STUDIES OF ANCIENT EGYPTIAN FOOTWEAR. TECHNOLOGICAL ASPECTS. PART VIII. FIBRE, COILED SANDALS

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1. *Introduction*

Footwear in ancient Egypt was varied, ranging from simple eared sandals to open shoes made of leather and sewn sandals to open shoes that were made of fibre. Coiled sandals of vegetable fibre are the topic of the present work as part of the Ancient Egyptian Footwear Project (AEFP; see Veldmeijer, 2010 for a detailed description of the objectives of this project).[1] As always, the focus of this series is on the manufacturing technology; other topics will be discussed in passing, to be dealt with in detail in a later stage of the project. The results of the identification of the material of several coiled sandals (as well as several other types of sandals), from the collections in the British Museum (London), the Petrie Museum of Egyptian Archaeology (University College London) and the Ägyptisches Museum und Papyrussammlung (Berlin) by means of optical and scanning electron microscopy is forthcoming (Cartwright & Veldmeijer).

The 15 sandals from several collections (table 1) that have been studied[2] can be divided in three types on the basis of the sole construction (figure 1): coiled with plied string,[3] coiled with braids (divided in two variants: Variant 1 with coarse braids and Variant 2 with finer braids — see below for more differences) or coiled with flat strips that consists of two cores around which unspun fibre is looped.

2. *Description*

2.1. *Sole Shape*

Roughly, the shape of the sole of coiled sandals can be divided in oval and (highly) shaped with a constricted waist. The first are seen with the Plied String Type and Variant 1 of the Braided Type. UC 28308 of the Braided Type, Variant 1 seems to be oval in shape, but this is due to the fact that the sole lack the heel part. The construction of the front part — the inclusion of a separate centre part as described below and the subsequent start of the waist without it — strongly suggest a shaped sole originally. Only one sandal of Variant 2 of the Braided Type has an oval shape. Thus, the shape cannot be used as classification criterion.

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[1] See also www.leatherandshoes.nl.

[2] Two pairs, housed in the Bata Shoe Museum, Toronto, have not been studied and thus are not shown in the table.

[3] Cordage terminology is after Veldmeijer (2005).

Collection/ Identification	Provenance	Date	Type/ Variant	Measurements	Strap Complex	Remarks
British Museum QI 66A/365	Qasr Ibrim	Undated	Plied String	L: 260; W: 100; W max: 120. D string: 8.2/5.6	Not preserved	–
Petrie Museum UC 28308	Hawara	Late Roman Period? (395CE-250CE)	Braid, Variant 1	L: 20 cm. W: 8.5 cm#	Not preserved	–
World Museum Liverpool M 11902	?	New Kingdom	Braid, Variant 1	W heel: 81.8; W max.: 103.3. L: 245. T: 18.1	Not preserved	–
Petrie Museum UC 28020	Hawara	Roman Period (395CE-30BCE)	Braid, Variant 2	W heel: 65; W front: 63. L: 195. T: 10.5	Not preserved	Still dirt adhering to sole. Worn. Thirteen coils at heel; 20 at toe. Edge reinforced by attaching core with winding. Note that with entry 'UC 28300iii' the latter part of 3rd?Cent A.D is suggested as date for this sandal.
Petrie Museum UC 28033	Hawara	Roman Period (395CE-30BCE)	Braid, Variant 2	W heel: 53; W max.: app. 58. L: 175. T: 8.5. D straps: 3.5-4.1	Triple 3-D braid in T (without core)	Material ID forthcoming (Cartwright & Veldmeijer). Worn. Edge reinforced by attaching core with winding.
Petrie Museum UC 28300i, ii	Hawara	Late Roman Period? (395CE-250CE)	Braid, Variant 2	W heel: 47; W front: 62; L: 225. T: 2.5. D straps: 3.5	Not preserved	Sixteen coils at heel; 22 at toe. Same as Petrie UC 28300iii.
Petrie Museum UC 28300iii	Hawara	Late Roman Period? (395CE-250CE)	Braid, Variant 2	L: 22.7. W: 6.8 cm#	Duplo 3-D braid in T	Edge reinforced by winding. Same as Petrie UC 28300i & ii.
Ashmolean Museum 1888.810	Hawara	Late Roman	Looped	W heel: 55.7; W waist: 44.4; W front: 70.6. L: 235. T: 8. D front strap: 6.3; D back strap: 4.4	3-D braid in T	Leather reinforced edge.
British Museum EA 4418/4419	Giza, Tomb	?	Looped	W heel: 53.7; W max.: 68; W front: 55. L: 235. T: 7.7. W back strap: 4.6; W front strap: 5.6	3-D braid in Y	Measurements taken of the right sandal. Remnants of leather suggest reinforced edge.
Petrie Museum UC 28301i	?	Late Roman Period? (395CE-250CE)	Looped	L: 21.2 cm. W: 7 cm#	Not preserved	Coils held in place by rod put through transversely.
Petrie Museum UC 28301ii	?	Late Roman Period? (395CE-250CE)	Looped	L: 24 cm. W: 7.3 cm#	Not preserved	Coils secured with rods.
Petrie Museum UC 28302	Hawara?	Late Roman Period? (395CE-250CE)	Looped	L: 24 cm. W: 8 cm#	3-D braid in Y	Remnants of leather suggest reinforced edge. Material ID forthcoming (Cartwright & Veldmeijer).
Petrie Museum UC 28303	?	Late Roman Period? (395CE-250CE)	Looped	L: 24.5 cm. W: 7.3#	3-D braid in Y	Leather reinforced edge and junction front/back strap. Material ID forthcoming (Cartwright & Veldmeijer).

Table 1. Summary of most important features and measurements of coiled sandals, showing collection and identification (first column), provenance (second column), date (third column) and type/variant (fourth column). This is followed by the measurements (fifth column), details of the strap complex (sixth column) and, finally, the remarks. Measurements marked with '#' are taken from the archives of the Petrie Museum of Egyptian Archaeology (UCL).

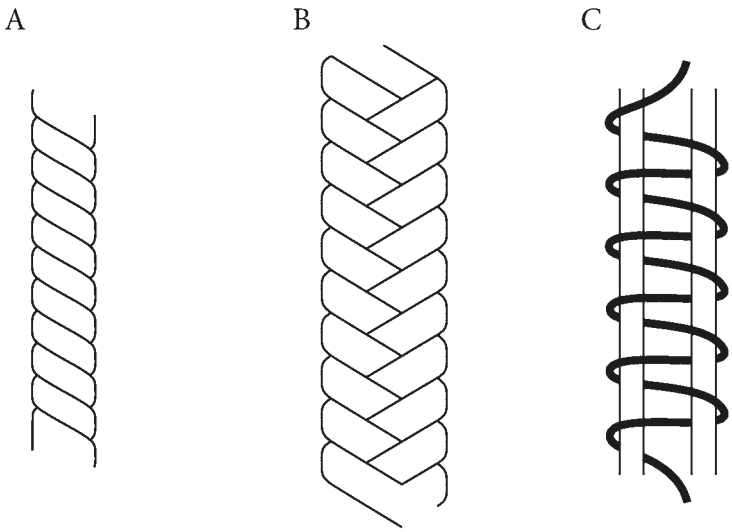


Figure 1. Units from with which the different types of coiled sandals are made, giving the types their name. A) Plied String; B) Braid; C) Loop. Drawings by E. Endenburg/A.J. Veldmeijer. Not to scale.

Remarkably, all sandals of the Looped Type have highly shaped soles, most clearly seen in UC 28302 (figure 4B). However, this does not mean that this shape does not occur with the other types: UC 28301i, ii and iii all have a comparable shape too but the lateral expansion is far less distinct. The heel is rounded and the waist is slightly constricted. Further towards the toe, the width of the sandal increases distinctly but mainly at the lateral side. This results in a large expansion of the lateral edge after which it runs diagonally towards the narrow toe. The medial edge has a slight convex curvature from the waist towards the toe.

2.2. *Sole Construction*

2.2.1. Plied String Type

The sole construction of coiled sandals is relatively simple. The single sole of the only example of the Plied String Type (QI 66A/365; figure 2) — excavated from an undatable context in Qasr Ibrim — is made by coiling a plied string (figure 1A; the string is sZ_2[4] of palm fibre (see Veldmeijer, 2006/2007: 62). The coiled string is secured with stitches at a right angle, but without additional edges or reinforcement. A slight indication of waist might be identified, but this seems to be due to differences in diameter of the string rather than an intended feature of the sole shape itself. The sole of QI 66A/365 is incomplete: the heel is missing, probably due to wear because the ventral surface is worn too.

[4] Veldmeijer (2006/2007) erroneously refers to the string as zS_2.



Figure 2. The Plied String Type is represented by one sandal (QI 66A/365) from Qasr Ibrim (see also Veldmeijer, 2006/2007). Photography by E. Endenburg. Courtesy of the Egypt Exploration Society. Scale bar in cm.

2.2.2. Braided Type

The sole in the Braided Type is made of a coiled braid (figure 1B). In all cases the edge of the braid faces dorsal and ventral. In other words, the width of the braid makes the thickness of the sole. This type has two variants. In Variant 1, the braid is coiled and secured at right angle with string. The oval shape of WML 11902 is obtained by starting the coiling in a circle once, after which the coiling is done in a more elongated way. In UC 28308 (figure 3A), the coiling is not started in a circle, but more oval. After four windings, which roughly make up the centre of the front half of the sandal (arrow in the figure), the coiling is expanded (*i.e.* elongated) to create the back half. Since this part lacks a centre as in the front, the heel is distinctly smaller. It is possible that the sole consists of two parts: the centre part of the front half (arrow) and the subsequent, separate coiling over the entire length of the sandal, but this could not be ascertained without deconstruction of the sole and hence was not carried out.

A comparable way of constructing the sole is seen in Variant 2 (figure 3B), but in general the braids are (much) finer and there are more windings. Moreover, the coiling is much tighter. Although most are highly shaped with a rather narrow waist, the shape of UC 28033 (figure 3B left) is less clearly defined. The edges of this variant are finished by adding a core

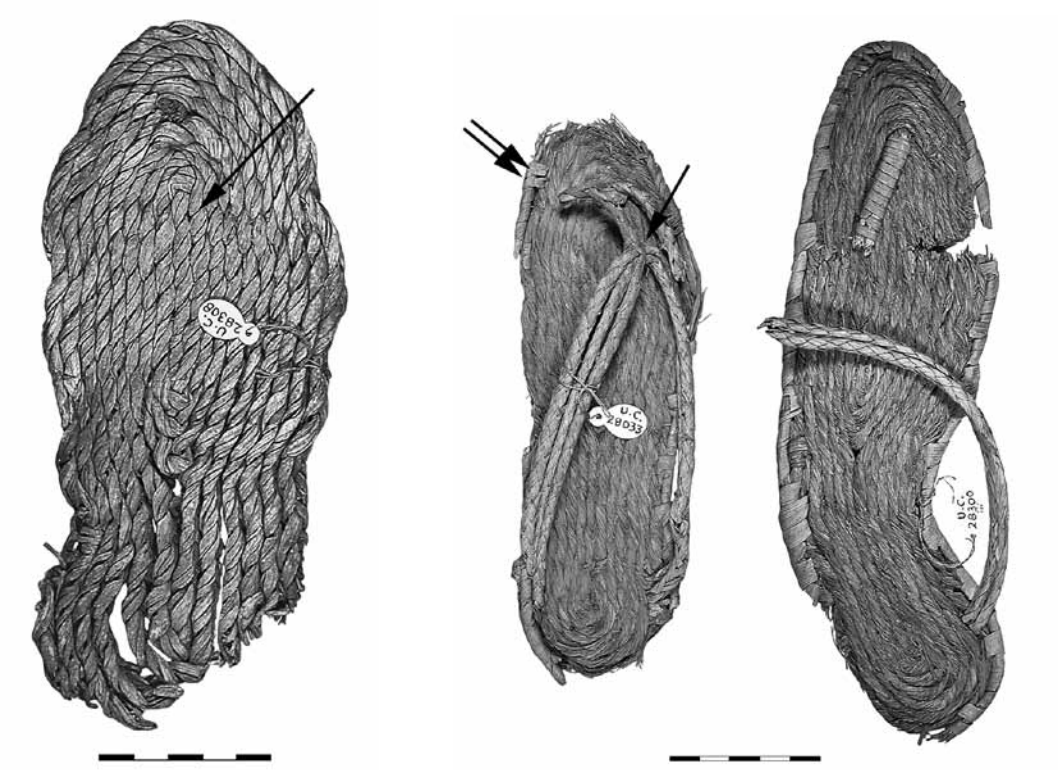


Figure 3. The Braided Type consists of two Variants. A) An example of Variant 1: UC 28308; B) Two examples of Variant 2: UC 28033 and UC 28300iii. Courtesy of the Petrie Museum of Egyptian Archaeology (UCL). Reworked by E. Endenburg/A.J. Veldmeijer. Scale bar in cm. The arrows are explained in the text.

that is clad with a strip of palm leaf. Occasionally one winding includes the last coil of the sole proper to secure the separate edge (double arrow in figure 3B). A comparable edge is seen in UC 28020 and UC 28300 (figure 3B right), but is not registered with the other two types (but the Looped Type has different reinforcements of the edge, see below).

2.2.3. Looped Type

The sole of the Looped Type of coiled sandals (figure 4) is made of a flat strip that consists of two cores around which unspun fibre is looped (figure 1C). This strip is coiled in such a way that the edge makes up the dorsal and ventral surfaces of the sole. Thus the width of these looped strips is the same as the thickness of the sole. The coiled strip is held in place by stitches at right angle. In UC 28301i and ii, however, the coils are secured by inserting a small rod between the two cores (figure 5). The outermost winding is covered with leather that is folded over the edges. The edges of the leather strip are thus sandwiched between the edge of the sole and the outermost coil more inwards (arrow in figure 4A). It is not exactly clear what the main purpose was of this feature, but it certainly gives a nice

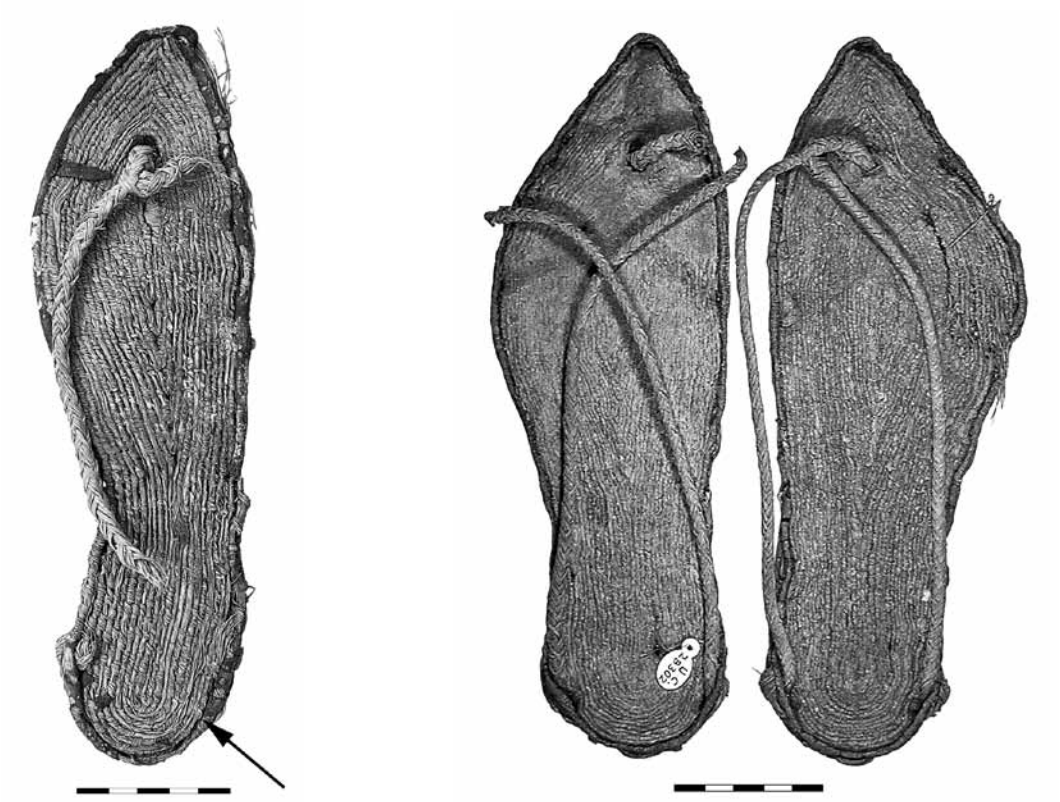


Figure 4. Two examples of the Looped Type. A) ASH 1888.810. Photography by E. Endenburg. Courtesy of the Ashmolean Museum, Oxford; B) UC 28302. Courtesy of the Petrie Museum of Egyptian Archaeology (UCL). Reworked by E. Endenburg/A.J. Veldmeijer. Scale bar in cm. The arrow is explained in the text.

finishing touch. However, decoration could also have been done with, for example, coloured vegetable fibres. Therefore, it seems more likely that the main purpose was to reinforce the edge, and especially to protect the stitches that secure the coils: leather is less prone to wear than fibre. The fact that this reinforcement was only done with soles that are made with looped strips might suggest that these strips are rather weak relative to the braids. However, also edges of the Braided Type, Variant 2 are reinforced but with an additional, separately applied edge that consist of a wrapped core rather than leather. The Braided Type, Variant 1 sandals are without reinforced edges.

2.3. *Strap Complex*

All strap complexes that are (partially) preserved show the same technology: braiding around a core, resulting in straps with a circular cross section (figure 6). Although this is the basic concept, there are differences in detail. The strap complex in UC 28300iii (Braided Type, Variant 2) is only partially preserved, but fortunately enough is preserved to identify

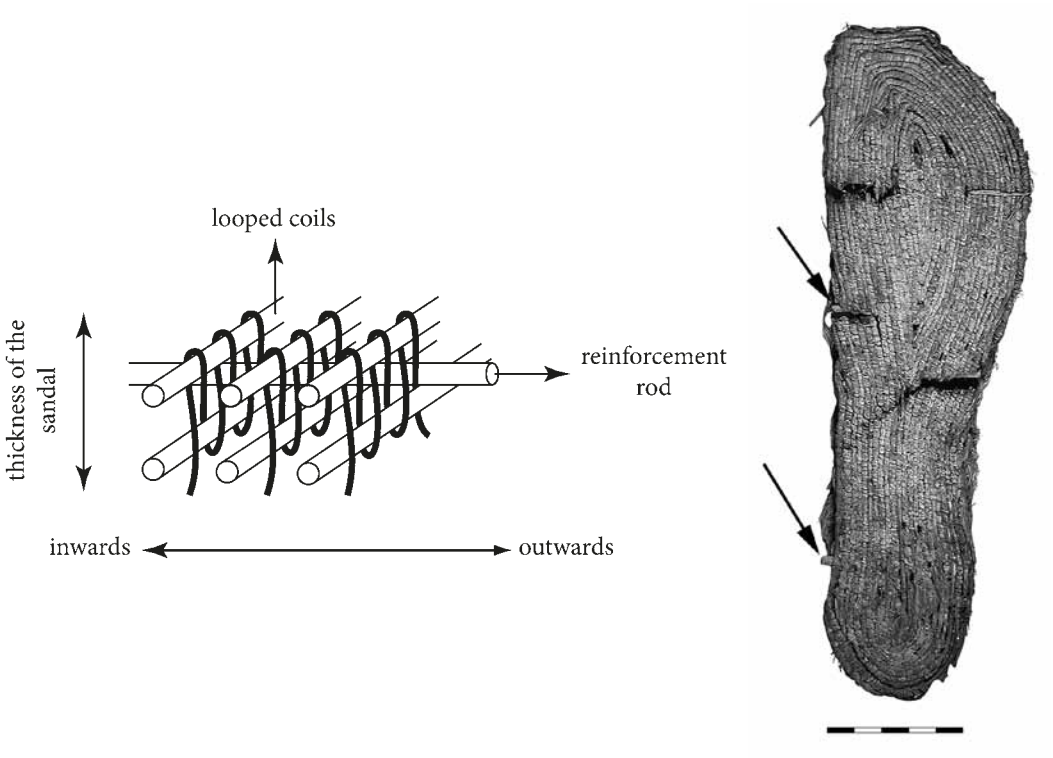


Figure 5. The coils in UC 28301ii are secured with small rods that are inserted at right angles between the cores of the coils (some of which are indicated with arrows). This contrasts to the usual construction in which the coils are secured with string. Courtesy of the Petrie Museum of Egyptian Archaeology (UCL). Reworked by E. Endenburg/A.J. Veldmeijer. Scale bar in cm. Drawing by E. Endenburg/A.J. Veldmeijer. Not to scale.

the technique. The back strap inserts between the outer coil (not counting the decorative reinforcement edge) and the subsequent coil. It is not clear how it was secured. The connection to the front strap is uncertain. A stub of the front strap is still *in situ* and shows two three-dimensional braids-with-core around which a narrow strip of leaf is wound to keep them together tightly. The front strap in UC 28303 (Looped Type) is wrapped too, but here with leather. Moreover, the back strap consists of one braid, rather than two. It is secured at the ventral surface by means of an overhand knot — this suggests that also the back straps were secured with a knot at the ventral surface, which is a way of securing that is rare in Egyptian sandals. The straps in UC 28033 (Braided Type, Variant 2) are braided without a core. The back straps consist of three braids, the attachment to the sole of which cannot be identified anymore due to wear. It is clear, however, that they are inserted between the last and one-but-last coil. The attachment to the front strap is extraordinary: one of the narrow strips of leaf that is used for braiding is made into a loop through which two back straps are pulled (arrow in figure 3B). The remainder of the front strap continues as the middle one of the three back straps to either side. Possibly, this central strap is thinner than the outer ones because it lacks a core, whereas the others do not. Due to wear, it is unclear how the front strap is secured.

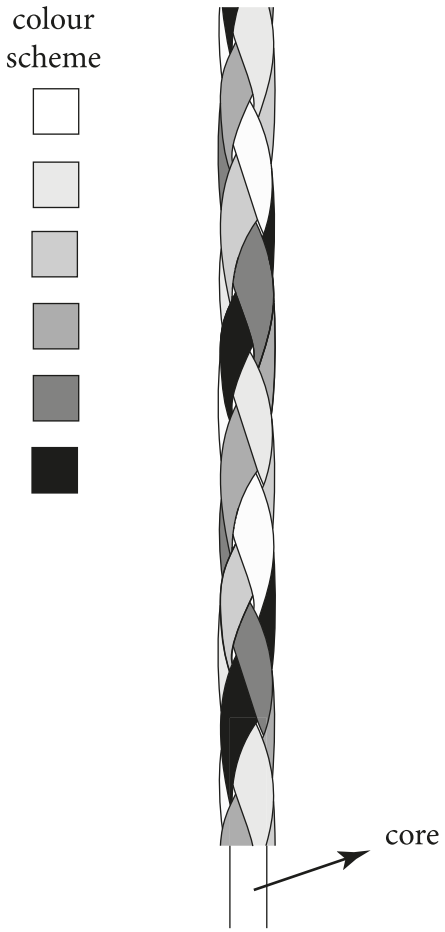


Figure 6. Straps in coiled sandals are often made of braiding around a core; three-dimensional braiding without a core, however, also occurs. Drawing by E. Endenburg. Not to scale.

The back strap of ASH 1888.810 (braided 'over two, under two, shift 1') is attached to the front strap by braiding them together. The straps in BM EA 4418/4419 are also made of three-dimensional braids (likely 'over 2, under 2, shift 1') but include a core, in contrast to for example ASH 1888.810. The two back straps are braided together into a 'front strap', slightly above the insertion through the sole. Thus the strap complex can be described as 'Y-shaped', as are all the others in this category of sandals.

3. *Wear*

The nature of the soles in the Looped Type at one hand and the Braided and Plied String Type on the other hand differ. The looped soles are stiff due to the tight coiling and does not allow bending whereas the soles of the other types are much more flexible. In this, the Looped

Type behave much more like sandals with a wooden sole and hence the wear differs from the other Types: the wear occurs predominantly at the heel's edge and not at the point where in other sandals the sole would bend during walking and thus often shows wear — at the articulation of the toes with the metatarsals (for example UC 28300iii).[5] One should, however, keep in mind that wear would be much more severe when walking on hard surfaces: in Egypt, however, walking would have been done much more often on soft surfaces such as sand.[6]

The separate edge of the Braided Type clearly is a weak point: the edge is incomplete in all examples. Although the attachment by means of occasional stitches (see above) suggests that the edge is decorative rather than functional, in the places where the edge is broken, the outermost core of the sole itself is in most cases still (largely) intact. This suggests that despite the seemingly flimsy way of attachment, it did function as reinforcement nonetheless.

Other signs of use are noted in UC 28020, where the fibres are compressed. Comparable wear is seen in ASH 1888.810 but here also seeds and coarse sand grains still adhere to the ventral surface. The damage to the strap complex or even the lack of it is not always easy to explain: for example, it could be due to wear or due to rough handling, either in ancient times or post-excavation (the broken strap in ASH 1888.110 is an example of the latter). Moreover, the kind of wear differs with the various straps. For example, the straps in sewn sandals Type C discussed elsewhere (Veldmeijer, 2009c; 2010) are not in contact with the foot continuously and thus rubbing is limited. The straps in coiled sandals, however, are less bulky and lie close to the foot. The close contact with the foot results in continuous rubbing of the strap over the foot and this leaves its marks on the strap.

4. *Date and Distribution*

The only sandal of the coiled category that is dated to pre-Roman times is the Plied String Type; all other dated sandals are Roman. The Qasr Ibrim sandal is the only sandal of the provenanced specimens that does *not* come from Lower Egypt (Hawara, Gizeh). Probably, the distribution of these variants was limited to this area; how can we otherwise explain the lack of these sandals further south where the preservation circumstances are so much more favourable? The report by Bresciani (1976: 19, 62) and Russo (2004: 185-186) of coiled sandals from Medinet Madi (Narmuthis) in the Fayum Oasis seemingly supports this suggestion.

5. *Comparison and Discussion*

There are interesting differences between the sandals presented here and the ones reported in literature. Especially remarkable is the shape of the sandal depicted in plate XXVI of Bresciani (1976: 62): the sandal has a narrow waist with a slightly expanding, rounded heel. The front, however, is extremely wide and has a square front edge.[7] Although the only

[5] Possibly, the cracks in UC 28301ii are due to wear.

[6] Or more muddy substrates.

[7] Note the resemblance with the so-called 'cowmouth' or 'Tudor Shoe' (for example Goubitz et al., 2001: 275-279.

example of coiled sandals, the shape does occur more often among Egyptian footwear.[8] The sole consists of two parts: the 'centre' part of the front and the 'lining' that solely makes up the heel. This system possibly is present in the Braided Type described here, but has not been identified in the other types, which suggests that the sole in the Medinet Madi sandal consists of braids too. However, the width of the coils seems to be too small for braids and are much more comparable to the looped construction. Another sandal presented by Bresciani has a shape that compares well with the general shape described here. However, the third sandal is not only much bigger in overall size, but has a much longer, pointed toe as well. Again, not an uncommon shape for sandals, but not seen with other known coiled sandals. The large width of the coils of this latter sandal suggests braiding or, perhaps, a sole made of plied string.

A problem arises with the sandal described by Russo (2004: 185-186). A coil, probably made of halfa grasses or reed, is wrapped with strips of vegetable fibre. Russo suggests that, in doing so, it tightly secures the coils. This would be a technique referred to by the AEFP as 'coiled sewn' (Veldmeijer, 2009a), but the few intact parts of the centre coils visible in the overview photograph (Russo, 2004: Tavola IV) does not show such a construction. It seems, therefore, more likely that the wrapped cores were secured differently, possibly by means of transverse stitching. Actually, string that serves this purpose might even be visible at the edge. If this is, indeed, correct than this means a close resemblance to the looped type discussed here and classification within one group would thus be preferable. Consequently, the name of this group might than be changed into 'Core Type', distinguishing between the 'Looped Variant' (described in the present work) and the 'Wrapped Variant' that is mentioned by Russo. However, the observations presented here are on the basis of Russo's description and the photographs, and since the sandals are much worn, confirmation by first-hand study is necessary before being able to change the classification. A remarkable feature of the 'Russo sandal' is the large back strap, which is a wide plaited strip that inserts at the edge and runs towards the front strap, thus forming an Y-shaped strap complex. The front strap consists of a core around which the outer layer is plaited.

Several sole manufacturing techniques have been recognised among ancient Egyptian fibre sandals.[9] The sole in sewn sandals are made of bundles of grass (usually halfa but reed was used on occasion) that are secured by sewing with palm leaf strips, thus wrapping the bundle. In coiled, sewn sandals the same technique, *i.e.* wrapping a bundle of fibre and sewing, is combined with coiling as seen in coiled sandals discussed in the present work. Sewn-edge plaited sandals[10] consist of a plaited sole that is secured along the perimeter with a sewn edge and is therefore markedly different from the sole of coiled sandals. Finds from Qasr Ibrim

[8] SAIUH 1170, a woven sandal in the Sammlung des Ägyptologischen Institut der Universität Heidelberg; UC 28291ii and UC 28292 are leather sandals in the Petrie Museum of Egyptian Archaeology (UCL) and the fibre composite sandal UC 28309i-iv also in the Petrie Museum of Egyptian Archaeology (UCL) (see Veldmeijer, In Preparation).

[9] No repetitive references are made to the technological papers by the AEFP of sandals that already have been published. Instead, the reader is referred to the parts of the series and references therein (see www.leatherandshoes.nl for a list). Only the most often occurring techniques are discussed. In several sandals techniques are combined, but represented by only one find (BM EA 4456 is a good example).

[10] And the related open shoes that are made of fibre (Veldmeijer, 2009b).

have soles that are made by weaving or twining linear cordage (but finds from Deir el Medinah suggests that these techniques were also used in Pharaonic times; especially Gourlay, 1981a: 56-57; 1981b: 41-45; Veldmeijer, 2006/2007 and references therein).

The shape of the strap complex differs from those in sewn sandals: the junction between the front and back straps is much further back and closer to the ankle, due to the much shorter back straps (sometimes described as 'T-shaped'). Moreover, the straps in sewn sandals are made of papyrus and although identification of the material of the strap of the coiled sandals is pending (Cartwright & Veldmeijer) it is certain that they are not made of papyrus. The strap complex in coiled, sewn sandals differs distinctly: the front strap consists of thick strip of possibly reed that is looped around the back strap. Note that another example of coiled, sewn sandals has a strap complex that is comparable to the papyrus straps in sewn sandals (see above). The strap complex in composite sandals of fibre (especially Montembault, 2000: 39-43; Veldmeijer, In Preparation and references therein) is most comparable to the strap complex in coiled sandals. A distinct difference is, however, that in the vast majority of the composite sandals, the straps are very fragile — usually braids of narrow, single strips of palm leaf — whereas the straps in the category of sandals discussed in the present work are clearly much stronger and often includes a core. Moreover, the degree of wear as well as the number of sandals in which wear of straps can be detected, suggests that the sandals were made for daily use in contrast to the composite sandals of fibre: their use seems to have been very limited.

Despite the fact that we know of several of the sandals that they were recovered at Hawara and that thus dating them would seem relatively easy, this is unfortunately not the case. Nevertheless, the date of one sandal is fairly certain: according to Petrie (1889: 13) "A large quantity of sandals were also with this interment — some of papyrus, some of string, some of leather; and some leather shoes, all of which are here figured." It is not clear what is meant, because plate XXI only shows one leather shoe, two leather sandals and three fibre sandals; hardly a large quantity. But the dating is fairly certain because of a coin: 340 AD. Although a description of the coiled sandal lack, the sketch of the sandal in Petrie's plate XXI suggests it is one of the Looped Type (*cf.* figure 4), the identification of which is mainly based on the central part in the front and the shape of the sole. In this particular case we can even link the sandal in Petrie's figure with the archaeological specimen: ASH 1888.810 (figure 4A).[11]

6. *Acknowledgements*

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[11] Note that since the sketch was drawn, the lateral back strap broke shortly above the attachment to the heel.

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