The other physical type (BL 5B, BL 16 + 25, 5 RS 5, RS 14 and RS 19) consists of somewhat wider but much shorter scrolls, with widths from ca. 20 to 27 cm and heights from 17.2 to 44.4 cm (Figure 2). These manuscripts contain a variety of textual genres that do not have any obvious correlation with their physical types: two collections of sūtras (BL 12+14, RS 5) and one individual sūtra (RS 19), four canonical verse texts (BL 1, BL 5B, BL 16 + 25, RS 14), and one commentary on an anthology of canonical verses spread over at least three scrolls, two of which (BL 9, BL 13) are included in this study. In four of the scrolls, the primary text is followed by a secondary text: another verse commentary on scroll BL 13, and story sketches on scrolls BL 1, BL 12 + 14 and BL 16 + 25. The primary texts of these scrolls were produced by five different scribes; a sixth scribe added the story sketches to scrolls BL 1, BL 12 + 14 and BL 16 + 25, and a seventh scribe added the second commentary to scroll BL 13 (see Table 2 for further details).

⁵ The extant portion of this scroll consists of a single sheet with a width of 23 cm and a preserved height of 40.5 cm, placing it squarely in the range of the short-format scrolls. Its overall proportions most closely resemble those of scroll BL 5B from the same manuscript deposit (Table 2 and Figure 3). Lenz 2003 does not discuss the construction of the scroll, but needle holes are clearly visible to the left of lines 18, 21-22, 25, 29-37, 41-43 and 46 on his plates 6 and 7. While stitched margins are more typical of long-format scrolls, they do occur with short-format scrolls, and one of the two other clear examples is again scroll BL 5B (section 3). The content of scroll BL 16+25 corresponds to the last thirteen verses of the second chapter of the Khotan Dharmapada, providing a parallel with the short-format scroll RS 14 which contains the first chapter of the Anavataptagāthā and probably formed the first of a set of scrolls (Salomon 2008, 10-11, 330-331). If scroll BL 16 + 25 was also part of a set, inscribed on the recto only and containing the first two chapters of a Dharmapada (pace Norman 2004, 118-119; section 4), then the lost text requiring ca. 89 cm of vertical space – can be distributed between two lost scrolls with a height of 43 cm each and a lost strip with a height of 3 cm at the top of BL 16 + 25, resulting in three evenly-sized scrolls with a height very close to that of BL 5B. Finally, BL 16 + 26 was clearly folded in half horizontally (Lenz 2003, 3-4), another characteristic of short-format scrolls (section 5).



Fig. 1: Long-format Gandhāran scroll BL 9 (Baums 2009, pl. 3–9).



Fig. 2: Short-format Gandhāran scroll RS 5 (Glass 2007, pl. 1).

3 Production

The raw material of Gandhāran scrolls was the periderm of one or more birch species (especially Betula utilis).⁶ This living tissue separates the dead outer bark of the tree from the living inner bark and itself consists of three functional layers: cork tissue, cork cambium and cork cortex (Yamauchi 2009, 15–16). Embedded in and crossing through these layers are numerous lenticels, porous areas that have

⁶ Previous discussions include Bühler 1877, 1896, 88, Janert 1955/56, 65–72 and Vorob'eva-Desiatovskaia 1987–88, 27–38.

the shape of narrow horizontal ellipses and that are responsible for the exchange of gases between the environment and the inner bark of the tree. The periderm of the tree stem is further crossed by the wooden tissue of twigs that grow out of it.

The use of bark as writing material in early Gandhāra is confirmed by the Roman historian Curtius Rufus, who in the 1st century CE writes in his history of Alexander the Great:

libri arborum teneri haud secus quam chartae litterarum notas capiunt.⁷

A passage from the Mākandikāvadāna (in the Mūlasarvāstivādavinaya and the Divyāvadāna) lists birch bark and writing utensils that are used at a recital of Buddhist texts, presumably to reduce part of the oral transmission and explanation to writing:

etā dārikā rātrau pradīpena buddhavacanam pathanti. atra bhūrjena prayojanam tailena masinā kamalavā tūlena.8

Writing on birch bark is most famously evoked in classical Sanskrit literature by Kālidāsa at the beginning of his *Kumārasambhava*, where the Himālaya is described as:

nyastākṣarā dhāturasena yatra bhūrjatvacaḥ9

and, especially, in the second act of his drama Vikramorvaśīya, where the heroine Urvaśī uses an improvised birch-bark letter to confess her love to the king who on receiving it exclaims:

bhūrjapattragatoyam akṣaravinyāsah10

(see Janert 1955/56, 65–66 for further details of the description of the bark in this passage).

^{7 &#}x27;(Sheets of) tree bark, hardly less supple than (papyrus?) sheets, capture the records of literature.' - It is unclear whether this was the case in the time of Alexander himself or is an anachronism introduced by Curtius Rufus on the basis of contemporary practice; cf. section 6 on Nearchus's reference to cloth letters.

^{8 &#}x27;These girls recite the word of the Buddha at night by lamplight. Birch bark, oil, ink, a pen and cotton are needed for this.'

^{9 &#}x27;Where birch skins are inscribed with letters by means of mineral liquid.'

^{10 &#}x27;It is an inscription of letters on a birch sheet!'

Tab. 2: Overview of ten Gandhāran scrolls	(arranged by width)	
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	Dimensions (cm)	Construc- tion	Scribes	Content	Description
BL 9	14 × 118.6 + x	multi- sheet	BL scribe 4	commentary	Baums 2009, 67-69
BL 13	14 × 70.3 + x	multi- sheet	BL scribe 4, BL scribe 14	commentary,	Baums 2009, 67-69
BL 1	15.1 × ca. 250 ¹¹	multi- sheet	BL scribe 1, BL scribe 2	Anavataptagāthā, story sketches	Salomon 2008, 83–87, Lenz 2010, 51 ¹²
BL 12 + 14	ca. 15.5 × 76 + <i>x</i>	multi- sheet	BL scribe 1, BL scribe 2	three <i>Ekottarikāgama</i> sūtras, story sketches	Allon 2001, 42–45
Dhp-G ^K	21 × ca. 500	multi- sheet	Dhp-G ^K scribe	Dharmapada	Brough 1962, 18–19, Salomon 1999, 96–98 ¹³
RS 14	ca. 20 × ca. 30	single- sheet	RS scribe	part of Anavataptagāthā	Salomon 2008, 329-330
BL 16 + 25	23 × ca. 43(?)	single- sheet(?)	BL scribe 1, BL scribe 2	part of <i>Dharmapada</i> , story sketches	Lenz 2003, 3-7
RS 5	26.8 × 27.6	single- sheet	RS scribe	four <i>Saṃyuktāgama</i> sūtras	Glass 2007, 72-73
RS 19	20.9 × 17.2	single- sheet	RS scribe	one <i>Saṃyuktāgama</i> sūtra	Lee 2009, 3
BL 5B	27 × 44.4	single- sheet	BL scribe 9	Khaḍgaviṣāṇasūtra	Salomon 2000, 23–27

¹¹ The preserved part of this scroll measures 159.8 cm in height (Salomon 2008, 84), and it cannot be ruled out that this represents most of its original size, which would make it the second of a set of two scrolls, originally inscribed with the Anavataptagāthā on one side only, with story sketches added later on the empty spaces of at least the second scroll. This would provide a better match of scroll BL 1 with the general pattern of the British Library Collection, in which most or all of the scrolls appear to have fallen well short of 200 cm in length and where in all clear cases only small amounts of material are missing from the tops of scrolls, but in the absence of positive evidence for such a disposition of scroll BL 1 and pending further reconstructions of scrolls from the British Library Collection, the editor's proposal is tentatively followed here.

¹² The dimensions given by Salomon and Lenz differ slightly. The former are followed here.

¹³ The empty top of the first sheet of this scroll is not included in any of the published plates. The visible portion of this sheet is 40.6 cm high (Salomon 1999, 97), and its total height is here estimated as 45 cm.

We have little information about the production process of Gandhāran scrolls, beyond what can be deduced from the available specimens. This is partly because the use of scrolls died out in the 3rd century CE and the use of birch bark for other manuscripts ceased in the 17th century CE (see section 6), partly because there are few references to the preparation of birch-bark manuscripts in South Asian literature. 14 The only external description is provided by the 11th-century Persian scholar and traveler Alberuni who writes (Sachau 1888, I 171):

In Central and Northern India people use the bark of the $t\hat{u}z$ tree [...]. It is called $bh\hat{u}rja$. They take a piece one yard long and as broad as the outstretched fingers of the hand, or somewhat less, and prepare it in various ways. They oil and polish it so as to make it hard and smooth, and then they write on it. [...] Their letters, and whatever else they have to write, they write on the bark of the tûz tree.

Each sheet of early Gandhāran birch-bark manuscripts, whether in scroll or other formats, was made from one single piece of bark as harvested from the tree, and there was no process of laminating several pieces to form a sheet. For the palm-leaf-inspired pothi format, this had already been observed by Hoernle 1893–1912, xix, who speaks of "several layers of periderm" (i.e., a feature of the natural anatomy of the bark), and it was further demonstrated by Kaye 1927, 10, who observed that the same lenticels are visible on the recto and on the verso of the Bakhshali manuscript. 15 It was confirmed by the examination of birch-bark manuscript fragments from Bamiyan (7th century CE; Yamauchi 2009, 24, 35–36) as well as of folio 364 of the Gilgit *Dīrghāgama* manuscript (8th or 9th century CE; linkyoung Choi, personal communication). That the same holds true of the two main types of Gandhāran scroll is apparent from an examination of the lower edge of the short-format scroll RS 5 (Glass 2007, pl. 1 and 2) and of the long-format scroll Dhp-G^K (Brough 1962, pl. XIII and XIV). The natural layers of birch bark do, however, tend to separate as the bark ages, and the application of oil described

¹⁴ Urvaśi's letter is written, on the spur of the moment, on bark torn straight from the tree, but this cannot be indicative of the general procedure. The available specimens all show that birch-bark manuscripts were very carefully planned and constructed, and from the living inner bark rather than from the inferior outermost layers of bark shed by the tree. The passage in the *Mākandikāvadāna* provides more detail, but the purpose of some of the materials listed there – particularly the oil and cotton - remains unclear.

¹⁵ The statement in Sander 1968, 28 ("mehrer[e] dünn[e], aufeinandergeklebte Schichten") appears to be based on a misunderstanding of Hoernle's description. The formulation in Salomon 1999, 107 ("component layers or laminations") is not clear, but that in Salomon 2000, 23-24 ("only two laminated layers [...] written on a single, unusually large and fine piece of bark") suggests a correct understanding of the situation. For the sake of clarity, the terms 'lamination' and 'laminated' should be avoided in future discussions of birch-bark manuscripts.

by Alberuni (and possibly alluded to in the Mākandikāvadāna) may partly serve to introduce additional, more permanent adhesive between the layers of the bark (cf. Yamauchi 2009, 48–49 for a similar experimental procedure applied in modern conservation). Another effect of the oil may have been an increased capability of the bark surface to attract and retain ink particles.

The polishing of the sheets mentioned by Alberuni also appears to have improved the suitability of the bark surface for writing. Yamauchi 2009, 27–28 reports that lenticels are slightly dented on the outer surface of the birch bark and slightly raised on the inner surface, and since in Alberuni's time birch-bark sheets were regularly inscribed on both sides, it would have been desirable to level the protruding ends of the lenticels. This leveling had less positive effect on embedded wooden tissue, and these areas remained difficult to write on (see section 4). Yet another possible treatment of the bark surface was suggested by the analysis of seventh-century birch-bark fragments from Bamiyan which found possible traces of yellow pigment (Yamauchi 2009, 4, 23, 36) although no remnants of coloring were visible on the bark. None of these methods of bark preparation (oiling, polishing and coloring) should be uncritically projected back by more than five hundred years onto the early Gandhāran scroll tradition, but they do suggest what to look for when physical analyses of the scrolls are carried out.

According to Alberuni, the strips of bark harvested from the trees measured approximately 25 cm in width and 100 cm in height. Since removal of the inner bark interrupts the conveyance of water and nutrients inside the tree, the maximum width of the harvested strip (corresponding to approximately one quarter of the circumference of a full-grown birch tree) was probably at least partly determined by the need to keep the tree alive for future use. Another influence will have been the target width of the finished sheets, which in turn was conditioned by ease of use as well as the historical origin of the Gandhāran scroll format (see section 6). The height of the harvested strip would appear to be the maximum that could be conveniently removed without the help of a ladder (since the very foot of the tree where the stem widens into the root system would not have yielded suitable bark). If the same procedure was followed in early Gandhāra, then the sheets for the short-format scrolls were simply derived by cutting the harvested and prepared strip into three or four pieces.

The construction of the long-format scrolls (called *pustaka*; Falk 1993, 305– 306, Salomon 1999, 87) was considerably more complicated. The easiest way to form a scroll that is 250 cm (BL 1) or 500 cm (Dhp-G^K) high would seem to be the vertical joining of three, four or five of the harvested bark strips, and this is what Senart 1898, 199 and Hoernle 1900, 125-126 (the latter with reference to Alberuni's description) suggested for scroll Dhp-G^K (the only Gandhāran scroll known at the time) whose preserved sections happen to be ca. 118.8 cm,

48.9 cm and 131.4 cm high. Kaye 1927, 10, on the other hand, was familiar with the construction of Egyptian papyrus scrolls from individual sheets that are glued together (cf. section 6) and suggested a similar construction for scroll Dhp-G^K, but could not see any positive evidence for this in Senart's plates. Janert 1955/56, 73 (referring to Hoernle but unaware of Kaye) reverted to the idea that harvested birch-bark strips were used in their full size, but goes even further and suggests that scrolls were made from one single piece of bark, which in view of the great height of the Khotan Dharmapada scroll was quite implausible. Brough 1962, 18–19 does not address the question of component sheets in his brief remarks on scroll construction.

The discovery of the twenty-eight Gandhāran scrolls that are now preserved in the British Library (approximately half of which belong to the long-format type) finally provided new evidence to decide the question and prompted Salomon 1999, 92–98 to reexamine scroll Dhp-G^K. As it turns out, all long-format scrolls now known, including scroll Dhp-G^K, are made from several sheets that are vertically attached to each other in the manner described below. The orientation of each sheet within the scroll is such that the lenticels are parallel to the upper and lower end of the scroll and perpendicular to its left and right margin, thus either following the orientation in which the bark was attached to the birch tree, turning it upside down or a combination of both possibilities. As a consequence, the direction in which the scroll is folded (from bottom to top) is perpendicular to the bark's natural curvature around the tree trunk (left and right), and it is possible that this choice was made in order to ensure that the scroll would lie flat during use.

In the five clear cases of long-format scrolls in this study, the heights of the component sheets range from an exceptionally short 13.1 cm through 17.5 cm up to 49 cm and thus correspond very closely to the range of heights of the shortformat scrolls (17.2 cm to 44 cm). In contrast with this, the widths of the component sheets (and of the long-format scrolls that they build) range from 14 cm to 21 cm and are thus considerably narrower than the widths of the short-format scrolls (ca. 20 cm to 27 cm; see Table 3). For production of the Khotan *Dharma*pada scroll, the individual sheets were arranged in decreasing order of height from the top to the bottom of the scroll (looking at the recto), and the same may be true of scroll BL 1 (Salomon 2009, 86; Figure 3). In scroll BL 12 + 14, on the other hand, the bottommost sheet is larger then the next sheet up (looking at the recto), and the two bottom sheets of scroll BL 13 are exactly equal in size. The same is true of the three bottom sheets of scroll BL 9, to the top of which is joined at least one shorter sheet. The sequences of equally-sized sheets in scrolls BL 9 and BL 13 were probably produced either by folding the harvested strip over on itself or by superimposing roughly cut sheets, and then trimming them to the same size with

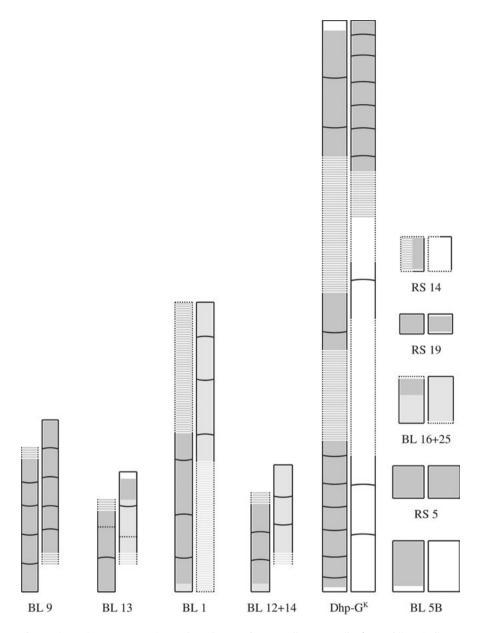


Fig. 3: Dimensions, construction and text layout of ten Gandhāran scrolls. (Curved lines indicate the direction of overlap of sheets. Dotted lines mark reconstructed portions of scrolls. Dark grey shading is used for the original texts of scrolls, light grey for secondary texts added to them.)

a knife, as suggested by evidence from the long-format scroll LC. This scroll has two large square holes, about four millimeters in diameter, in the same relative position just above a join on its first and second preserved sheets. The text of the scroll avoids these holes (see section 4), showing that the damage was caused prior to inscribing. The corresponding positions of the holes make it most likely that they were caused by accidental piercing with a pointed object – maybe a knife – while they were superimposed for cutting to the same size. The surrounding bark indicates that the object was twisted counterclockwise (looking at the recto) while penetrating the sheets.

Tab. 3: Sheet sizes of five long-format Gandhāran scrolls

	Width of sheets (cm)	Heights of sheets (cm)
BL 9	14	19.8, 25.2, 25.2, 25
BL 13	14	27, 29
BL 1	15.1	49, 36, 30
BL 12 + 14	ca. 15.5	23.5, 27
Dhp-G ^K	21	ca. 45, 46.9 23.5, 20.4, 20, 23.1, 17.5, 13.1

All known long-format scrolls are incomplete, but the original heights of two of them (BL 1 and Dhp-G^K) can be calculated with a fair degree of accuracy from their content, and the original number of sheets used in their construction can thus be estimated. Salomon 1999, 96–97 presented an estimate for Dhp- G^{K} on the basis of the schematic representation of the scroll in Brough 1962, 11, not realizing that this drawing does not accurately represent the proportions of the scroll (see Figure 3), and that the heights of its two missing portions have been additionally reduced to fit the drawing onto the page. Assuming with Brough that the first gap in the preserved scroll (between fragments B and A) is somewhat larger than the second (between fragments A and C), and assuming with Salomon that the size of sheets decreased regularly from the top to the bottom of the scroll, an additional two sheets need to be reconstructed between Salomon's sheets 3 and 4, and one additional sheet between sheets 5 and 6. The total number of sheets making up the scroll is thus likely to have been fifteen. A similar estimate can be made for scroll BL 1 on the assumption that the preserved portion of the scroll represents about one half of its original length (Salomon 2008, 84; but see note on Table 2 and compare Figure 3). The complete scroll would then have been made from six sheets.

As in Egyptian papyrus scrolls (see section 6), the sheets of Gandhāran birchbark scrolls are primarily joined to each other by an undetermined type of glue which is applied to the bottom two or three centimeters of one side of one sheet to paste it onto or under the top of the following sheet. Following papyrological practice (Porten 1979, 78), these areas of a scroll where one sheet is joined to the next will be referred to as joins. Sometimes excessive application of glue appears to have led to a crinkled surface in the finished scroll (Salomon 1999, 96). In the current condition of many Gandhāran scrolls, the glue has lost its adhesive power and sheets have become separated (cf. Salomon 1999, 93 fig. 9). To avoid such separation during the anticipated lifetime of scrolls, their joins were often reinforced with threads stitched across them. Three patterns of stitching have been observed so far: (1) In the scroll Dhp-G^K, two short vertical lines of stitches cross the join. These lines are between 1.7 cm and 3.5 cm long and between 3.5 and 6.5 cm distant from the outer margins of the scroll (Salomon 1999, 96; Figure 4). In his first description of these join-reinforcing stitches, Salomon suggested they were peculiar to scroll Dhp-GK and that no reinforcements were used in the BL scrolls, but closer examination has since revealed join-reinforcing stitches in all four long-format scrolls described in this article as well as in other long-format scrolls. (2) In scrolls BL 1, BL 9, BL 12 + 14 and BL 13, a single line of stitches ca. 2.5 cm in length crosses each join in its horizontal center. Although the thread has disintegrated in these scrolls, the needle holes through which it passed are clearly visible on inspection (Allon 2001, pl. 6, Salomon 2008, 86). Only the joins between the first and second preserved sheets of BL 9 (fourth and fifth from the bottom) and BL 13 (second and third from the bottom) lack visible stitch marks, and it is possible that these two pairs of sheet were irregularly joined by glue only (Baums 2009, 68). Together with the fact that the sheets below the unstitched joins in these scrolls are equally-sized, whereas the ones above are observably (BL 9) or potentially (BL 13) of different sizes (see above), this suggests that in these two



Fig. 4: Margin threads and join-reinforcing threads in scroll Dhp-GK (Senart 1898, pl. III).

cases pre-existing scrolls of three and two sheets were secondarily extended by the addition of at least one more sheet at their top. (3) In the unpublished scroll BL 15, the join-reinforcing stitches take the form of a broad zig-zag pattern from the left to the right margin in which the individual lines of the zig-zag are ca. 2 cm long and meet each other at right angles (see, e.g., frame 30; Figure 5). In scroll LC, a narrower zig-zag pattern in which the lines meet each other at sixty-degree angles similarly follows the join.¹⁶



Fig. 5: Join-reinforcing thread (needle holes) in scroll BL 15 (courtesy of The British Library Board).

In some scrolls the overlapping of the individual sheets follows a single consistent pattern (Figure 3). Throughout the preserved portions of scrolls BL 9 and Dhp- G^K , of any pair of sheets the one that is closer to the top of the scroll (looking at its recto) is glued and stitched onto the one that is closer to the bottom. This pattern appears to be reversed in scroll BL 12 + 14, where the three preserved sheets are joined so that of any pair the lower one (looking at the recto) lies on top of the higher one, and the same may be true of scroll BL 13 (even though it forms a set with scroll BL 9) where, however, the direction of overlap of the first and second sheets could not be determined with certainty.

The long format is further characterized by threads stitched along the left and right margins, all the way from the top to the bottom of a scroll, at a distance of 0.5 to 1.0 cm from the edge of the bark. These threads are mostly preserved in scroll Dhp-G^K (Figure 4). In the long-format BL scrolls they have disintegrated except for small remnants, but needle holes attest to their presence where the margin itself is preserved. Most likely the purpose of these margin threads was to increase the vertical cohesion of the scroll (Salomon 1999, 94). Frequent folding of a scroll would result in horizontal cracks and eventually in the separation of

¹⁶ The rightmost part of one of the joins of scroll BC 2 has been additionally reinforced by a patch of birch bark glued over its verso (Strauch 2008, 107), but this isolated case is best regarded as an improvised repair of a specific problem, not as an additional type of join reinforcement.

the bark into horizontal strips. The margin threads would slow down this process by preventing vertical overextension of the scroll, and if the bark did separate along a horizontal crack the threads would still provide a minimal amount of vertical cohesion and prevent the scroll from splitting altogether. One negative consequence of sewing threads down the margins was the resulting perforation that led to a tendency for the left and right edges of scrolls to break off. The benefit of increased vertical cohesion appears to have outweighed the drawback of weakened margins during the lifetime of the scrolls, but in the centuries since their disposal some scrolls (notably the BL scrolls) have suffered a complete disintegration of their margin threads, followed by a destruction of their edges along the exposed perforation. While characteristic of the long format, margin stitching in some rare cases also occurs in short-format scrolls. The only clear examples are scroll BL 5B, the exceptionally long short-format scroll RS 12 and probably also scroll BL 16 + 25 (see section 4 below). The unique scroll BL 3A has strips of what appears to be coarse birch bark, approximately 1.5 cm in width, pasted down the recto and verso of the preserved left margin and taking the place of margin stitching (not noted by the editor, but clearly visible in Lenz 2003, fig. 18-19 and Lenz 2010, pl. 22–25). It is uncertain whether this scroll belongs to the long or short format.

There is no evidence that a roller (such as a cylindrical piece of wood) was attached to the bottom of any of the long-format scrolls. Brough 1962, 12 suggested that "a manuscript of birch-bark would suffer less in being used if it were rolled than it would if folded" and that "[i]f a roll was the original intention, it must be assumed that it was wound round a cylinder, possibly of wood, since the end of [fragment] N, which would have been the innermost part, shows no signs of the tight folding which is characteristic of most paper strips which have been rolled without a centre-piece." In fact, however, the bottom of scroll Dhp-G^K shows exactly the kind of damage that would be caused by folding without a roller and that occurs frequently among the BL scrolls: a piece corresponding to two strips of the folded-up scroll has broken off along horizontal cracks, leaving a gap one strip from the very end of the scroll. Observing this, Salomon 1999, 101 still attempted to use it as an argument in favor of the original presence of a roller since "[t]his damage could have been inflicted when the scroll was separated from such a rolling cylinder to which it had been pasted or otherwise attached." The detached fragments are, however, preserved and can be inspected on plates IV and XVIII of Brough 1962, where their recto is empty and their verso carries the partial lines numbered 367–370. The surface of the recto does not show any irregularity or damage that might have been caused by attachment to a roller, but the left-hand portion does display the kind of horizontal crack that is indicative of tight folding and that, one strip up and down, did lead to the detachment of

these fragments. The other piece of evidence that Salomon adduced in favor of the use of rollers are two small holes near the bottom of scroll BL 12 + 14. But in the description of Allon 2001, 44, "[t]he hole on the left side of the recto is about 2.5 cm from the original bottom margin of the manuscript, and the hole on the right is about 1.4 cm from the bottom," whereas one would expect them to be at the same height if they were caused by pins attaching the bottom of the scroll to a roller. Allon continues to remark that if they were caused by such pins, then "the bark would have been pinned onto the roller from the verso side, which formed the original outside of the scroll." This would have subverted the purpose of a roller since the scroll, rolled up with its recto facing the inside (see section 5), could then only have gone around the roller after a very sharp crease at the point of attachment which would have led to the speedy separation of the roller itself. The available evidence thus indicates that no rollers were attached to the bottoms of Gandhāran scrolls.

4 Inscribing

The principal writing utensils available in Gandhāra and suitable for birch bark were pens (made from reeds or similar material) and brushes (Bühler 1896, 92, Janert 1955/56, 87, Sander 1968, 35–36). Many Gandhāran manuscripts show signs of having been written with a hollow pen whose nib was split to conduct ink from the inside to the tip and angled to accommodate the handedness of the scribe: split letter strokes where the ink ran low and varying widths of strokes depending on their direction (Glass 2000, 28-30). The use of pens in Gandhāra is further indicated by two replica copper pens found at Taxila (Marshall 1951, II 598). It is safe to assume that pens were the regular writing utensil, but the occasional use of brushes cannot be ruled out.

The ink used for Gandharan manuscripts is black and presumably soot-based (notwithstanding Kālidāsa's poetic dhāturasa; section 3). Janert 1955/56, 87–96 lists various ink recipes used in ancient and medieval India and summarizes the report of Bühler 1877, 30 according to which the ink used for later Kashmiri birchbark manuscripts was made from burnt almonds boiled in cow urine, which in combination with birch bark produced waterproof writing. The recipe of early Gandhāran ink will remain unknown until a detailed analysis is carried out on a sample of the material. Concerning the water resistance of the later Kashmiri ink, we observe that there are no clear cases of ink erasure due to water damage in the early Gandhāran manuscript material, with the possible exception of scroll BC 13, one side of which contains an area of faded writing that by its shape suggests the

spread of a liquid. A scribal method of erasing an erroneous aksara consists in smudging it out (Glass 2000, 148), but since this type of erasure would be carried out before the ink was dry it cannot be taken as a sign of water-soluble ink. The only known palimpsests among Gandhāran manuscripts are written on palm leaf, and in these cases the application of another solvent than water cannot be ruled out.

In the act of writing, scribes avoided uneven areas of the scroll, especially embedded wooden tissue (cf. Salomon 2008, pl. 17), join-reinforcing threads and the edges where sheets overlap with each other.¹⁷ The usual procedure for rough spots in the bark is quite simply to skip them, but occasionally (e.g., on the recto of scroll LC) they are marked with horizontal lines to show they have been left empty on purpose. In some manuscripts, particularly the BC scrolls, the verso of the scroll (corresponding to the inner side of the birch tree's periderm) has a much coarser texture than the recto, but this did not in and of itself prevent its use for writing.

In most long-format and some short-format scrolls, the horizontal delimitation of the text area was provided by the threads running down the left and right margins. Two of the BC scrolls (long-format BC 3 and short-format BC 5) do not feature margin threads, but have ink lines drawn down the margins where a thread would have run, illustrating how margin threads had come to be perceived as an integral part of text layout (Strauch 2008, 107). 18 The sculpture shown in Figure 6 goes to the length of reproducing the margin threads or corresponding ink lines of two scrolls in stone, further illustrating their importance for the Gandhāran scroll format. Vertically, the text area can in principle extend all the way to the bottom of the writing surface, but it may stop a little short if the end of a textual subdivision occurs just before the bottom of the scroll (e.g., in longformat BL 1, BL 12+14 and Dhp-GK and short-format BL 5B). The very top of a scroll is often left empty (for instance in long-format Dhp-GK and short-format BC 8), presumably to protect the inscribed part when the scroll was folded up. Within

¹⁷ Salomon 1999, 96 uses the scribal avoidance of join-reinforcing threads and sheet edges to argue against Brough 1962, 13 that the entire length of a long-format scroll was ready-made before a scribe commenced his work, and that the scribe either commissioned a complete scroll of the size he thought appropriate or chose from a variety of differently-sized ready-made scrolls. While the careful and regular construction of most scrolls does suggest professional manufacture on a large scale, the features of some scrolls, such as the lack of reinforcing threads and smaller sheets in the upper part of scrolls BL 9 and BL 13 and the changing direction of sheet overlap in scroll BL 1, still indicate a certain element of improvisation in their manufacture, whether by a specialized scroll maker or by a scribe.

¹⁸ The same type of development occurred in Central Asian paper manuscripts where painted circles took the place of string holes in earlier palm-leaf manuscripts.

the text area, the scribe fills lines from right to left (the writing direction of the Kharoṣṭhī script) proceeding from the top of the recto to the bottom. If he wishes to continue his text on the verso of the scroll, he flips the scroll over vertically and begins to fill the verso from the same end (the innermost part of the folded-up scroll), proceeding from there back towards that end from which he started to fill the recto (the outermost part of the folded-up scroll). In one case (scroll BC 16), the scribe reached the end of the verso before he had completed his text, and proceeded to add two more lines in the right margin (with the feet of letters pointing towards the right edge of the scroll) and one more line in the top margin (with the feet pointing towards the top edge); the intended reading order of these three



Fig. 6: Three monks with scrolls (Taddei 1983, pl. IIb).

lines has not yet been determined, and it cannot be ruled out that more text was added to the lost left margin of the verso. In general, the horizontal orientation of lines is maintained quite accurately, but some of the more cursive hands (e.g., BL scribe 2 and the RS scribe) introduce a downward slant from the beginning (right side) to the end (left side) of the line. This slant is particularly distinct in short-format scrolls, presumably because they could be more easily rotated under writing than long-format scrolls.

In most Gandhāran scrolls, the text block is structured by punctuation marks and word spacing. The former typically occur at two different levels, with small dots indicating lower-level phrase units and larger circular designs indicating paragraph- or chapter-level divisions. Some scrolls (BL 9, BL 13, BL 28) additionally mark the end of a paragraph or chapter by placing a similar design in the right-hand margin of the manuscript between the margin thread and the edge of the surface (Baums 2009, 70, 105-106). For the same purpose, the Dhp-G^K scribe placed a horizontal line of abstract geometric shapes under the end of each chapter, starting from the right edge of the text block or in the right margin, and extending between one quarter and one half of the width of the text block leftwards (cf. Brough 1962, pl. XV). Word spacing is used especially with verse texts, which are typically laid out so that the four quarters of a stanza fill one line and are separated by spaces (Falk 1993, 316–317; cf. Brough 1962, pl. I). Stanzas in verse texts and paragraphs in prose texts can also be numbered, with the number sign following the unit in question. The Dhp-G^K scribe instead noted the number of verses in each chapter at its end (after the final punctuation mark or to the left of the horizontal line of abstract shapes). The very end of a text is sometimes marked with the lifelike drawing of a flower or a stūpa. In one special case (Figure 7), the flower occurs at the bottom of the recto of a scroll (BL 13), but the text actually continues on the verso with two more paragraphs. It is possible



Fig. 7: End-of-text mark in scroll BL 13 (Baums 2009, pl. 21).

that the part on the verso represents a secondary extension of this text, consisting of a loosely joined sequence of explanations of a selection of Buddhist verses.

Where the end of a text is preserved it does not usually carry any additional information, such as a text title or the name of a scribe or owner. The 'Split' Collection does, however, include one scroll (SC 5) that preserves parts of two chapters from a *Prajñāpāramitā* and a detached fragment that appears to be from the bottom of a sheet and contains the following two lines (Falk 2011, 23, pl. 8):

```
padhamage postage prañaparamidae budhamitra ///
idraśavasa sadhaviharisa imena ca kuśalamulena sarvasatvana matrapitra ///
```

The first line specifies the content of this scroll as "the first book of the Prajñāpāramitā of Budhamitra," referring either to the scribe or to the owner of the manuscript. After a stretch of lost text, the second line continues "dwelling together with Idraśrava" – probably a further specification of Budhamitra – and adds "by this root of good, for all beings, for mother and father" before breaking off.

This note on the *Prajñāpāramitā* manuscript sheds light on the interpretation of another fragment of birch bark in the British Library collection (BL 3B) that appears to belong to the end of a text written by the same scribe as scrolls BL 7, BL 9, BL 13 and BL 18 (Salomon 1999, 40-42, Baums 2009, 609-611). The lines in question, which occur just above a partially preserved join and skip over a centered join-reinforcing thread, read as follows:

```
++++++++++++++/// [t]. a i di navodasa *
```

The first line ends with the number word 'nineteen' which probably refers either to the content or to the size of the preceding last chapter of the text. The second line appears to contain information about the text as a whole. It starts with an expression in the locative case containing the word 'book' modified by a lost attribute – probably a numeral as on scroll SC 5. The word gasae 'verses' is a feminine nominative plural and thus probably constitutes the subject of the statement, followed by the number word 'twenty-five' (repeated in number signs) that appears to be its attribute. This leaves an ambiguous reference to the monk Saghaśrava in the genitive singular; it could mark him as the composer of the verses or the commentary on them or, more likely, as the scribe or owner of the manuscript. The term 'colophon' has been used for the text-final statements on these fragments. They probably occupied the typical position of a colophon at the end of a text, and at least the text-final statement of the *Prajñāpāramitā* appears to share with

the later and more elaborate Gilgit colophons a reference to the beneficiaries of the merit that accrues from the production of the manuscript (von Hinüber 1980, 50).

The information on scroll fragment BL 3B is similar to that in the introductory line (possibly a verse) of scroll Dhp- G^{K} :

budhayarmasa samanasa budhanadisardhayayarisa ida dharmapadasa postaka dharmaśravena likhida arañi

Brough (1962, xx-xxii, 119, 177 (followed by Salomon 1999, 40-42)) read the third word from the end as *dharmuyane* and took it as a reference to the place where the manuscript was copied, but the reproduction of this passage on his plate I rather supports my interpretation as a personal name formed on the same pattern as Idraśava in scroll SC 5 and Saghaśrava in scroll fragment BL 3B. The Dhp-G^K line can then be unambiguously translated as: "This is the Dharmapada book of the monk Budhavarma, dwelling together with Budhanadi; it has been written by Dharmaśrava in the monastery." In contrast to SC 5 and BL 3B, Dhp-G^K thus clearly distinguishes between owner and scribe. The Dharmapada introductory verse differs from BL 3B in not providing a number of text units, a service that in general always follows the text or part of a text in question.

Neither the text-final statement on scroll fragment BL 3B nor the introductory statement on scroll Dhp-G^K occupy a position that would have allowed them to identify the content of the manuscript when it was folded up. Unless external means were used to identify folded-up scrolls (such as tags or containers with labels), the information would have to be provided on the only part of a scroll's surface that is visible in its folded-up state: the very end of the verso (on the other side of the same sheet as the beginning of the recto). Unfortunately, this part is only preserved in scroll Dhp-G^K, and no photographs have ever been published of the relevant portion of the manuscript (the verso of fragment O). Until this desideratum is filled and the end of the verso of Dhp-G^K is examined for the possible presence of a line specifying the content of the scroll, we have at least one piece of circumstantial evidence in the address line of the private letter on scroll BC 15 (Strauch 2008, 127). The strip of bark bearing this address has become detached from the rest of the scroll, but the empty vertical space preceding and following the address shows that it was not directly adjacent to the body of the letter, and the surface structure and width of the strip suggest that its position was indeed at the very end of the verso so that it would have been visible on the outside of the folded-up (and possibly sealed) letter. 19 This makes it likely that if the identification of a folded-up literary scroll was provided on the manuscript itself, then it would also have occurred at the very end of the verso.

Almost always, a single scribe was responsible for the writing of a text, but one exception exists in scroll LC which contains a single text, but where the recto was written by one scribe and the verso by another.²⁰ When a significant amount of free space remained on a scroll, either because it was only inscribed on the recto or because its text did not extend all the way to the bottom of the verso, a secondary text was sometimes added at a later point by a different scribe (Figure 3). Among the ten scrolls studied in this article, two different types of text combination can be observed. The first is represented by scroll BL 13, where what appears to be the final part of a multi-volume commentarial text occupies all of the recto and in its present form (see above) extends 24 cm down the verso. It is followed by a similar but distinct commentarial text that is written by another scribe. Here the intention was clearly to write a sequel to the text that already existed on the scroll. The second pattern is represented by scrolls BL 1, BL 12 + 14 and BL 16 + 25. In each of these, a Buddhist canonical text (two verse texts and one set of sūtras) is followed by a string of narrative sketches written in a very casual style by two different scribes. It has not been possible to determine any relationship of content between the primary texts of these scrolls and the narrative sketches, and here the unused writing surface appears to have been repurposed for a new task without reference to the text that the scroll already contained. In each of the cases of reuse discussed so far, representing the habits of three different scribes, the secondary text follows the primary text immediately, without any vertical space and sometimes even finishing the last line of the primary text. A different procedure can be observed in scroll BC 1, where a collection of canonical sūtras was evidently meant to occupy just the recto of the scroll, but where due to lack of space the very last line of the text had to be written at the top of the verso. A secondary magical text was then added to the verso of the manuscript, but in this case only after a long vertical gap that apparently corresponds to one sheet of the scroll (i.e., the secondary text appears to start on the second sheet of the verso). Yet another arrangement occurs in scroll BC 9, where a scholastic text is added on the verso of a scroll whose entire recto is occupied by a treatise on statecraft.

¹⁹ The surface structure of the strip containing the address line indicates that it was written on the verso of the scroll, and the width of the strip places it at the very end of the preserved part of the verso (Ingo Strauch, personal communication).

²⁰ This situation is comparable to the larger-scale collaboration of scribes on the Gilgit Dīrghāgama manuscript described in Melzer 2007, 68-77.

Summarizing these observations and surveying the known corpus of Gandhāran scrolls, the following patterns of scribal practice emerge:

- Short texts such as letters (BC 15) and some stotras (BC 8 and BC 10) only 1. required one side of a short-format scroll to write down.
- 2. Prestige literature such as Buddhist canonical texts (BL 1 and BL 12 + 14), but also the non-Buddhist treatise on statecraft (BC 9), tended to be written only on the recto of both short-format and long-format scrolls. Where the length of such a text exceeded the available space, it could in principle be continued on the rectos of further scrolls. No absolutely clear cases of such continuation scrolls for prestige literature have yet been found, and it is possible that the primary mode of transmission for this type of literature remained oral and that the available manuscripts of complete texts or the beginnings of texts served special purposes. On the other hand, BL 16 + 25 does appear to be a continuation scroll, and BL 1 (see note on Table 2) may be another example. An exception to the pattern is the work of the scribe of the Senior collection of manuscripts, who produced both single- and double-sided scrolls of extracts from canonical literature. Another exception is scroll Dhp-G^K which probably contained the entire text of the Dharmapada using both the recto and almost half of the verso. Both of these exceptions date from the 2nd century CE (the Senior scrolls certainly, scroll Dhp-G^K probably) and are thus approximately one hundred years younger than the other known manuscripts of canonical texts. It is possible, but remains speculative, that they represent further developments in two different directions: a greater reliance on written transmission on one hand, and an increased emphasis on ritual uses of manuscripts on the other.
- New literature including commentaries on canonical texts (BL 9, BL 13 and BL 18), other scholastic treatises (BL 28), Mahāyāna sūtras (BC 2) and stotras (BL 5B), as well as casual texts such as story sketches (BL 2), could be written on both sides of a scroll where needed and were demonstrably continued on further scrolls when both sides of the initial scroll were filled (BL 9, BL 13 and BL 18).
- In addition, some forms of new literature (the scholastic treatise on BC 9) and casual texts (the story sketches of the British Library Collection) would reuse empty space on other manuscripts, and at least in the latter case without reference to the original content of the scroll. One related property shared by some new literature (BL 13) and casual texts (BL 4) is that a scribe could add additional material to another scribe's text (which is a different practice from that in scroll LC, where a single preexisting text was divided between two scribes to share labor or merit).

While the tendency for canonical texts to occur in partial manuscripts (especially the beginnings of texts) indicates the continuation of a strong oral transmission. the commentarial and scholastic literature shows clear signs of written transmission in addition to oral features. The commentary in scrolls BL 7, BL 9, BL 13 and BL 18, for instance, contains misspellings based on the shape of Kharosthī letters (such as the gotra name paracariya \leftarrow *parayaria for *paraśaria, and the technical term drithiśari for *drithiyari; Baums 2009, 150, 326) besides representations of dialect features (such as tida instead of Gāndhārī thida) that suggest that both a written source and reading aloud or recitation played a role in the production of the manuscript. The Sangītisūtra commentary in scroll BL 15 contains another clear example of written transmission in the section on the six vivadamula, where part of the text has been omitted because the eye of a copyist or somebody reading aloud skipped from the word *drithi* in one line of a source manuscript to the same word in the next line.

A feature of the casual story sketches may also indicate the production of one manuscript on the basis of another. Nine places on five different scrolls where these sketches occur have interlinear notes stating likhidago 'it has been written,' likhidage aca avadane 'this avadāna has been written' or variants thereof. In his detailed discussion of these notes, Salomon 1999, 71–76 observed that they were in another hand than the story sketches themselves, and he suggested that they either represent the certification of a supervisor that the manuscript had been produced correctly, or – more likely in view of the casual nature of the text – that another scribe who had made copies from the manuscripts we have noted this fact in his exemplars. Lenz 2003, 108-110 argued for a variant of Salomon's rejected hypothesis in which the notations were added not by a supervisor of manuscript production, but by a teacher in a classroom setting to confirm that his students had written down their story sketches correctly. Revisiting the issue, Lenz 2010, 21–22 suggests instead that the notations may well have been written by the same scribe as the story sketches themselves, but did not provide a reason why the scribe should have annotated his own text in this way. Provisionally accepting Lenz's suggestion, Mark Allon proposes in personal communication one possible explanation that attractively links the likhidago notes with the frequent injunction vistare yasayupamano siyadi 'it shall be expanded according to model' at the end of individual sketches (Lenz 2003, 85-91) and which also explains their extreme succinctness and casual style: the story sketches may be neither classroom exercises nor the memory aids of a storyteller, but rather instructions for the production of another manuscript in which the stories are told in full, and the author of the sketches would have noted the completion of the full stories by himself or by another scribe on his instruction sheet. While much unclarity thus remains about the purpose of the likhidago notation, two of these three explanations (by Salomon and Allon) involve hypotheses about manuscript production in early Gandhāra that could be confirmed by new manuscript discoveries (either of a direct copy of one of the sketches, or of a collection of full stories based on the sketches).

5 Use and disposal

Beyond the scrolls themselves and the little that is known about their archeological context, the only evidence for how they were used is provided by depictions in Gandhāran art (collected in Salomon 1999, 103–104). The one most relevant for the monastic context of our scrolls is a relief described by Taddei 1983, 338, showing three monks seated around a table with open scrolls in their hands (Figure 6). One of the monks joins the fingers of his right hand in a gesture that, as Taddei suggests, may indicate that a debate (presumably about the content of the scrolls)

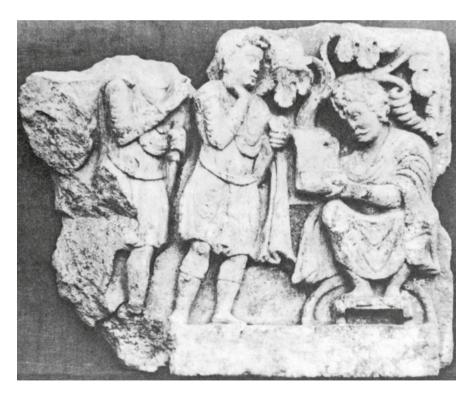


Fig. 8: Mustachioed man with scroll (Rahman 1993, pl. XLIa)

is underway. Another relief, from Shnaisha Gumbat in Swat (Rahman 1993, 95), shows a mustachioed man seated under a tree, holding an open scroll in both hands from which he reads while two young men listen attentively (Figure 8). Rahman interprets the scene as "a government functionary reading out instructions," and while one may disagree with the specifics, here we do seem to witness the use of a Gandhāran scroll outside the monastic context. A third depiction of scroll use is found on another relief from Swat that is now kept in the British Museum (Tissot 1985, 109, Kurita 1988–90, II fig. 859, Zwalf 1996, I 232). It shows a seated man with partially shaved head or close-fitting cap, holding an open scroll in his left hand while looking up at a stooping woman approaching him with a box-shaped object in her arms (Figure 9). This scene has received a wide range of differing interpretations – a poet and his muse (imitating Greek models), the schooling of the Bodhisattva or a scene from the *Mahāummaggajātaka* involving a young minister and a handmaiden – and pending new evidence it seems wisest not to draw conclusions from any of these possibilities. Considering the ambiguous hairstyle of the man holding the scroll, both a monastic and a non-monastic context seem possible.

Returning to our documents, we first observe that a large number of horizontal creases occurs in the bark of both short-format and long-format scrolls, and that often these creases have led to breaks separating the bark into horizontal strips. The distance between creases, and thus the height of strips into which the bark has broken, increases regularly from the bottom of a scroll to the top. In the long-format scroll BL 9, for instance, the next-to-bottommost strip is 1,7 cm high, whereas the next-to-topmost preserved strip measures 4.2 cm in height. This indicates that the scrolls were folded up from the bottom to the top, and was confirmed during the opening of the scrolls in modern times. Textual study combined with the observation of their opening showed that the scrolls were folded up so that the recto faced the inside, a procedure that offered the best protection for the textual content on the recto and the upper part of the verso.²¹ This puts to rest various earlier theories about the Khotan *Dharmapada* scroll, in particular the idea that it was folded up concertina-style, whose proponents mistakenly considered a scroll with roller (not used in Gandhāra; section 3) the only probable type.²² In one case (scroll BL 13), a horizontal crack caused by the par-

²¹ One apparent exception (scroll BL 21) was found folded up with its recto facing the outside, but this seems to be a case of casually folding a worn-out scroll for disposal (Salomon 1999, 50-51).

^{22 &}quot;Une fois écrits, [les feuillets] étaient repliés sur eux-mêmes de façon à se présenter sous l'aspect de cahiers de 20 centimètres de long sur un hauteur de 4 centimètres et demi à 5 centimètres" (Senart 1898, 199); "[m]ost probably it was never intended that the manuscript should



Fig. 9: Man with scroll and woman (Tissot 1985, fig. 257).

ticularly tight folding at the bottom of the scroll was repaired using three small strips of differently-colored birch bark (measuring 0.2×0.5 cm, 0.2×0.6 cm and 0.2×0.6 cm respectively) that have been glued over the crack in the same way that we would use adhesive tape (Figure 7).

Once they were vertically folded into a tight, flat package, the short-format scrolls were additionally folded in half horizontally. In some cases (e.g., scrolls BC 8 and RS 24) this fold could be observed directly when the scrolls were found (Khan/Khan 2004, 12, Lenz 2003, 4; Figure 10), and in their current open arrangement it can take the form of a vertical crease (less crisp than the horizontal ones) running down the middle of the scroll or of an outright break caused during modern opening. In other cases, the material along this crease had disintegrated completely before the scrolls were deposited or in the centuries until their rediscovery. It is not immediately apparent why the short-format scrolls would be subjected to this additional folding since it does not make them significantly easier to store or deposit and subjects the material to additional stress. I note for now that the only known non-literary scroll (the letter BC 15) also appears to have been

be rolled up; possibly it was to be hung on a wall" (Kaye 1927, 10); "[t]he present appearance of some of the parts suggests that it was of the concertina-type, though it is possible that it was originally intended to be a roll" (Brough 1962, 12).

folded in this way since a noticeable crease runs down the middle of the sheet and the outermost strip has broken in half, and will discuss this question further in section 6. In contrast, none of the long-format scrolls in our sample have been folded horizontally, presumably because the greater height of these scrolls and consequently the greater thickness of the vertically folded-up package made an additional horizontal folding difficult or impossible (cf. Salomon 1999, pl. 6).

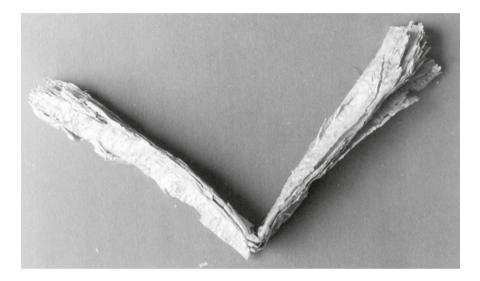


Fig. 10: Short-format Gandhāran scroll, folded up (Khan/Khan 2004, fig. 5).

Two of the short-format scrolls in the Bajaur collection (the letter BC 15 and the stotra BC 10) have a hole, two or three millimeters in diameter, near the middle of the right half of each bark strip. When these scrolls were folded up vertically the holes would line up, and it therefore seems likely that they were caused by piercing the scroll while it was folded-up vertically but not folded in half horizontally. In the case of the letter, a string bearing a seal could have passed through it (Ingo Strauch, personal communication), but it is not clear why the stotra scroll should have received the same treatment.

The users of Gandhāran scrolls would sometimes annotate the text of their scrolls, but a meaningful discussion of this phenomenon will have to wait until more texts have been edited and until palaeographic study makes it easier to distinguish the hand of a user of a manuscript from that of its scribe. The reader is referred to the discussion of the likhidago annotations in section 4 and will note that even in this well-documented case the identity of the annotator remains uncertain. A possible customization of a manuscript by its user, but just as likely a feature provided by the scribe, are the margin marks indicating subsections of a text (also discussed in section 4).

The information available about the day-to-day use of Gandhāran birch-bark scrolls is thus rather limited, and so is our knowledge about the details of and motivations behind the disposals that preserved some of these scrolls for posterity (section 2). Because none of the manuscript discoveries were made in the course of archeological excavation, information about their disposal is only available for three collections: the BL collection, the RS collection and the BC collection. In his discussion of the first of these, Salomon 1999, 69-86 suggested that the deposit of the BL scrolls is parallel to the Jewish custom of depositing worn-out manuscripts (rather than destroying them) out of respect for their religious status. His argument was based on the observation that many of the BL scrolls appear to have been damaged and incomplete before their deposit. It is difficult to estimate how much of the disintegration of birch bark is due to handling in antiquity rather than environmental circumstances in the centuries that passed, but their used status is borne out by the fact that one of them (BL 21) was casually folded up inside out, and that in two cases (BL 3 and BL 5) parts of several unrelated scrolls were folded up together. When the RS collection was discovered, it soon became apparent that it differs from the BL collection in three important respects: all of its manuscripts are written by the same scribe; they are in an excellent state of preservation and were possibly unused when deposited; and they were discovered inside a pot with an inscription that in all respects (short of using a word for 'relic') conforms to the usual formula for relic establishments (Salomon 2003). On the basis of these facts, Salomon 2009 argues that the scrolls of the RS collection were custom-made for the purpose of ritual installation as dharma relic, and that such an installation was successfully carried out, while maintaining and refining his position that the BL collection represents a ritual burial of worn-out texts. He supports his argument with new archeological data reported in Tarzi 2005 for Buddhist monastic sites around Hadda in Afghanistan. These finds revealed two relevant patterns of use for clay pots such as the ones that contained the BL and RS scrolls: on one hand, they were used as funerary urns and buried outside the western and southern walls of a monastery; on the other, they were used as outer containers for reliquaries and placed within small stone chambers in stūpas.

While in the light of all available evidence, it does seem likely that the Senior scrolls constitute a dharma-relic deposit, whether or not they saw prior use, the case is less clear for the BL scrolls. Their container does not carry any reference to the purpose of the deposit, and the fact that similar containers were used for human burials at Hadda does not necessarily mean that the disposal of these worn-out scrolls was also conceptualized as a burial. We will be right in regard-

ing it as a respectful disposal, whether intended to be permanent or temporary, but lack the data to deduce much beyond this main fact.²³ Coming to the third major deposit of Gandhāran scrolls, the Bajaur collection, we cannot even be sure whether these manuscripts were in fact deposited in a formal sense. They were reported to have been found in a small stone chamber or box resembling the one that at Hadda contained a clay pot with reliquary, and on this basis Salomon 2009, 28–29 suggested that they like the RS scrolls might represent dharma relics. On the other hand, no pot or other object related to relic establishments were reported in connection with the Bajaur material; in contrast to the RS collection it contains a variety of textual genres on scrolls that do show signs of handling and use; and in contrast to both the BL and the RS collection, the Bajaur collection contains one clearly non-Buddhist text (the letter BC 15).²⁴ While we cannot rule out that this one unrelated text slipped into a dharma-relic establishment by accident, the overall picture remains as inconclusive as with the BL collection, and we cannot rule out either that the Bajaur collection was simply part of a monastic library, either in its regular place of storage or hidden away, that was left behind when the monastery was abandoned (Strauch 2008, 104–105).²⁵

6 Origin and survival

Discussions of the origin of the Gandhāran scroll format (most recently Jäger 2006, 189) have been almost entirely restricted to comparisons with Greek and Chinese scrolls, but the connection of either of these two traditions with Gandhāra faces serious historical problems. While we have direct documentary evidence for a flourishing use of Gandhāran scrolls in the 1st century CE and possibly also in the 1st century BCE, the existence of two Gandhāran sites with Asokan inscrip-

²³ A cautionary tale is presented by the private letters from Hermopolis discussed below: they were found in a sealed jar in a necropolis for the ibis bird, among thousands of other jars containing ibis mummies, and no rationale for this kind of disposal of secular and ephemeral documents is apparent (Kraeling 1953, 18, Bresciani/Kamil 1966, Fitzmyer 1981, 29).

²⁴ The treatise on statecraft (BC 9) is also not a Buddhist text, but in this case the secondary text on the scroll - a Buddhist scholastic treatise - would have warranted its inclusion in a dharmarelic deposit.

²⁵ In principle, other types of ritual deposit than burial and relic establishment also need to be taken into consideration, as illustrated by a recent discovery in Bamiyan. In the course of conservation work on the remains of the eastern giant Buddha statue, twenty small manuscript fragments were found that had been deposited in a metal container inside the statue. They contain part of the pratītyasamutpāda formula and provide first evidence from South Asia for the custom of depositing manuscripts in statues (Matsuda 2009, 8).

tions using the local script Kharosthī - whereas Aśoka's inscriptions in the rest of South Asia use Brāhmī (von Hinüber 1990, 55) – indicates that a local Gandhāran manuscript tradition existed already in the middle of the 3rd century BCE. At this point in time, Greek colonies had been established in Bactria, but another century would pass before Gandhāra was fully incorporated into the Greek sphere of influence, and direct contacts between Gandhāra and China are even less likely at this early date.

Also in terms of format, Greek and Chinese scrolls differ markedly from the two Gandhāran formats in that they are written and read in horizontal orientation, with vertical lines progressing from right to left in the Chinese case and horizontal lines arranged in columns in the Greek case. If either of them had served as model for the Gandhāran scrolls, it would be hard to explain why the latter should have undergone such a radical change in format. Previous discussions of Gandhāran scrolls and their origin also suffered from an excessive focus on the long-format type. This was initially due to the fact that scroll Dhp-G^K was the only available specimen, but even after the discovery of the BL collection, the impression that the long format was more widely used and characteristic for the tradition persisted (Salomon 1999, 98). The picture changed radically with the RS collection which consists almost entirely of short-format scrolls, and with the Bajaur collection which consists in equal parts of short- and long-format scrolls, and as argued in footnote 5 even the BL collection contains more examples of the short format than was apparent. This new-found preponderance of short-format scrolls further weakens any connection with the Greek and Chinese scroll traditions, and it suggests that the short-format scrolls played a more central role in the development of the Gandhāran tradition than previously thought.

A complete reevaluation of the origin of the Gandhāran scroll format is thus needed, and the first question is whether any other ancient manuscript culture was in contact with Gandhara and could have been instrumental in the development of the Gandhāran tradition. The most obvious candidate is the Achaemenid empire which ruled Gandhāra from the 6th to the 4th century BCE. It has long been agreed that Kharosthī – the writing system used in Gandhāran inscriptions and manuscripts - is a derivative of the Aramaic script used in the administration of the Achaemenid empire (von Hinüber 1990, 55, Falk 1993, 92–99), and if the Aramaic scribal tradition provided the graphical raw material for Gandhāran manuscript culture, then its influence may very well also have extended to the physical support of texts – the format, construction and use of manuscripts – and it is surprising that this possibility has so far received no discussion at all.

Our earliest evidence for Aramaic scribal practice are Assyrian bas-reliefs of the 8th and 7th centuries BCE, depicting the recording of plunder (Dougherty 1928, 129-133, Hyatt 1943, 73, Lemaire 1985, 119; Figure 11). These records were kept in

duplicate, on clay tablets in cuneiform script and on parchment or papyrus manuscripts in Aramaic script. In these reliefs, the Aramaic scribe is shown standing up, with a pen in one hand and a flexible sheet or scroll, curling up at the bottom, in his other hand. Lemaire 1985, 119–122 collects the evidence for the material of Aramaic manuscripts and suggests that leather was used where special durability was called for (e.g., in the Achaemenid royal archives, and thus in the records of plunder), but that papyrus – where available – was the more common writing material for other purposes (including letters and private contracts).²⁶



Fig. 11: Aramaic scribe with scroll in Assyrian relief (Hyatt 1943, fig. 5).

Documentary evidence for the Achaemenid Aramaic scribal tradition is available from the 5th and 4th centuries BCE. The total known corpus includes about 150 documents and consists of the following major manuscript deposits:

 Approximately one hundred contracts, letters and other documents on papyrus from the archive of a Jewish military colony in Elephantine at the southern border of Egypt. The bulk of these was published in Sayce 1906, Sachau 1911 and Cowley 1923; Kraeling 1953 added seventeen documents.

²⁶ Haran 1982 similarly argues that papyrus was the common writing material in Israel until about the 5th century BCE, when the beginning canonization of Biblical literature in the Second Temple period led to the preferred use of parchment for scriptural texts. Hicks 1983 acknowledges the existence of both papyrus and parchment manuscripts in early Israel, but suggests the texts that came to constitute the Old Testament may have been written on parchment from the beginning.

- Five private letters on papyrus sent from northern Egypt to Hermopolis in 2. central Egypt, where they were discovered inside a jar in a necropolis for the ibis bird (Bresciani/Kamil 1966).
- Thirteen letters on parchment sent by Arsham, the satrap of Egypt, from Susa 3. to his local governor (Driver 1954).
- Thirty official letters, lists of provisions and records of debt, probably from 4. the archive of the satrap of Bactria, written on parchment, and all but one dating to the 4th century BCE (Shaked 2004, Naveh/Shaked 2012).

Within the Achaemenid empire, letters such as those of the satrap Arsham were conveyed over great distances by a postal system of highways, horses and relay stations that was subsequently adopted by Alexander the Great (Westermann 1928, 375–376). In the 4th century BCE, Alexander's general Nearchus reported that in Gandhāra letters were written on tightly-woven pieces of cloth (ἐν σινδόσι λίαν κεκροτημέναις; Janert 1955/56, 53-55, Falk 1993, 290), and it is likely that he referred to Aramaic letters used by the Achaemenid bureaucracy in Gandhāra (von Hinüber 1990, 20-21), even though cloth is not attested among the Aramaic finds from Bactria, Persia and Egypt. In the 3rd century BCE, the Asokan inscriptions in Aramaic (Boyce/Grenet 1991, 131-149) attest to the continued use of this language and script in Gandhāra.

Detailed studies of the Aramaic documents from Egypt and Persia have been carried out by Bezalel Porten (especially Porten 1979 and 1980), and the following overview of Aramaic scroll construction and use is based on his findings. The recent publication of the Bactrian archive has confirmed the results set out below.

At least in those parts of the Achaemenid empire where papyrus rolls were available, the Aramaic tradition also distinguished between a long format (horizontal scrolls filled in columns and used for literary works and long lists) and a short format (for letters, contracts and shorter accounts; Porten 1980, 41). Depending on the importance of the short-format documents and on the available raw materials, they could be produced from more durable parchment or less durable papyrus (and, according to Nearchus, also from cloth). In the case of papyrus, the starting point for both scroll formats were long rolls of about 40 cm in width that had themselves been glued together from sheets in such a way that on the recto the papyrus fibers were perpendicular to the joins, while on the verso they were parallel to the joins. The orientation of the horizontal long-format scrolls was accordingly such that the lines of writing followed the direction of the fibers (and were perpendicular to the joins) on the recto, but in the short-format scrolls the lines of writing are perpendicular to the fibers (and parallel to the joins) on the recto. This indicates that in the production, inscribing and use of short-format Aramaic documents the orientation of the writing material was vertical (Porten 1979, 80), and confirms the visual evidence of the Assyrian reliefs.

Based on an examination of more than 30 Aramaic short-format documents, Porten 1979, 78–79, 92 distinguishes three different types of width among papyrus scrolls – a small size of 25–26 cm, a medium size of 27–28 cm and a large size of 30–32 cm²⁷ – as well as a typical width of 30–32 cm among parchment letters. The width range of Aramaic short-format scrolls thus overlaps with that of the Gandhāran short-format scrolls studied in this article (ca. 20 cm to 27 cm), but not with that of the Gandhāran long-format scrolls (14 cm to ca. 15.5 cm). Porten does not provide an account of the heights of his documents, but the photographs published in the editions of Aramaic documents show that their height varied as much as that of the Gandharan short-format scrolls, from a slightly-wider-thanhigh aspect ratio (like in scroll RS 19) to scrolls that are considerably higher than they are wide (like BL 5B), depending on the space requirements of their content (Porten 1979, 92).

Aramaic papyrus scrolls (and presumably also parchment scrolls) were inscribed with a black ink made from carbon mixed with a thin gum solution, using a reed brush (specimens of which have been found) as writing instrument (Porten 1979, 76, 79–80). While some uncertainty remains about the exact composition of Gandhāran ink and while no original pens have yet been discovered in Gandhāra, the basic tools of the two scribal traditions thus agree in general outline. When an Aramaic scribe needed to correct a mistake he blotted it out using a piece of cloth or his finger (Haran 1982, 168–169), another habit that he shared with his Gandhāran counterparts (see section 4).

The extent to which the Aramaic writing material was filled with text, and the way in which the text was laid out, depended both on the type of text and the nature of the material. Letters on parchment and contracts on parchment or papyrus were inscribed on the recto only (Porten 1979, 88-90, 92). In the case of parchment, this was due to the coarse surface of the verso which made it unsuitable for writing. The motivation for writing contracts on one side only is less clear, but it is likely that the physical protection of the content was more important in this type of text than in others. When a scroll was inscribed on both sides, the scribe would flip it over vertically in reaching the bottom of the recto, and continue inscribing the verso from the same end of the scroll (Porten 1980, 42), in just the same way as the early Gandhāran scribes. The text area of Aramaic shortformat documents starts one or two centimeters from the right edge of the scroll, and lines run as close to the left margin as their content allowed, corresponding

²⁷ Porten 1980, 39-40 operates with two standard widths of 27 cm and 32 cm instead.

exactly to the Gandharan practice. The top sheet (approximately 15-20 cm) of a contract scroll was usually left empty (Porten 1979, 81), presumably again for the protection of the content of the scroll when it was folded up, a practice that we also observed in the Gandhāran long-format scroll Dhp-G^K and in the shortformat scroll BC 8. When an Aramaic scribe ran out of writing surface before he could complete his text, he would turn the sheet clockwise and continue writing in the right margin (Porten 1979, 92), in the same fashion that the scribe of Gandhāran scroll BC 16 continued his text in the right (and top) margin when he had reached the end of his verso. The endorsement of an Aramaic contract and the recipient address of an Aramaic letter were written at the very bottom of the verso so that they would be visible when the scroll was folded up (Porten 1979, 80-81). As shown in section 4, there are strong indications that the recipient address on scroll BC 15 also occupied this position, providing yet another parallelism between Aramaic and early Gandhāran scribal practice.

For storage or transportation, Aramaic short-format documents would be folded up vertically from the bottom to the top of the scroll, in such a way that the recto faced the inside (Porten 1979, 80-81). When the scroll had been folded up all the way into a compact strip, one of several forms of horizontal folding would be applied, depending on the type of document: contracts were folded in thirds, while letters were folded either in half, or first in half and then in quarters (Porten 1979, 88–90; Figure 12). The primary vertical folding of Aramaic shortformat documents thus corresponds precisely to the folding of both short-format and long-format scrolls in early Gandhāra, and one of the two variants of horizontal folding of Aramaic letters corresponds to the horizontal folding of Gandhāran short-format scrolls.

In view of this long list of detailed agreements in the way that short-format documents were prepared, inscribed and used in the Achaemenid empire and in early Gandhāra, and on the historical background of the Achaemenid administration of Gandhāra at the time when the Aramaic script was first adapted to the writing of the Gandhari language, I therefore suggest that Aramaic manuscript formats and scribal habits as practised in the Achaemenid empire likewise formed the starting point for the Gandhāran manuscript tradition. The immediate point of contact between the two traditions is provided by their short-format documents, and also historically it seems likely that the inhabitants of Gandhāra under Achaemenid administration primarily (or even exclusively) observed the use of Aramaic manuscripts and writing in the form of documents regulating their everyday affairs. When they made this new cultural technique their own, evidently also applying it to legal and administrative purposes, the first innovation consisted in the use of the locally available writing material birch bark. The long strips of bark harvested from trees replaced the strips of parchment and rolls

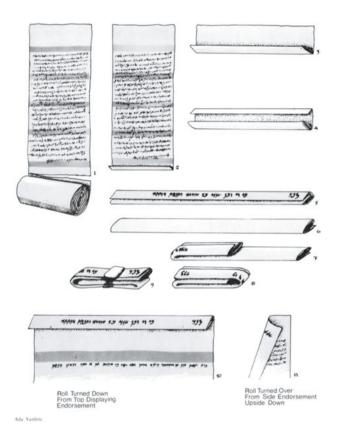


Fig. 12: Inscribing and folding of an Aramaic contract scroll (Porten 1979, 79).

of papyrus, and vertical margin threads were introduced to compensate for the greater fragility of birch bark, but in all other respects the preparation and use of short-format documents remained the same that it had been in the Aramaic tradition.

When manuscripts started being used for the transmission and ritual handling of Buddhist (and non-Buddhist) literature, the need for a separate long format arose. But as noted above, the Aramaic long format was probably never very familiar in Gandhāra and presumably disappeared completely as a possible model with the collapse of the Achaemenid empire in the 4th century BCE. The corresponding Greek long-format type may have been used in the Greek colonies in Bactria around the same time, but the cultural influence of these Greek colonies did not permeate Gandhāra until the middle of the 2nd century BCE, and thus the Greek scroll also appears to have been unavailable as a model for the development of the Gandhāran long-format type. Because of the unavailability

of these external models, the development of the Gandhāran long-format scroll proceeded as a simple vertical extension of the short-format type as described in detail above, but possibly inspired by the observation that Aramaic short-format scrolls on papyrus were cut from rolls that were originally glued together from sheets. If this scenario is accepted, then it suggests that the development of the Gandhāran long-format scroll occurred between the end of Achaemenid rule and the beginning of strong Greek influence in Gandhāra, at some point of time beween 300 and 150 BCE.

The evidence thus indicates that birch-bark scrolls in two different formats constituted the primary manuscript type of Gandhāra for approximately five hundred years, until they fell out of use and were replaced by the pan-South-Asian writing material palm leaf and its narrow horizontal format. The almost complete disappearance of the scroll format appears to have gone hand in hand with the replacement of Gandhari as a literary language by Sanskrit, and both processes are clearly illustrated by the 2nd- to 4th-century CE Kharosthī manuscripts found at Bamiyan and in Xinjiang (see Table 1) which are not only exclusively written on palm leaf but show a high degree of Sanskritization. The later use of birch bark for other manuscript types falls outside the scope of this article, but it is interesting to note that we can distinguish three cycles of the introduction and adaptation of manuscript traditions in Gandhāra and the surrounding areas:

- In the 6th century BCE, Gandhāra comes under the influence of the Achaemenid empire and is introduced to the Aramaic administrative manuscript tradition. It adapts both the writing system and the writing material of this tradition to the local language and to a locally available raw material.
- In the 2nd century CE, Gandhāra comes into closer contact with the manuscript traditions of mainland South Asia, using the Brāhmī script and palm leaf as writing material. The local script and literary language are given up, and birch-bark manuscripts imitating the palm-leaf format become the general manuscript type of Gandhāra (Sander 1968, 24, 27–29).
- In the late 1st millenium CE, Gandhāran Buddhist manuscript culture gradually disappears. Western paper formats and the codex are introduced to the region, but in Kashmir birch bark continues to be used for the production of manuscript codices, until paper is adopted as the general writing material under Mughal influence in the 17th century CE (Bühler 1877, 29–30).

The Gandhāran scroll format survived in niche applications for amulets and ritual purposes (Gough 1878, 17-18, Bühler 1896, 88, Janert 1955/56, 71-72, Losty 1982, 9). The earliest example for this practice appears to be part of the same manuscript deposit as the rest of the BL collection (Salomon 1999, 46). The scroll in question (BL 6) is exceptionally narrow (5.5 cm) and made from a single piece

of bark. In contrast to all other known Gandhāran scrolls it is written in Brāhmī. It appears to contain a Buddhist sutra comparing the human body to a city (not a medical text as initially reported). A very similar narrow paper scroll, measuring 6.4 cm in width and containing a collection of sūtras and magical formulas, was found in Shorchuk on the Northern Silk Road (Waldschmidt 1959). At the other end of the spectrum in terms of size and chronology, we find large illustrated scrolls to be carried in procession, such as the twenty-meter-long cloth scroll containing a Devanagari text of the Bhāgavatapurāna illustrated in Gaur 1972, 160. In all of these later scrolls the general parameters of text layout and the direction of folding or rolling remained the same as in the early Gandhāran scroll types.

Further research is needed on the historical relationship between the Gandhāran birch-bark scroll format and the thin sheets of gold, silver and copper that often accompanied contemporary Buddhist relic deposits, recording their donor and beneficiaries and sometimes quoting from canonical literature (Baums 2012). These metal sheets are typically much wider than high and rolled up horizontally, but some resemble the short-format birch-bark scrolls in their dimensions, and the Senavarma gold sheet (Baums 2012, no. 24) shows signs of having been folded in thirds horizontally (like the Aramaic contract scrolls, but without prior vertical folding). Janert 1955/56, 42 independently suggested that the metal sheets might imitate pieces of birch bark folded up and deposited in reliquaries, and several reports of birch-bark "twists" found in reliquaries but now lost (summarized in Salomon 1999, 59–61) may refer to these prototypes for the metal sheets. Two recently-found copper books – consisting, respectively, of five and eight plates that have the general shape and size of birch-bark sheets and are linked to each other by metal rings – may similarly represent metal imitations of long-format birch-bark scrolls, and the recent edition of the shorter of these books (Falk 2014) reveals a relic-donation formula expanded by numerous scriptural quotations, similar to the text on the Senavarma gold sheet. A full edition of the other copper book remains an urgent desideratum, but it seems increasingly likely that the legendary reports of Buddhist canonical texts engraved on copper and interred in stūpas – most notably by the Chinese pilgrim Xuánzàng (7th century CE) in reference to the Buddhist council under Kanişka (Bühler 1896, 90, Janert 1955/56, 43, Falk 1993, 309) – are rooted in a memory of such long, literary relic inscriptions on copper imitations of long-format birch-bark scrolls.

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