Studies of ancient Egyptian footwear:

Technological aspects. Part VI. Sewn sandals*

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Introduction

It is often said that the ancient Egyptians went barefoot most of the time. Though undoubtedly they did on occasion, many museums all over the world house large quantities of ancient Egyptian footwear. Moreover, if we take P. Harris (BM EA9999, 72.12 and 73.1) literally, the Pharaoh gave away thousands of sandals (Grandet 1994: 96, pl. 34). Furthermore, Janssen (1975: 292 98) in his work on Deir el-Medinah, shows that sandals were a common commodity, the find of many specimens of leather and fibre footwear supporting his observation (Gourlay 1981a: 55 64; 1981b: 41 60, pl. v, xx; Montembault 2000: 87 91, 106, 194, 205; personal observation Ägyptisches Museum und Papyrussammlung Berlin).[55]

Detailed analyses of excavated footwear, however, are few, and our knowledge of footwear is therefore less detailed than one would expect.[56] The present paper presents a total of 75 entries of sewn sandals (including three sewn sandals imitated in other materials),

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[55] See Schwarz (2000: 229-230) for some additional comments based on literature. Although her work is on leather, the part dealing with sandals makes, strangely enough, no differences between leather and fibre footwear.

[56] Most encyclopaedias do not treat sandals separately, but at best, as part of clothing (for example Green 2001: 278), as often done in dictionaries (for example Wilkinson 2005: 53). Most dictionaries however, do not mention sandals at all (for example Shaw & Nicholson 1995). In Seyfried 1984 sandals are dealt with only from an Egyptological point of view. Shoes are not mentioned at all. Despite the lack of detailed research, statements that Egyptian sandals are of poor construction and flimsy are widespread (for example in Partridge 1996: 83-4) and premature at best.

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housed in various collections (Table 1).[57] This study is part of the Ancient Egyptian Footwear Project (AEFP), a work that aims to better understand ancient Egyptian footwear in all of its aspects.

As the AEFP is a multidisciplinary ongoing research, the present paper focuses only on the different technological aspects associated with making various types of footwear. Other footwear related subjects (e.g. philology, iconography, indication of status) will be dealt with only in passing, as they will be discussed in detail elsewhere. In describing footwear, the terminology follows that of Goubitz, van Driel-Murray and Groenman-van Waateringe 2001: 1 334). Terminology of knots follows Ashley (1993, but see also Veldmeijer 2006) and for cordage terminology see Veldmeijer (2005) and Wendrich (1991, 1999). The preliminary classification of footwear (Category, Type, Variant) is based on Montembault (2000). Goubitz, van Driel-Murray and Groenman-van Waateringe 2001: 1 334 use, however, recognisability rather than a classification on the basis of technological features. With sandals, this often goes hand in hand.[58] Thus, this study of ancient Egyptian footwear uses a combination of these two systems.[59]

Description

Shape

The studied specimens are grouped into three Types within the category 'Sewn Sandals' (Table 1A), based on shape (fig. 1). This subdivision is not meant to prove that swayed soles evolved from straight soles as both, straight and swayed soles, occurred throughout Egyptian history and in most sandal categories. Moreover, since many sandals are undated, a detailed sequence through time on the basis of archaeological material is, at present, not possible, although preliminary thoughts will be presented. The sequence is presented because of the close resemblance of the subsequent shapes. Although these differences are small, the variations between the first and last of the sequence are considerable. Note that in some, the attachment area for the back straps is indented at one side. This is due to the severe pulling of the attachment rather than a design feature, such as seen in some other sandal types.

In general, the sandals classified as Type A (Figs. 1, 2A, B, E) are coarse sandals with up to 30 rows of sewn bundles in adult size ones (there are a few exceptions: MFA 72.4760 has 46 bundles; MET 22.3.21b has 29: this is the left one of a pair and the right one, MET 22.3.21a, has 31). Sandal A1 is symmetrical with a slightly constricted waist. Sandal A2 is still uniform but the waist is slightly more constricted; the front part is wider relative to the back half. The waist in sandal A3 is constricted too but the front part is slightly less wide. However, it already shows a tendency of swaying. The next sandal, A4, has a less distinctly constricted waist and is therefore more uniform but nevertheless clearly asymmetrical longitudinally. Sandal A5 shows a more elongated curvature of the lateral side combined with

[57] The material from the tomb of Tutankhamun, which consists for the major part of sewn sandals (see <www.ashmolean.org/Griffith> for Carter's notes; Reeves 1990: 157; Bothmer 1979: 130), housed in the Egyptian Museum Cairo and the Luxor Museum, will be published elsewhere.

[58] With shoes, this is different, as in appearance comparable shoes can be made in different ways, for example with or without rand. This, in its turn, can be originally designed but can also be due to repair, the exact origin of which in many cases cannot be determined anymore. Furthermore, the appearance of a shoe is important, evidenced for example by the fact that inserts are always placed in such a way that they are hard to notice, i.e. at the medial side of the shoe. In sandals, a good example for same technology but different shapes are some types of Sewn Edge Plaited Sandals (Veldmeijer, in preparation A) and Fibre Composite Sandals (Veldmeijer, forthcoming).

[59] This approach differs fundamentally with Alfano's (1987), who based a typology on depictions of footwear.

a slightly more distinct constriction of the waist. The asymmetry in sandal A6 is increased, but the curvature is still only visible at the lateral side and especially at the front part. In the last sandal, A7, the curvature of the lateral edge is strong and covers two-thirds of its length. But besides this, the medial edge is clearly curving towards the big toe, a feature not seen in the previous ones.

There are only six examples of Type B sandals (Figs. 1, 6A). In general, the sewn bundles are finer and there are always between 30 and 60 bundles in adult size sandals. The shape differs from Type A sandals in the fact that they are clearly swayed and have a distinctly pointed big toe area. Sandal B1 has a squarish front with a small, curved lateral front part. Sandal B2 shows a less square front, and the curvature of the lateral side is more elongated. In sandal B3, the big toe part is most distinct, the front being much more diagonal and less curved than B2; the lateral side shows a strong curvature which starts, due to the diagonal front, more towards the heel. The waist is strongly constricted.

Type C (Figs. 1, 2C, E) sandals differ from Type A and B sandals in having a clearly pointed toe. The fact that the toe is upturned is due to pulling of the front strap. Generally the sole of this Type is much thinner than that of others; nonetheless the construction is strong enough to last. In the other Types, the sole is too thick and sturdy to be so easily curved and held by the strap complex. Type C sandals are slightly asymmetrical longitudinally, thus indicating the shape of the foot. The pointed toe in sandal C1 is less distinct as is the case in sandal C2, where the width at the ball of the foot is smoother.

Sole

(in)sole

The sewn sandals consist of a sole, which is made of transverse bundles of halfa grass (see n.70), which are fastened by a strip of palm leaf that wraps the grass bundle and is secured by sewing (fig. 2D). The stitches of the subsequent rows are sewn through the previous row, either through the bundle (fig. 2A), or mainly through its winder (fig. 2B; note that often a small strip of the grass bundle is included here as well).[60] Generally, the stitches in the same row overlap each other if the sewing is tight (i.e. a high number of stitching per cm, fig. 5), although this is not always so. If the stitching goes through the ones in the previous row, it might split the stitch and pushes the halves outwards and under the previous one. In this case, the overlap is only at the split ends (MFA 72.4760, Petrie 7499i [fig. 5a] and ÄM 617 are good examples). In the less tightly sewn sandals, the stitches are relatively severely pulled out, thus leaving gaps between the two parts and revealing much of the grass cores. If the stitch of the subsequent row is stitched in between the stitches of the previous row, the stitch is not split and the overlap is deliberate (good examples are ÄM 10962 [fig. 5b] and MET 10.3.21 [fig. 5c]).

The sandals that are made with bundles of a large diameter, usually from Type A, are not always coarsely sewn. On the other hand, the sandals that are made with narrower bundles, Type B and C, are always sewn with fine stitching. The width of the sewing strips varies from relatively large (19 mm as in BM EA4424 and ÄM 6994) to very fine (3.5 mm in MegT 5160 [fig. 2C]). The width relates to the diameter of the bundle: larger diameter means wider strips and smaller diameter smaller strips, although EgCa JE95356=CG51129 is an exception to this 'rule.' Variations of width of the sewing 'thread' in one sandal are negligible. Sometimes in pairs the two sandals have different numbers of bundles. This is observed especially with the coarser sandals, i.e. Type A.

[60] Wendrich (2000: 260, fig. 10.6) mentions the same difference in basketry.

The horizontal rows are bordered by an edge, which is made in the same technique, i.e. a grass core[61], which is sewn with palm leaf strips. The innermost row of this edge consists of two narrow cores, which sandwiches the sole and sewn together (fig. 3). The subsequent row (the edge usually consists of three rows, but in some sandals there are two [Table 1A; see fig. 4]; edges consisting of only one row have not been registered) is placed against the first and does not sandwich the sole. The third row is placed next to it, but in Type C sometimes half on top of the second core. The innermost as well as the middle rows clearly serve as a reinforcement of the edge. The outermost row is decorative rather than functional; in most cases it has a smaller diameter.

The layout of the edges varies considerably (Table 1A; fig. 5). Most sandals have two large (i.e. large diameter) inner rows with the outermost one being smaller. In some, the middle row is much larger than the outermost and innermost. In rare occasions, the rows that make up the sandal's edge are of about equal diameter. Although most edges are relatively small, there are exceptions. Usually, smaller sandals belonging to children have a relatively wide edge (MET 36.3.234a, b) but sometimes the edge in adult sandals is similarly broad (ÄM 627 is a good example).

In one instance (fig. 4) the stitches of the edge incorporate one of the transverse bundles on different spots (see below). Obviously this would have strengthened the construction but it is seen in only one pair of sandals. Usually the sewn fibre sole is the only sole-layer. However, examples are known from Tutankhamun's tomb where the sole is covered with a layer of textile fabric, forming an 'insole.'

Treadsole

Some specimens show remnants of a leather treadsole: Petrie (1890: 28) mentions sewn sandals being covered with a leather treadsole. Unfortunately, he neither gives details on how the two soles were attached nor on the shape of the sandals.[62] BM EA4429 has tiny holes at the inner side of the sandal's edge (fig. 6A), which are possibly the stitch holes for the attachment of a treadsole (fig. 6A inset). The ventral surface of the sole is covered with patches of resinous material, which most likely are remnants of leather, as in certain conditions, leather turns into resin-like material (Van Driel-Murray, 2000: 303; personal observation). The remnants of the layer are very consistent in thickness and quite smooth where they adhere to the sole. Examples from both Types A and B sandals show remnants of a leather treadsole (fig. 6B). Another feature, only seen on one pair of sandals (BM EA4428 4429) is the reinforcement of the front strap hole with stitches that thus form a square.[63]

Strap complex

The strap complex in all sandals is comparable in construction, although minor variation in size occur, mainly the strap-width. A cladded, strong loop of palm leaf (pre strap) is fastened to the edge of the sandal by the cladding, which is stitched through the sole. The loop points upward. The pre strap serves as reinforcement of the back strap (fig. 7A, B),

[61] In some of Tutankhamun's Type C sandals, the outermost row, sometimes partially placed on top of the middle one, consists of the fruit-bearing stalks of the date palm. Possibly this is the case with the other Type C sandals too.

[62] Petrie's description of the fabric however, leaves no doubt that he talks about sewn sandals (see 'Date and Distribution').

[63] It is tempting to suggest that BM EA4428 and 4429 are the sandals described by Petrie, because this shape of sandals is typical for the Middle Kingdom (see 'Discussion'). However, the registration number of the British Museum reveal the objects entered in 1839, well before Petrie's work at the Middle Kingdom site.

which is fixed to the pre strap with a palm leaf or papyrus strip, which usually extends a few centimetres high[64] and is wrapped around the pre- and back strap. This cladding can just be wound around it, as seen in the sandals of Yuya and Tjuiu, from KV46, but sometimes the cladding is knotted with a series of half knots. Towards the sole the pre strap tapers. Using a pair of sandals of Yuya and Tjuiu (EgCa JE95353=CG51125) as example (obviously there are differences with other sandals, but these are not substantial and thus the example gives a good indication), the width of this pre strap/back strap construction is about 9 mm at the attachment of the sole and at the top of it, it is about 20 mm wide; the thickness is approximately 10 mm halfway its length. The pre strap is situated at the outside of the back strap.[65] In most examples belonging to Tutankhamun, the back strap is pulled through the pre strap outside in; this is also seen in some other examples. Although the pre strap is made of palm, the back strap is made of various layers of *Cyperus papyrus*. The use of different materials is very decorative. The back strap is rather thick, which even increases dorsally of the foot. Using the same pair of sandals of Yuya and Tjuiu as example again, the thickness is about 12 mm. In especially Type C sandals, the back strap increases in width at the point where it bends in a nearly 90-degree-angle over the side of the foot (Type 1; see fig. 2E); in EgCa JE95353=CG51125 the widest part of the back strap is 44.3 mm but the width is subject to relatively large variation. However, in especially Type A sandals (and in the only example of survived back strap of Type B sandals), the back strap is of (almost) equal width and overall the layout seems to have been given less attention (Type 2; see fig. 2B, E).

The front strap is attached at the centre of the back strap by means of looping and sometimes secured by means of a narrow strip that is tied below the looped attachment (fig. 7C arrow). This however, is only seen in front straps without transverse cladding as in the cladded ones, the cladding has the same function, i.e. tightly securing the looping to the back strap. The lower part of the front strap is usually inserted in the sole off centre in order to fit better between the first and second toe. The strap is slightly (in some examples from Tutankhamun more distinctly) convex if you look at it from aside. At the ventral surface, in all cases in which it is preserved, the strap is secured with a crown sinnet (fig. 7D, cf. Ashley 1993: 480[#2917]). There is more variation in layout of the front strap than in the back straps, but never in the way in which it is attached to the back straps. Five types are distinguished, one of which is identified only ones (Type 4). Type 1 is a front strap that consists of uncladded strips of papyrus and is looped around the back straps and inserted in the front of the sandal. Type 2 has a core of plam fibre, clad longitudinally and the lower part (the part just before going through the sole) is cladded in the same technique as occasionally seen with the back straps, i.e. half knotted (e.g. Petrie UC16555). The front strap referred to as Type 3 is entirely cladded, but by means of winding a strip of papyrus around a core, rather than knotting. This either partially covers the core (for instance most of Yuya and Tjuiu's) or entirely (for example ÄM616). Type 4 is completely different and only seen in one sandal (NMAL AU 4: fig. 7E). Here a small, cladded loop, not unlike the pre strap, is pulled through the sole. It seems unlikely that the toe had to be put through

[64] Although the cladding is substantially higher in some of Tutankhamun's sandals.

[65] A painted image in the Egyptian Museum, Cairo (corridor of room 24, March 2007), shows a pair of sandaled feet. Judging the shape of the strap complex, the sandals are sewn sandals. The right one clearly shows the cladded beginning of the back strap. Although the looped pre strap would not be visible, as the pre strap is in all archaeological examples is entirely cladded, apparently the artist regarded it as characteristic and drew a loop sticking out above the cladding proper.

the loop.[66] More likely it is a repair to which the original but broken front strap was tied (now lost), comparable to the pre- and back strap construction. The fifth type is seen in ÄM 6994 1, 2 (fig. 7F). In contrast to all other types, here the front strap has a core of two zS_2 strings made of palm fibre, which are covered, longitudinally, by papyrus. These strings, together with the papyrus strips, also form the crown sinnet at the ventral surface. The core however, can also consist of grass (Tutankhamun's sandals) or, as in ÄM 616, of palm leaf. This is done in such a way that the seam is at the invisible, ventral side of the front strap. Note that, in addition to the longitudinal strip of papyrus, there might be a cladding (ÄM 616). This type of front strap, albeit with a different core, is very popular in Type C sandals.

The hole through which the front strap was inserted in BM EA4428 and 4429 is reinforced with stitches arranged in a square around the hole. However, this is an exception: usually the strap inserts in a slit between two transverse bundles.

Although all sewn sandals are equipped with a strap complex as described above, it was not unique to this type of sandal, as several Sewn Edge Basketry Sandals also have such a strap complex (Veldmeijer, in preparation A)

Tutankhamun

An exhaustive study of Tutankhamun's footwear is forthcoming, which includes a detailed comparison with the footwear corpus of Yuya and Tjuiu, but it is important to note that all of Tutankhamun's fibre footwear consists of sewn sandals of a very fine quality (Type C, Variant A). The remaining footwear is based on sewn sandals: one pair of shoes, for example, consists of a leather treadsole of Type C shape, covered with a thin sheet of gold, which act as insole. The gold is worked and shows the pattern of a sewn sandal. Attached to the sole is an upper, consisting of a leather inner layer and an outer layer that is made of rows of gold circular and diamond shaped beads. Another pair, however, shows the same configuration but even with the sewing palm leaf imitated. Also, the pair of golden sandals found at the feet of Tutankhamun's mummy resembles sewn sandals.

Imitation

Sewn sandals, imitated in gold, have already been mentioned. Additionally, a part of a wooden sandal with a sewn motif was found in Amenhotep II's tomb (Daressy, 1902: 72, pl. xx). Other examples come from the tomb of Yuya and Tjuiu. One isolated left sandal from Yuya and Tjuiu (EgCa JE95355=CG51121, Table 1B; Davis et al. 1907: pl. xliv; Quibell 1908: 58 59) consists of a sole of rawhide of which the dorsal and ventral surfaces are covered with a thin layer of white gesso. This gesso layer is distinctly thicker at the ventral surface. The dorsal surface is gilded, with the foil being folded around the edges but not covering the ventral surface; wrinkles are clearly visible in the foil. The gesso layer serves to securely adhere the gold to the sandal. The shape of the sole falls within Type A, although it is more elongated.[67] Further evidence for the imitation of sewn sandals is the fact that the strap complex, including pre straps, is the same in shape. The strap complex is likely to consist of the same layers, but unfortnately could not be examined as it is intact and the cross-section could not be examined. Similarly, the method of attaching the pre

[66] One example of Tutankhamun's footwear shows a band (foot strap) running over several toes, rather thanthe big toe is known was among its footwear. Here, however, the loop runs over more toes than only the big toe.

[67] Note the resemblance to Type C sandals.

straps to the sole could not be observed; they were probably inserted into holes in the sole, as is seen EgCa JE95355=CG51121 (see below).

An example of a more detailed imitation is the pair EgCa JE95349=CG51124 (Table 1B, Davis et al 1907: pl. xliv; Quibell 1908: 58-59), also from Yuya and Tjuiu. Again, the shape is comparable to Type A sandals, but more elongated. Although the strap complex is detached and incomplete, the sole is intact, obscuring a view at the cross section. It is likely though, that the sole's construction is comparable to EgCa JE95355=CG51121 (a gessoed and gilded layer of rawhide). The gold foil however, also covers the ventral surface. The horizontal-bundle-pattern, so characteristic for sewn sandals, is stylized in the gesso layer. There are at least 43 in the left one, the exact number of which could not be established as it is obscured by the strap complex that adheres to the dorsal surface, and 40 in the right one. The edge consists of three bundles. The pre strap as well as the front strap is of the same shape as the isolated one and, in contrast to the soles, without details. They are inserted in holes and emerge at the treadsole at the same level as the sole's surface. The gold foil is unwrinkled.

Manufacture

The production of sewn sandals consists of various actions. Invariable, the first thing to do is the harvesting and preparation of the material (see Wendrich 1999: 273 82). The bundles are made of halfa grass, *Desmostachya bipinnata* or *Imperata cylindrica,*[68] plants which have been used in Egypt extensively for cordage, basketry and matting from earliest times onwards (references are abundant, but for a short survey see Greis 1949: 252 53) up to the present day (for example Greis 1949: 252 53; Wendrich 1999). Sewing is done with strips of *dom* palm leaf (*Hyphaene thebaica*), a plant which is extensively used for basketry, matting and related objects (Greis 1949: 255 56; Murray 2000: 620 21; Wendrich 1999: 274 77). The strap complex is made of papyrus. Papyrus (*Cyperus papyrus*) was much used throughout Egypt's history, but mainly for the production of papyrus that was used for writing (Leach and Tait 2000: 227 53). As already pointed out by Lucas (1948: 130), papyrus was rarely used for basketry (but did find some use in boxes) and seems to be limited in footwear[69] only for the production of fine, so called tomb sandals[70] (Petrie 1889: 12; personal observation 2006) and straps. Another application of papyrus, especially in Pharaonic Egypt, was for the production of cordage, mainly with fairly large diameters (Ryan and Hansen 1987: 9 13) although this too seems to have been limited: the coils of rope found in Mersa Gawasis for example, which is dated to the Middle Kingdom, were not made of papyrus (Veldmeijer and Zazzaro 2007; Veldmeijer et al. submitted).

After preparing the material, the grass bundles were made and the sewing could start. It seems unlikely that the bundles were cut to length individually. Instead, the bundles may have been cut to the approximate length, the shape of the sandal drawn on them (or indi-

[68] For basket making these two species of halfa grass are interchangeable (Wendrich 1999: 147-148). Without microscopic analysis of all sandals, one cannot assume this is true for footwear as well. Greiss (1949: 268, pl. iii, xiv) identified the material of the sewn sandal from Deir el Medinah as halfa grass *Imperata cylindrica* and dom palm *Hyphaene thebaica.* Vogelsang-Eastwood (1994: 140) came to the same identification of the materials used in sewn sandals. The results of the identification of the material of sewn sandals in the British Museum London, The Petrie Museum of University College, London and the Ägyptisches Museum und Papyrussammlung Berlin together with C. R. Cartwright and A. J. Clapham are forthcoming.

[69] This preliminary observation makes one wonder about the texts, which mention papyrus sandals. An evaluation is forthcoming by F. Hagen and A. J. Veldmeijer)

[70] However, the identification of the material of these sandals is in progress.

cated in another way) and than cut into shape. More practical however, would be if the roughly cut bundles were sewn first and cut after the shape was indicated. This means that the stitches of the transverse bundles were left unfinished and secured by means of the innermost row of the edge, which, as described above, consists of cores sandwiching the sole's edge dorsally and ventrally, followed by the rest of the edge. The sewing strip of one row was not used to continue sewing the next row as the connections which would result from this method, have not been observed. Examples from Tutankhamun suggest that the point to stop sewing was estimated: at the edge, some stitches do not extend to the edge proper, exposing a small portion of the grass core. If the shape and measurement was indicated, this may have been done with some sort of mold[71] (which could also be a sandal or the other sandal of a pair) as the difference between the two sandals of a pair are usually negligible, especially in Types B and C (remarkably the sandals of Yuya and Tjuiu are an exception [Table 2][72]). Moreover, in a pair of sandals with swayed soles, they are always perfect mirror specimens.

In the final stage, the straps were attached: first the pre strap to which the back straps were attached previously, fastening to the sole, then the front strap, which was looped to the back strap, put through the sole and knotted. Note that due to the thickness of the front strap, the opening between the bundles takes the shape of a slit. Finally, the sandal may have been covered with a leather treadsole but it seems more plausible that the treadsole was attached first, after which the front strap was inserted through both soles.[73]

The production of the imitation sandals would start with the cutting of the rawhide to which the gesso was applied (and modelled in the case of EgCa JE95349=CG51124), followed by the gilt. The separately made strap complex, made in the same sequence, was attached last.

Wear

The weakest part of the sandals is the straps. These are often broken off at the point where they attach to the sole, i.e. the pre strap to which the papyrus back strap is attached. The front strap is often entirely missing, or is broken just above the point where it emerges at the dorsal surface. Often the most severe wear of the sole is the ventral surface, especially the heel, which is completely worn through in some cases (e.g. ÄM 8056). This may be manifested as a hole or a worn through heel's edge. In the case of the latter, the dragging of the heel over the ground causes this wear. Another, but less severely worn part is at the ball of the foot. Remarkable is that there are no signs of wear of the crown sinnet observed.[74] One would expect the knot would be compressed, or there would be some sort of dent or even cracks around it in the sole due to the pressure of the owner's weight.[75] However, this type of wear is likely considerably less on relative soft surface, as the knot would be pressed in the sand, and thus the forces would be reduced. The same reasoning could explain the lack of wear caused by friction of the sole with the ground. Some sandals, like the pair from the tomb of Nefertari (MEgT 5160), show wear on the dorsal

[71] An interesting find from Amarna is a wooden 'shoe-pattern' (Peet & Woolley, 1923: 69, pl. XX, 2), which might have functioned as mold.

[72] More on this in the mentioned comparison between these and Tutankhamun's footwear corpus.

[73] Because some sandals from other Categories has a fastening of the front strap which is sandwiched between the in- and treadsole, it cannot be ruled out altogether, however unlikely, that in sewn sandals, the front strap penetrated the insole only and was fastened at its ventral surface. The lack of a complete treadsole prohibits further conclusions.

[74] Although some examples from Tutankhamun do.

[75] This is especially evident in several of Tutankhamun's sandals.

surface, caused by the movement of the foot. Unfortunately, it was not possible to study the ventral surfaces of this particular pair because they are mounted on a display panel and too fragile to dismount. Consequently, it could not be established whether this ventral surface is worn. Examples from Tutankhamun show a slight discoloration and malformation of the dorsal surface.

In general, however, the degree of wear of the sole is surprisingly little, even in sandals of which it can be safely assumed they have been worn (adhering dirt, broken and sometimes repaired strap complexes). This shows the strength of the sole and may explain the great popularity of this type of sandal in the New Kingdom. On the other hand we have nearly unworn sandals, like those of Yuya and Tjuiu. These sandals are in excellent condition, but the stitches of the ventral surface are slightly compressed, perhaps caused by the weight of the wearer. This suggests that these sandals were used, but infrequently. Either new ones regularly replaced the older sandals, or these are not daily sandals but only used for special occasions. For the time being, however, we cannot entirely rule out the possibility that Yuya's and Tjuiu's sandals were made for the burial. Obviously, the imitated sandals were not used in daily life.

Date and distribution

The situation for this type of sandals in terms of dating and context is less unfortunate than for other types of footwear since we can rely on a large number from New Kingdom context, especially the Eighteenth Dynasty. Nevertheless, there are indications that sewn sandals did occur before the New Kingdom, although biases in the archaeological record are large and there are many unprovenanced and undated sandals. Statements such as that made by Vogelsang-Eastwood (1994: 140) that sewn sandals are introduced in the New Kingdom, should therefore be taken with caution. Besides the specimens studied for this work, other examples have been published. The one example from Deir el Medinah (Gourlay 1981a: 62; 1981b: 56, pl. xx) is dated to the Eighteenth Twentieth Dynasty. The small fragment housed in the Louvre (Montembault 2000: 38 39) is undated. In their work on the Eleventh Dynasty temple at Deir el-Bahari, Naville and Hall (1913: 26, pl. xxviii, 2) mention the discovery of one sewn sandal, but conclude that it must have been left there by workmen of the Eighteenth-Nineteenth Dynasties; the reason for this conclusion are not given. The tomb of Thutmose III contained sewn sandals (Daressy, 1902: 289) and the tomb of Amenhotep II contained remnants of a wooden sandal that imitated sewn sandals (Daressy, 1902: 72, pl. xx). The 'pair' of sandals from the Rafalovitch collection is labelled 'Late Period' but unfortunately, it is not clear why.[76]

The shape of the sandals in depictions, which are dated to the Middle Kingdom (Montembault 2000: 47 50; Vogelsang-Eastwood 1994: 142) fits well with Type B (fig. 1). This date is supported by archaeological evidence (see Table 1). Moreover, the well-known and abundant Middle Kingdom wooden tomb sandals (e.g. Montembault 2000: 47, 48, 50 51)[77] provide further support that this shape can be recognised from the Middle Kingdom.

The majority of the dated sandals in Table 1 and 2 are from the New Kingdom with an emphasis on the (late) Eighteenth and early Nineteenth Dynasty: three entries are dated as possibly New Kingdom, one to the Nineteenth Dynasty and the remaining to the Eight-

[76] The 'pair' of sandals from the Rafalovitch collection (now in the Odessa, the Archaeological Museum of the Academy of Sciences of Ukraine, Berlev & Hodjash 1998: 149-51, pl. 166) were, originally, not a pair; not only the shape is slightly different, but one is made with fine stitching and 34 transverse bundles whereas the other one is much coarser and made of 21 bundles.

[77] Tomb sandals were known in the Old Kingdom but seem to differ in shape.

eenth Dynasty (including those from Tutankhamun and Yuya and Tjuiu). The picture, however, is distorted due to the fact that more remains have survived from the New Kingdom than from earlier eras. An unusual find of sandals from Lahun (Twelfth Dynasty) is mentioned by Petrie (1890: 28): the 'Sandals were very closely and beautifully stitched up of rush [sic], and usually soled with leather. A small bundle of rush [sic] was wound round by a rush [sic] thread, which at every turn pierced through the edge of a previous bundle. Thus these successive bundles were bound together edge to edge, and a flat surface built up. This was edged round in the same way. In basket making exactly the same principle was followed, with great neatness. [...] The rush [sic] sandals soled with leather [...].'

From the description it is clear that Petrie writes about sewn sandals, indicating that the technique is not restricted to the New Kingdom. This observation is supported by the fact that the depiction of sewn sandals is very characteristic: there can hardly be any misinterpretation of the transverse bundles of the pair of sandals depicted on the inner side of the foot part of a coffin found in Gebelein, which is dated to the Middle Kingdom too (Steindorff 1901: pl. ii). Moreover, sandal ÄM 10962, also a Type A sandal, originates from the city centre of Middle Kingdom Lahun.[78] This suggests that Type A and B sandals occurred before the New Kingdom. At least the occurrence of Type A sandals continued into the New Kingdom. Type C sandals seem to appear as late as the New Kingdom and their context clearly suggests that they were restricted to the higher ranks of the society (see below).[79]

The majority of the specimens of which the provenance is known, originate from the Theban area. Although it is tempting to suggest that these sandals are Theban in nature, three entries come from Sedment in the Fayum, and others from Kahun. Spatial biases undoubtedly distort the picture, as in the more northerly areas the preservation circumstances are less favourable for organic material. Moreover, although perhaps not likely, specimens that are unprovenanced could originate from area's outside Thebes. It is unclear whether the sandals were made in the immediate vicinity of the settlements or tombs where they were found, or that they were distributed from several production centres. However, differences in detail of the sandals might point to different sandal makers/production centres. The fact that sometimes museums' records mention that the items were obtained in Luxor, does not necessarily mean that the objects were 'excavated' here; the trade in antiquities was very much centred in Luxor.

Discussion

The technique used here is referred to as 'sewing' rather than coiling for reasons as explained elsewhere (Veldmeijer 2006/2007: 71). However, in order to make distinction between sandals made with horizontal, sewn bundles and sandals that are made by sewing a coiled bundle (Veldmeijer in the press) the sandals discussed in this paper are referred to as 'sewn' sandals opposed to the 'coiled sewn' sandals. The term 'coiling'

[78] It cannot be entirely excluded that this is one of the sandals found by Petrie, mentioned above, although there is no trace of leather treadsole.

[79] Though iconography is beyond the scope of this work, Type C sandals are frequently depicted in New Kingdom times in paintings, reliefs and sculptures but disappear in the course of the late New Kingdom. Indeed, archaeological finds from post-New Kingdom times seems to lack.

should be reserved for basketry[80] and sandals in which the coils are fastened with other means than sewing (stitched transversely through the coils [Veldmeijer in preparation B]).

A preliminary typology proposes four types within the category Sewn Sandals, referred to as A, B and C. The imitations are regarded as a separate Type D. Doubtless they are an imitation of the popular sewn sandals, but differentiated by the use of different materials (none of which are fibres). Three Variants can be identified in Type D: wood, rawhide covered with plaster and gold foil, and those made of metal. Within Types A and B, two variants are recognised: with and without leather treadsole. Type C consists of two variants: without an insole and with an insole (only represented by examples from Tutankhamun). There is no indication that Type C sandals had a treadsole. Within the variants without a second sole, distinction can be made between the finer ones from royal context, which consists of a large number of sewn bundles for adult size sandals, which mount up to over 50 but often over 60, and the coarser ones, represented mainly by some finds from Yuya and Tjuiu's tomb, which consists of far fewer transverse bundles.

The first archaeological evidence for the sewing technique in sandals dates to the Middle Kingdom. Type B sandals can be dated to the Middle Kingdom on the basis of its shape and context and does not seem to have existed after that period. Type C sandals were restricted to the New Kingdom and achieved their largest popularity in the Eighteenth Dynasty and first part of the Nineteenth Dynasty. A detailed iconographic study (in progress) is likely to refine this picture.

Some specimens of Type A and B sandals are covered with a leather treadsole, but it is unlikely this was a common feature as there are just too few preserved examples with this extra sole or with indications that the sandal originally had one. Besides the function of reinforcing the sole, the leather treadsole might have had a more specific reason for adding. Wet soil would adhere easily to the sewn fabric but would have less opportunity to do so at the smooth surface of the leather. One wonders, considering that the provenanced ones come from the Fayum, whether this was the reason of the extra sole and thus a geographically induced feature. Moreover, could the lack of a leather treadsole in Type C sandals mean that the owners were not expected to tread on 'dirty' ground?

There is no pattern in the layout of the edge. The innermost and middle rows of the edge are clearly reinforcements; there is no functional or technological explanation for the third row or the difference in diameter of especially the middle and outermost row. On the other hand, it has a certain decorative value. The conclusion that the differences are due to the preference of different sandal makers and/or production centres seems plausible. The differences in the strap complex within one category (differences in size rather than technique) might be explained in the same way as well as the way the back strap were (or were not) clad, the position of the pre strap (at the inner or outer side of the back strap) or the style of stitching. However, the quality of stitching is also linked to the overall quality: in general the stitching in Type C sandals is executed with much more care and refinement. Because the various differences occur with sandals from the same geographical area, this seems much more plausible than to explain them as geographical differences, but a combination of the two is not wholly impossible. A seemingly more particular example provides BM EA4426 (fig. 4). Here, the stitches of the edge incorporate one of the transverse bundles on various spots. As this is observed only once, this may be interpreted as a peculiarity of a specific sandal maker rather than a generally used technique of a production centre.

[80] Wendrich (1991: 136-137) already mentions this and discusses in her ethno-archaeological work (1999: 25-56 & 157-160) in detail the terminology as used by various scholars. Coiling in basketry is explained too.

The precision in shape and measurements in the few examples of pairs, especially in the royal specimens of Type C sandals, suggests that the sandal maker made the sandals using an example (a mold for instance). However, in the absence of archaeological examples, one might argue that the sandal maker merely used the finished one by matching its dorsal surface with the dorsal surface of the other sandal and thus cutting the shape. Pragmatic as the ancient Egyptians were, if a sandal was slightly too short relative to the other, the sandal maker inserted an extra bundle.

Schwarz (2000: 215, n. 764) remarks: 'Das frei verfügbare Material und die einfache Anfertigungstechnik lässt den Schluss zu, dass Sandalen aus Papyrus o.ä. Jederzeit von dem Tragenden selbst verfertigt wurden und als Produkt einer Werkstatt eher zu vernachlässigen sind'. Statements as these, which are not based on detailed study of archaeological material, are premature, as might be apparent from the detailed study of sewn sandals presented here.[81] Moreover, the statement that the manufacturing of fibre sandals is simple, which it is in some cases, equally applies to some leather sandals. Moreover, it is difficult to imagine a pharaoh making his own sandals.

It is difficult to assess the degree of wear when walking in sand and experiments should be undertaken to get more insight, but the degree of wear is assumed to be far less.[82] Nevertheless, we can be sure that various sandals presented here were worn, evidenced if not by wear of the ventral surface, by its broken strap complex (as well as iconographic evidence). We should bear in mind that most likely footwear was not worn all the time.

The many specimens of various qualities suggest that sandals were worn by people from diverse social levels. Presumably, Type A was meant for the lower echelons (fig. 8B), while Type C sandals clearly have been meant for the upper levels of the society (fig. 8A); the finer Variant A has only been found in royal context (Tutankhamun) and Variant B in non-royal context but still in contexts suggesting a very high status. Apparently such a distinction was delicate but important, as even the difference between the sandals from Yuya and Tjuiu and Tutankhamun is noticeable.[83]

Both men and women wore sewn sandals, as suggested by the sandals from Tutankhamun's tomb, the 'Nefertari sandals' and the sandals from the tomb of Yuya and Tjuiu, the difference of which seems to be the size only. We should however, bear in mind that the differences in foot size varies quite a lot and consequently the sandal for a woman with large feet might be of comparable size to the sandal for a man with small feet. The differences in age and thus size of feet, confirms this. Children's sandals, such as BM EA26928, are the miniature equivalents of the adult ones, although, due to using the same size materials, they look coarser and have, obviously, fewer bundles and fewer stitches for each bundle.

[81] Altough some types might have been homemade, such as for example certain coiled sandals (Veldmeijer, 2006/2007: 73-74).

[82] That is, when used a same amount of time. A sandal continuously used in sand will show a higher degree of wear relative to, for example, a sandal worn only ones on a stone surface. Moreover, the degree of wear is influenced by, among others, the weight of the owner, the way he or she walks and the activities he or she employs when wearing the sandals.

[83] The difference in status is also suggested in depictions (Goffoet 1991: 112). Additional comments in Schwarz (2000: 230). See also n.2, above.

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TABLE 1A.

Collection	Identification	Provenance	Date	Sole[84]							Strap complex		
				Orientation	Measurements	Leather treadsole	Shape	No. of rows	Average width row (in mm)	Stitching quality/overlap	Edge (Ø/Ø/Ø)[85]	Front strap; fastening	Back strap	Measurements
Type A														
Berlin[86] (ÄM)	AM616	?	?	Right	W heel: 92.5; W waist: 87.3; W front: 118.6. L: 310.0. T: 9.4.	-		20	12.5	coarse/ ✓	triple l/l/s	type 3; crown sinnet	type 2	D front: 13.0
Berlin (ÄM)	AM617	?	?	Left	W heel: 94.8; W waist: 88.4; W front: 119.8. L: 310.0. T: 9.0.	-		20	13	coarse/ ✓	triple l/l/s	lost; crown sinnet	lost	D front: 12.0
Berlin (ÄM)	AM 618	?	?	Right	W heel: 100.2; W waist: 97.6; W front: 123.0. L: 315.0. T: 7.8.	-		18	14	coarse/-	triple l/l/s	lost	lost	-
Berlin (ÄM)	AM627	?	?	Right ?	W heel: 103.3; W waist: 103.3; W front: 132.6. L: 340.0. T: 9.8.	-		21	14	coarse/-	triple s/l/s	lost	lost	-
Berlin (ÄM)	AM6994-1, 2	Thebes ?	NK?	Pair	See Table 2	-		19[87]	19	coarse/ ✓[88]	triple l/l/s	type 5; crown sinnet	type 2	D front: 8.6. W back: 24.0[89]
Berlin (ÄM)	AM6995	?	?	Pair	See Table 2	-		left: 21 right: 20	12	coarse/-	triple l/l/s	lost; crown sinnet	lost	-
Berlin (ÄM)	AM8056	Thebes ?	NK?	Pair	See Table 2	-		left: 18 right: 20	12	coarse/-	triple l/l/s	lost	type 1?	-
Berlin (ÄM)	AM10962	Kahun	MK	Left	W heel: 100.9; W waist: 90.8; W front: 120.3. L: 338.0. T: 8.0.	-		25	11	fine/✓	triple l/l/s	lost	type 1?	-

[84] Meant here is the fibre sole, which is, in the case of the presence of a layer of leather, regarded as the insole and the leather sole as treadsole.
[85] From innermost to outermost.
[86] Ägyptisches Museum und Papyrussammlung, Berlin.
[87] The heel in the right one is not preserved.
[88] But not equally throughout.
[89] Left sandal.

Collection	Identification	Provenance	Date	Sole[84]								Strap complex		
				Orientation	Measurements	Leather treadsole	Shape	No. of rows	Average width row (in mm)	Stitching quality/overlap	Edge (Ø/Ø/Ø)[85]	Front strap; fastening	Back strap	Measurements
Oxford[90] (ASH)	QL 1164a, b	?	?	Pair	Measurements of left sandal (QL 1164b). W heel: 91.3; W waist: 83.9; W front: 119.2. L: 335. T: 5.4.	-		a: 26 b: 27	12	fine/-?	triple l/l/s	lost	lost	-
Oxford (ASH)	1878.142	?	?	Left	W heel: 94.0; W waist: 10#. W front: 128.2. L: 300.0. T: 9.3.	-		26	10	fine/✓	triple l/l/s	lost; crown sinnet	lost	-
Oxford (ASH)	1887.2722	Thebes ?	?	Right[91]	W heel: 97.5; W waist: 95#; W front: 130.7. L: 315.0. T: 8.7.	-		20	13	coarse/-	triple l/l/s	lost	lost	-
London (BM)[92]	EA4424 & 4425	?	?	Pair	Measurements of right sandal (EA4425). W heel: 99.7; W waist: 101.2; W front: 134.2. L: 310.0. T: 9.5.	-		25	19	coarse/-	triple s/l/s	lost; crown sinnet	lost	-
London (BM)	EA4427	?	?	Right	W heel: 87.0; W waist: 85.0; W front: 116.5. L: 280.0. T: 6.6.	-		28	8	fine/-	triple l/l/s	lost	lost	-
London (BM)	EA4430	?	?	Right	W heel: 98.8; W waist: 95.2; W front: 129.4. L: 315.0. T: 7.8.	✓		23	12	fine/✓	triple l/l/s	lost	lost	-
London (BM)	EA4431[93]	?	?	Left[94]	W heel: 103.0; W waist: 95.7; W front: 140.4. L: 335.0. T: 7.5.	✓?		20	15	fine/✓	triple s/l/s	lost	lost	-
London (BM)	EA4435	?	?	Right	W heel: 100.4; W waist: 97.1; W front: 134.6. L: 325.0. T: 6.6.	-		21	14	coarse/-	triple l/l/s	type 1; crown sinnet	lost	-
London (BM)	EA26928	Thebes	NK?	Pair	Measurements of left sandal. W heel: 58.0; W waist: 46#; W front: 56.0. L: 123.0. T: 5.5.	-		10	8	coarse/-	triple e	lost	$sS_4[Z_2]$ string ?	-

[90] Ashmolean Museum.
[91] The worn surface is interpreted as ventral surface.
[92] British Museum.
[93] The dark discoloration might be due to the, now lost, leather treadsole.
[94] The worn surface is interpreted as ventral surface.

Collection	Identification	Provenance	Date	Sole[84]								Strap complex		
				Orientation	Measurements	Leather treadsole	Shape	No. of rows	Average width row (in mm)	Stitching quality/overlap	Edge (Ø/Ø/Ø)[85]	Front strap; fastening	Back strap	Measurements
London (BM)	EA36213	?	NK?	Pair	Measurements of left sandal. W heel: 86.0; W waist: 90[#]; W front: 115.8; W: 86.3. L: 265.0. T: 10.0.	-		20	11.5	coarse/-	triple s/l/s	lost	type 1	-
London (BM)	EA42147	?	New Kingdom ?	Left	W heel: 84.5; W front: 103.0; W waist: 80[#]; W heel: 79.2. L: 280.0. T: 6.7.	-		35	6.5	fine/-	triple l/l/s	lost	lost	-
New York (MET)[95]	22.3.20a, b	Thebe Cem. S pit 1008	Early D18	Pair	Measurements of left sandal (22.3.20b) W heel: 82.5; W waist: 85.0; W front: 122.0. L: 285. T: -[96].	-		24	10	fine/✓	triple l/l/s	type 1; crown sinnet ?	type 2	D. front strap: 10.0. Back strap: 10.0x24.0
New York (MET)	22.3.21a, b	Thebe Cem. S pit 1008	Early D18	Pair	Measurements of left sandal (22.3.21b). W heel: 79.5; W waist: 82.5; W front: 118.5. L: 285.0. T: -[97].	-		a: 31 b: 29	8.5	fine/✓	triple s/l/s	?	type 2	D. front: 14.0. Back: 10.5x18.5
New York (MET)	36.3.234a, b	Thebes radim, below TT71	D18	Pair	Measurements of left sandal. W heel: 49.5; W waist: 54.0; W front: 62.7. L: 135.0. T: -[98].	-		a: 9 b: 8	9.5	coarse/✓[99]	triple e	type 1; crown sinnet	type 2	D. front: 6.0. Back: 7.5
Boston (MFA)[100]	72.4759	?	?	?	W heel: 86.0; W waist: appr. 90; W front: 101. L: 220.0. T: -[101].	✓?[102]	 ?	28	5-7	fine/✓	triple s/l/s	lost	lost	-
Boston (MFA)	72.4760	?	?	Right	W heel: 73.0; W waist: 74.0; W front: 94.5. L: 270.0. T: 6.5.	-		46	4	fine/✓	triple l/l/s	lost	type 1	-
Leiden (NMAL)[103]	EG-ZM3039	?	?	Pair	Measurements of right sandal. W heel: 91.8; W waist: 88.0; W front: 121.0. L: 313.0. T:	-		21	12.5	coarse/-	triple l/l/s	lost	lost	-

[95] Metropolitan Museum of Art, New York.
[96] Not measured: the sandals were mounted and it was decided not to free them.
[97] Not measured: the sandals are mounted and it was decided not to free them.
[98] Not measured: the sandals are mounted and it was decided not to free them.
[99] But not throughout the entire sole.
[100] Museum of Fine Art, Boston.
[101] Too fragile to measure.
[102] A leather sole might have been attached by strips crossing over the dorsal surface of the sole, which is suggested by the remnants of leather strips. This type of attachment is also seen in coiled sandals, although it did not fasten an entire sole.
[103] National Museum of Antiquities, Leiden.

Collection	Identification	Provenance	Date	Sole[84]								Strap complex		
				Orientation	Measurements	Leather treadsole	Shape	No. of rows	Average width row (in mm)	Stitching quality/overlap	Edge (Ø/Ø/Ø)[85]	Front strap: fastening	Back strap	Measurements
					9.0.									
Leiden (NMAL)	AU 3a	?	?	Right	W heel: 96.4; W waist: 93.0; W front: 120.5. L: 318.0. T: 8.5.	-		19	13	coarse/ ✓	triple l/l/s	type 1; crown sinnet ?	type 1	D back: 10.5
Leiden (NMAL)	AU 3b	?	?	Right	W heel: 98.4; W waist: 91.4; W front: 120.4. L: 320.0. T: 8.0.	-		20	12	coarse/ ✓	triple l/l/s	type 1; crown sinnet ?	type 1	D back: 12.3
Leiden (NMAL)	AU 4	?	?	Pair	Measurements of right sandal. W heel: 96.6; W waist: 92.2; W front: 129.5. L: 318.0. T: 7.1.	-		left: 20 right: 24	left: 13 right: 12	coarse/ ✓	triple l/l/s	type 4; ?	lost	D front: 3.9
Leiden (NMAL)	AU 5a,b	?	?	Pair	Measurements of right sandal. W heel: 93.0; W waist: 92.2; W front: 123.0. L: 300.0. T: 9.0.	-		a: 19 b: 20	a: 13 b: 12	coarse/ ✓[104]	triple s/l/s	lost	type 1	D back: 8.3
Edinburgh (NMSE)[105]	A. 1921. 1470[106]	Sed-ment tomb 283	D18	Pair	Measurements of right sandal. W heel: 97.0; W waist: 95[#]; W front: 120.0. L: 300.0. T: 8.0.	-		a: 22 b: 17	?	coarse/-	triple l/l/s	lost; crown sinnet	type 1	-
London (Petrie)[107]	UC16556	Sed-ment, tomb 136	D18 AIII	Right	W heel: 95.0; W waist: 92.0; W front: 125.0. L: 300.0. T: 11.0.	-		19	14.5	coarse/?	triple l/l/s?	lost	type 1?	-
Type B														
London (BM)	EA4426	?	?	Pair	Measurements of right sandal. W heel: 88.5; W waist: 85.6; W front: 116.3. L: 288.0. T: 7.5.	-		40	7	coarse/-	duplo l/s	type 1; crown sinnet	type 2	-
London (BM)	EA4428	?	?	Left, pair with EA 4429	Measurements of right sandal (EA4429). W heel: 87.2; W waist: 88.0; W front: 120.2. L: 285.0.	✓		58	4	fine/✓	duplo e	lost	lost	-
London (Petrie)	UC28312i	Hawara ? Gurob?	?	Right ?	W: 117.0. L: 190.0. T: about 6.	-		32	3.5	fine/✓	triple l/l/s	lost	lost	-

[104] But not throughout the entire sole.
[105] National Museums Scotland, Edinburgh.
[106] Registered as a pair, but originally probably not.
[107] Petrie Museum of Egyptian Archaeology, University College London.

Collection	Identification	Provenance	Date	Sole[84]								Strap complex		
				Orientation	Measurements	Leather treadsole	Shape	No. of rows	Average width row (in mm)	Stitching quality/overlap	Edge (Ø/Ø/Ø)[85]	Front strap; fastening	Back strap	Measurements
London (Petrie)	UC7499i	Lahun	D12	Left?	W: 116.0. L: 96.0. T: 6.0.	-		14	4.5	fine/✓	triple	lost	lost	-
London (Petrie)	UC7499ii	Lahun	D12	Left?	W: 126.0. L: about 90. T: 6.5.	-		9	6	fine/✓[108]	triple	lost	lost	-
Type C														
Cairo (EgCa)[109]	JE91351a = CG51128	Thebes KV46 (Yuya & Tjuiu)	D18 AIII	Left, pair with JE 91351b	See Table 2	-		39	5.7	fine/✓	triple s/l/s	type 3; crown sinnet	type 1	D front: 10.3. W back (max.): 39.8.
Cairo (EgCa)	JE91351b = CG51128	Thebes KV46 (Yuya & Tjuiu)	D18 AIII	Right, pair with JE 91351a	See Table 2	-		39	5.0	fine/✓	triple s/l/s	type 3; crown sinnet	type 1	D front: 8.5. W back (max.): 29.1.
Cairo (EgCa)	JE95305a	Thebes KV46 (Yuya & Tjuiu)	D18 AIII	Right, pair with JE 95305b	See Table 2	-		46	4.7	fine/✓	triple l/l/s[110]	type 3; crown sinnet	type 1	D front: 10.5. W back (max.): 34.9.
Cairo (EgCa)	JE95305b	Thebes KV46 (Yuya & Tjuiu)	D18 AIII	Left, pair with JE95305a	See Table 2	-		48	4.7	fine/-	triple l/l/s	type 3; crown sinnet	type 1	D front: 13.5. W back (max.): 38.5.
Cairo (EgCa)	JE95348a = CG51120	Thebes KV46 (Yuya & Tjuiu)	D18 AIII	Right[111]	W heel: 74.5; W waist: 73.8; W front: 92.5. L: 263.0. T: 5.8.	-		36	5.8	fine/✓	triple l/l/s	type 3; crown sinnet	type 1	D front: 10.7. W back (max.): 36.4.
Cairo (EgCa)	JE95348b = CG51120	Thebes KV46 (Yuya & Tjuiu)	D18 AIII	Right[112]	W heel: 77.1; W waist: 74.4; W front: 93.8. L: 275. T: 6.0.	-		48	4.8	fine/✓	triple l/l/s[113]	type 3; crown sinnet	type 1	D front: 12.5#. W back (max.): 36.0.

[108] But not throughout the entire sole.
[109] Egyptian Museum, Cairo.
[110] The difference between the two inner and the outer bundles is small and is slightly more distinct in EgCa JE95305b.
[111] The entry number suggests EgCa JE95348a and EgCa JE95348b are a pair but in fact they are both a right sandal.
[112] The entry number suggests EgCa JE95348a and EgCa JE95348b are a pair but in fact they are both a right sandal.
[113] The layout of the edge is not consistent throughout and parts are s/ls.

Collection	Identification	Provenance	Date	Sole[84]								Strap complex		
				Orientation	Measurements	Leather treadsole	Shape	No. of rows	Average width row (in mm)	Stitching quality/overlap	Edge (Ø/Ø/Ø)[85]	Front strap; fastening	Back strap	Measurements
Cairo (EgCa)	JE95353a = CG51125	Thebes KV46 (Yuya & Tjuiu)	D18 AIII	Left, pair with JE95353b	See Table 2	-		48	5.3[114]	fine/-	triple l/l/s	type 3; crown sinnet	type 1	D front: 12.8. W back (max.): 41.4.
Cairo (EgCa)	JE95353b = CG51125	Thebes KV46 (Yuya & Tjuiu)	D18 AIII	Right, pair with JE95353a	See Table 2	-		46	5.4	fine/-	triple l/l/s	type 3; crown sinnet	type 1	D front: 12.6. W back (max.): 44.3.
Cairo (EgCa)	JE95354a = CG51126	Thebes KV46 (Yuya & Tjuiu)	D18 AIII	Left, pair with JE95354b	See Table 2	-		50	4.5	fine/✓	triple l/l/s	type 3; crown sinnet	type 1	D front: 12.4. W back (max.): 40.2.
Cairo (EgCa)	JE95354b = CG51126	Thebes KV46 (Yuya & Tjuiu)	D18 AIII	Right, pair with JE95354a	See Table 2	-		47	4.5	fine/✓	triple l/l/s[115]	type 3; crown sinnet	type 1	D front: 13.5. W back (max.): app. 42.0.
Cairo (EgCa)	JE95356 = CG51129	Thebes KV46 (Yuya & Tjuiu)	D18 AIII	Left	W heel: 77.5; W waist: 73.4; W front: 86.4. L: 240.0. T: 6.8.	-		16	12.5	fine/✓	triple s/l/s[116]	type 3; crown sinnet	type 1	D front: 9.6. W back (max.): 31.5.
Cairo (EgCa)	JE95357 = CG51130	Thebes KV46 (Yuya & Tjuiu)	D18 AIII	Left	W heel: 83.5; W waist: 84.5; W front: 100.8. L: 295.0. T: 5.4.	-	[117]	47	4.8[118]	fine/✓	triple l/l/s	type 3; crown sinnet	type 1	D front: 11.8. W back (max.): 41.3.
New York (MET)	10.184a, b	Thebes KV46 (Yuya & Tjuiu)	D18 AIII	Pair	Measurements of left sandal (10.184a). W heel: 84.5; W waist: 82.5; W front: 113.0. L: 300.0. T: -[119].	-		63	4	fine/-	triple l/l/s	type 1; crown sinnet	type 1	D. front: 9.0. W back (max.): 39.0.
Turin (MEgT)[120]	5160 (pair)	QV66 (Nefert-ari)	D19 RssII	Pair	Measurements of right sandal. W heel: 82.2. W front: 97.7. L: 293.0.	-		66	3.5	fine/✓?	triple e	type 3; ?	type 1	D. front: 10.8. W back (max.): 20.0.

[114] Average composed by relatively large low and high value.
[115] The difference between the two inner and the outer bundles is small and is slightly more distinct in EgCa JE95354a.
[116] But not consistent throughout; parts are l/l/s.
[117] Although classified to Category C, the waist is only very slightly constricted.
[118] Note the relatively big difference between the width of the bundles of the heel part and front part.
[119] Not measured: the sandals are mounted and it was decided not to free them.
[120] Museo Egizio, Turin.

Collection	Identification	Provenance	Date	Sole[84]								Strap complex		
				Orientation	Measurements	Leather treadsole	Shape	No. of rows	Average width row (in mm)	Stitching quality/overlap	Edge (Ø/Ø/Ø)[85]	Front strap; fastening	Back strap	Measurements
London (Petrie)	UC 16555a, b	Sed-ment tomb 136	D18 AIII	Pair	See Table 2	-		18	17	fine/✓	triple s/l/s	type 2; crown sinnet	type 1	D. front: 13.4. W back (max.): 40.2.
Type Unknown														
London (Petrie)	UC 28312ii	Hawara ? Gurob?	?	?	W: 67.0. L: 72.0.	-	?	18	3.5	fine/-	triple e	lost	lost	-
London (Petrie)	UC 28313	Hawara ? Gurob?	?	?	W: 72.0. L: 104.0.	-	?	11	8	fine/-	triple l/l/s	lost	type 1?	-

TABLE 1B[121]

Type D											
Cairo (EgCa)	JE95347 (c)a = CG51124	Thebes KV46 (Yuya & Tjuiu)	D18 AIII	Left, pair with JE95347(c)b	W heel: 53.5; W waist: 50.8; W front: 70.5. L: 240.0.			40	~34	N/A	triple/not applicable	as in JE95355		
Cairo (EgCa)	JE95347 (c)b = CG51124	Thebes KV46 (Yuya & Tjuiu)	D18 AIII	Left, pair with JE95347(c)a	W heel: = CG51.7; W waist: 48.6; W front: 68.5. L: 240.0.			43+[122]	~35	N/A	triple/not applicable	as in JE95355		
Cairo (EgCa)	JE95355 = CG51121	Thebes KV46 (Yuya & Tjuiu)	D18 AIII	Left	W heel: 57.9; W waist: 56.0; W front: 73.7. L: 240.0. T: 2.7.			The sole consists of a layer of rawhide, covered with plaster and, at the dorsal surface and edge, covered with gold foil. No indication of fabric, but the shape and especially the layout of the strap complex strongly suggests an imitation of sewn sandals. Strap are inserted in holes and not secured at the ventral surface (which is not covered with gold foil).						

TABLE 1.

Sewn (A) and in other materials imitated sewn (B) sandals, showing current location (first column), registration number(s) (second column), provenance (third column), date (fourth column), summary of the technological details of the sole (fifth, shared column), including general measurements (the measurements are given as the object is preserved and are all in mm) and the strap complex, the types of which are explained in the text (sixth, shared column). In the case of pairs, some are described as pairs whereas others are inserted separately (especially those from Yuya and Tjuiu to show the differences within the footwear corpus of one context), which depended on the identification code. Moreover, it would have rendered the table less clear if a second set of measurements was inserted in the same entry. The last column of the features of the sole shows the diameters of the rows of the edge relative to each other in the sequence innermost/middle (if present)/outermost (l=large; s=small; e=equal). Measurements marked with # are taken from photograph and less accurate; ~=approximate. Abbreviations: D=diameter; L=length; T=thickness; W=width; N/A=not applicable.

[121] Note that the shape compares well with category A sandals but is more elongated.

[122] The fragile condition did not allow the removal of the strap complex, which rests on the dorsal surface of the sole obscuring probably two or three more 'bundles'.

	AM6994	AM6995	AM8056	UC16555a, b	EgCa JE93505a, b	EgCa JE95353a, b	Eg Ca JE95354a, b	EgCa JE91351a
W heel	Incomplete/ incomplete	100.4/103.0	87.2/88.4	95.0/97.0	87.9/81.7	86.8/89.2	85.6/81.8	73.1/75.4
W front	129.3/128.6	128.7/126.2	110.0/111.0	114.0/116.0	103.8/99.4	104.4/103.0	100.6/96.8	89.5/92.8
W waist	95.1/app. 90	96.0/89.3	84.5/89.3	95.1/96.3	84.6/79.7	83.8/84.7	81.1/77.8	70.8/72.4
L	323/ incomplete	335.0/336.0	298.0/300.0	335.0/335.0	295.0/285.0	300.0/300.0	300.0/300.0	260.0/260.0
T	8.9/8.5	9.6/9.5	8.1/7.5	7.0/6.4	5.6/5.3	6.3/6.3	5.6/5.4	5.0/4.9

TABLE 2
Measurements (in mm) of pairs of sandals (left/right respectively) to show variations within pairs. The lengths showed least difference; widths are more prone to variation.

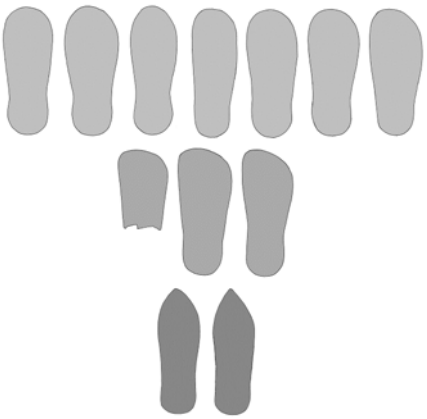


FIG. 1.
There are three distinct shapes seen in Sewn Sandals (all drawn as right sandals for clarity):

Type A. A1: ÄM 6995; A2: ASH 1887.2722; A3: ÄM 10962; A4: MFA 72.4760; A5: ÄM 627; A6: ÄM 6994; A7: MET 22.3.20.

Type B. B1: Petrie UC 28312i; B2: BM EA4428; B3: BM EA4426.

Type C. C1: MET 10.184, 1; C2: MEgT 5160.

Drawing A .J. Veldmeijer

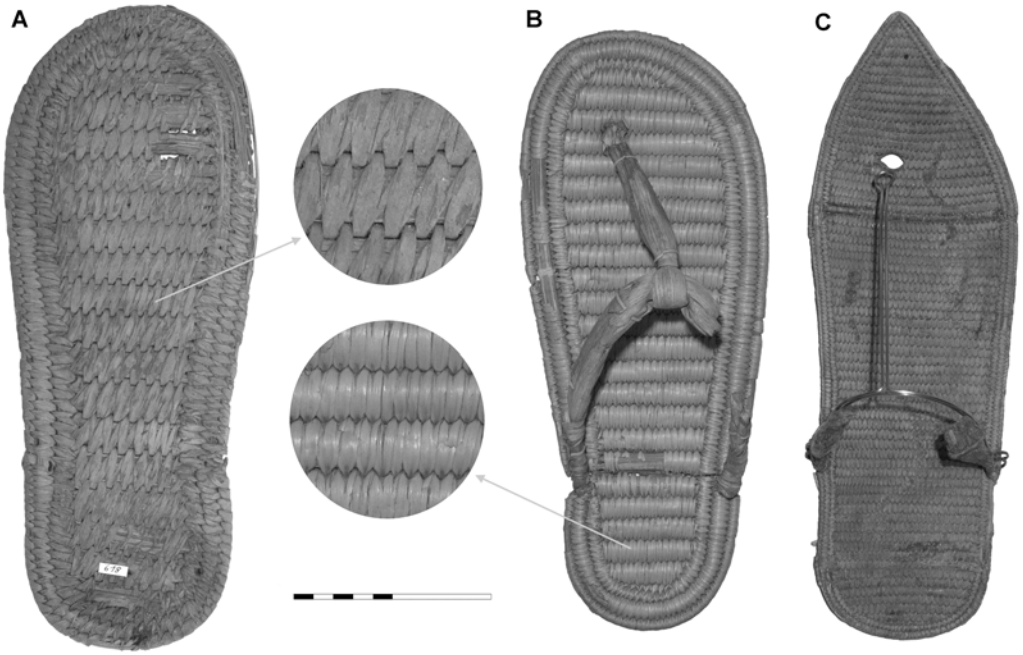


FIG. 2A C.
A: ÄM 618, made with coarse stitching.
E. Endenburg, courtesy of Ägyptisches Museum und Papyrussammlung Berlin.
B: MET 22.3.20, made with fine stitching. Back strap Type 2, front strap Type 1.
E. Endenburg, courtesy Metropolitan Museum of Art, New York.
C: MEgT 5160 (tomb of Nefertari). The exclusive Type C sandals are mostly made with fine stitches and over 60 transverse rows.
E. Endenburg, courtesy Museo Egizio, Turin

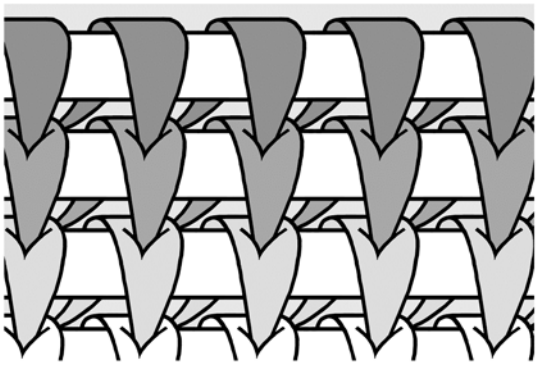


FIG. 2D.
Construction drawing of sewing technique. Not to scale.
E. Endenburg/A. J Veldmeijer.

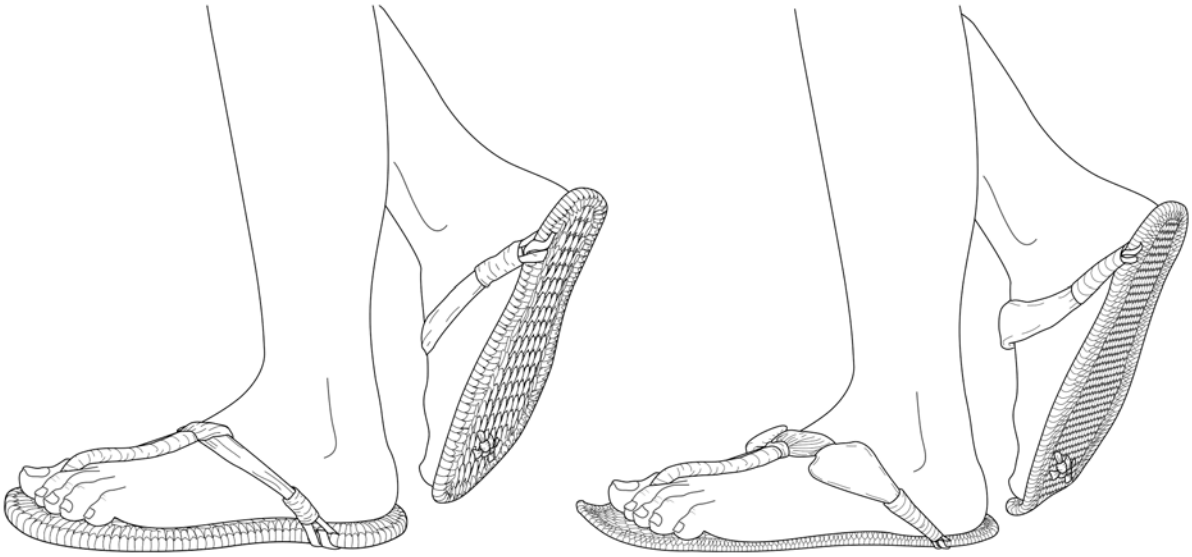


FIG. 2E F.
E, F: Artist impression of Type A and C sandals respectively.
Drawing M. H. Kriek.

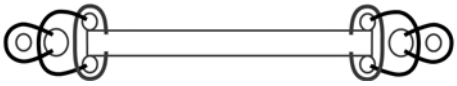


FIG. 3
Construction drawing of the edge. The sole is sandwiched at the dorsal and ventral surfaces by the core of the innermost row of the edge and sewn, on top of which are sewn the middle and outermost rows. Not to scale.
Drawing E. Endenburg/A. J. Veldmeijer.

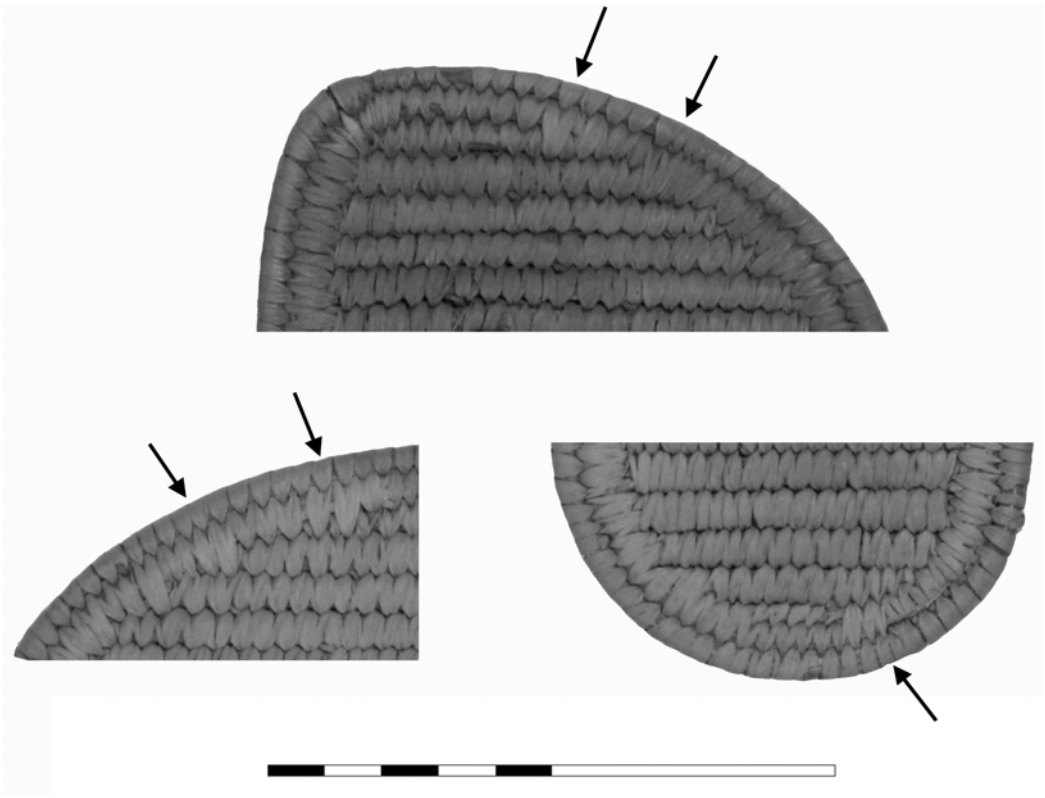


FIG. 4
The edge in some sandals consists of two bundles rather than three (cf. fig. 3 and 5). In one instance (BM EA4426) the stitches of the edge incorporates one of the transverse bundles on various spots.
Photograph A. 't Hooft, courtesy British Museum, London.

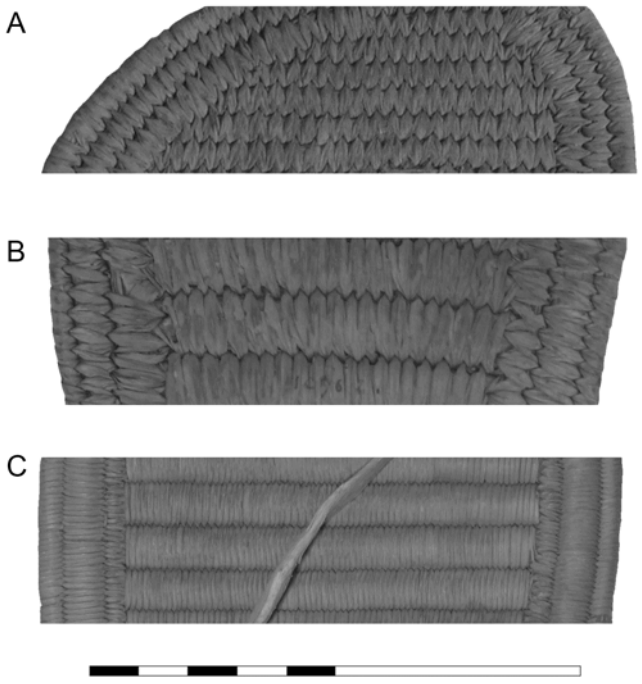


FIG. 5
Some sandals have an edge that consists of two rows only (see Fig. 4) but most sandals have an edge that consist of three rows. There are various possibilities in sequence of diameter of the rows (from innermost to outermost).

A: e. Petrie UC 7499i.
Petrie Museum of Egyptian Archaeology, UCL.

B: l/l/s. ÄM 10962.
E. Endenburg, courtesy Ägyptisches Museum und Papyrussammlung Berlin.

C: s/l/s. MET 22.3.21.
E. Endenburg, courtesy Metropolitan Museum of Art. New York.

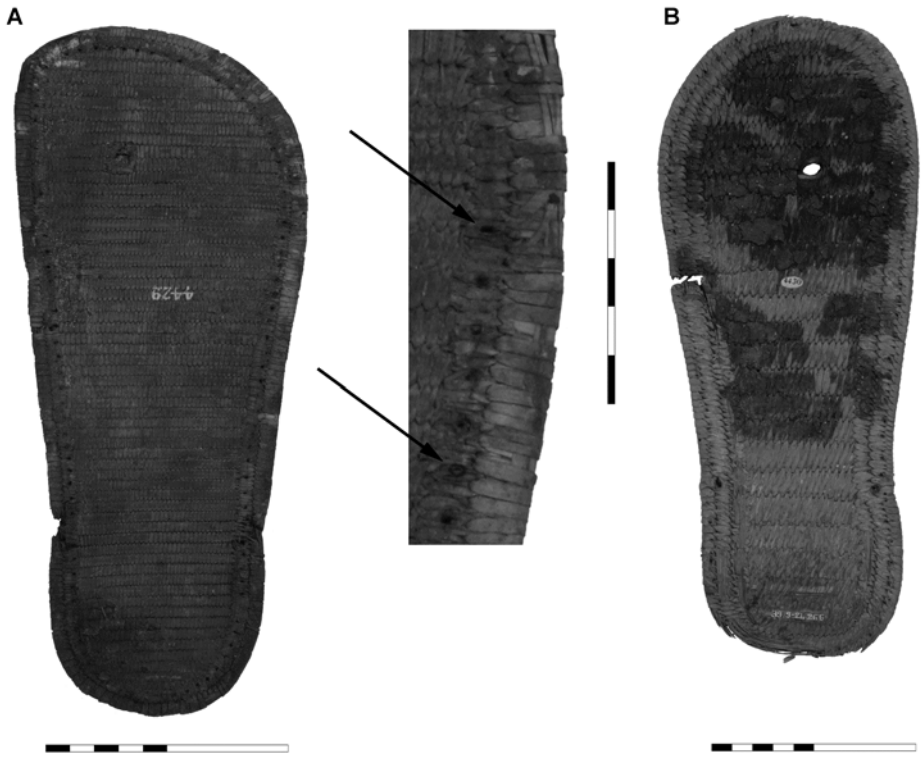


FIG. 6

Petrie (1890) mentions the presence of a leather treadsole.
A: BM EA4429 (Type B) has small stitch holes along the perimeter (inset), probably for the attachment of the leather treadsole. The leather might have caused the dark colour.
B: BM EA4430, a Type A sandal, clearly showing remnants of a leather layer.
Photograph A. 't Hooft, courtesy British Museum, London.

A.

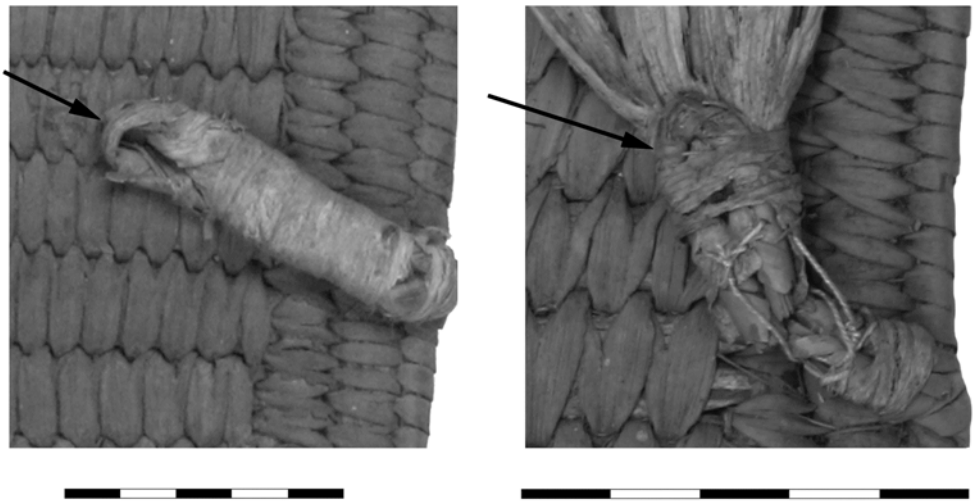


FIG. 7A

The strap complex in sewn sandals: the pre strap is a looped core of palm against which the papyrus back strap is placed and tied with a strip of papyrus or palm leaf. The cladding can be half knotted but is usually just cladded. BM EA36213 (left) shows a large cladded pre strap; the rest of the strap complex is lost. NMAL AU3 (right) shows the pre strap to which remnants of the back strap are still attached.
Photographs A. 't Hooft, courtesy British Museum, London/E. Endenburg, courtesy National Museum of Antiquities, Leiden.

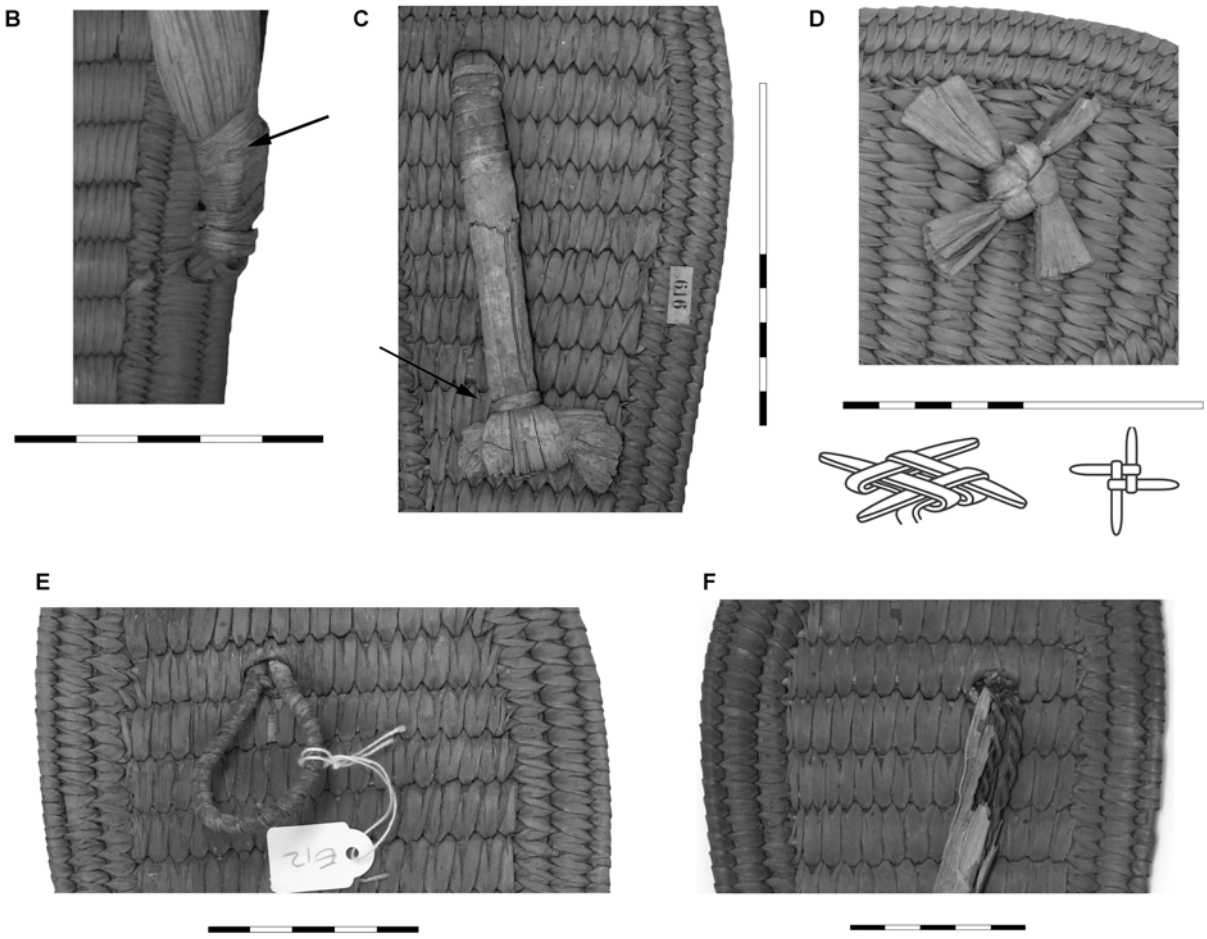


FIG. 7B F
The strap complex in sewn sandals:

B: MET 22.3.21a, b shows the pre strap at the outside of the back strap.
Photographs E. Endenburg, courtesy Metropolitan Museum of Art, New York.

C: ÄM 616, showing the attachment of the front strap to the back strap; Type 5. Note the cladded front part of the front strap.
Photographs E. Endenburg, courtesy Ägyptisches Museum und Papyrussammlung, Berlin.

D: Crown sinnet and its construction drawing (inset). The crown sinnet is, in sewn sandals, the common way to secure the front strap at the ventral surface of the sole: ÄM 617.
Photographs E. Endenburg, courtesy Ägyptisches Museum und Papyrussammlung, Berlin; inset E. Endenburg/A. J. Veldmeijer.

E: NMAL AU 4. This front strap is interpreted as repair to serve as reinforcement of the broken front strap, now lost. Note the resemblance to the pre strap.
E. Endenburg, courtesy National Museum of Antiquities, Leiden.

F: ÄM 6994-1, 2. The core of the front strap consists of two zS_2 strings: Type 5.
E. Endenburg, courtesy Ägyptisches Museum und Papyrussammlung, Berlin.



FIG. 8.
Artists' impressions.
Left: Type C sandals were worn by the higher ranks of society and were very popular with royalty.
Right: Type A sandal and its owner: the context of the archaeological examples show that these were worn by the lower ranks of society.
M. H. Kriek.