Preliminary Investigations into the Production of Glazed Steatite Beads:

Discussing the Use of Turquoise during the Badarian Period in Egypt

Maarten Horn, *Ägyptologisches Seminar, Freie Universität Berlin, Berlin, Germany*[1]

In the early twentieth century, Guy Brunton located a small number of turquoise beads and pendants in Badarian graves in the Qau-Matmar region in Middle Egypt. Recently, however, the use of turquoise during the Badarian period has been disputed. It is claimed that Brunton misidentified turquoise for glazed steatite, and that turquoise was not used in Egypt until the later Naqada IIC period. The current paper explores the verity of this statement by presenting the results of a preliminary investigation into the production techniques of Badarian glazed steatite beads. These support the notion that turquoise beads are misidentifications for glazed steatite beads. Conversely, they advocate in favour of the existence of turquoise pendants during the Badarian period, and thus against the notion that turquoise only began to be used from the Naqada IIC period onwards.

*Au début du XX*e *siècle, Guy Brunton a découvert un petit nombre de perles et de pendentifs en turquoise dans des tombes badariennes de la région de Qau-Matmar en Moyenne Égypte. Récemment, cependant, l'utilisation de la turquoise au cours de la période badarienne a été contestée. Certains prétendent que Brunton a pris de la stéatite vitrifiée pour de la turquoise, et que la turquoise n'a pas*

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été utilisée en Égypte avant la phase Nagada IIC. Le présent article explore les fondements de cette évaluation en présentant les résultats d'une enquête préliminaire sur les techniques de production des perles en stéatite vitrifiée d'époque badarienne. Ceux-ci confirment l'idée que les perles en turquoise sont bien une mauvaise identification de perles en stéatite vitrifiée. En revanche, ils penchent toutefois en faveur de l'existence de pendentifs en turquoise au cours de la période badarienne, et vont donc contre l'idée que la turquoise a commencé à être utilisée seulement à partir de la période Nagada IIC.

Introduction

Turquoise is one of several raw materials that, when found in Predynastic contexts along the Nile Valley, is often considered as a 'signpost' in terms of Egypt's early foreign relations. This is primarily due to the fact that the closest known natural occurrence of turquoise is located a considerable distance from these archaeological sites, in the southwestern part of the Sinai Peninsula (Aston et al. 2000: 20, 58-59). Since this location has, as such, been deemed to be 'out of reach' for Egypt's early populations, it follows that turquoise might have been procured via populations living in closer proximity to the source (e.g. Brunton & Caton-Thompson 1928: 41; Prag 1986: 60; Tutundžić 1989: 255-256). On the one hand, such a theory relies on certain presumptions surrounding the extent of the mobility of Egypt's early populations. On the other hand, this theory presumes that the identification of turquoise has been correctly assigned during excavations and is, therefore, not in need of any re-assessment. Yet, the method that is used to identify turquoise is not always specified in excavation reports, which leaves the accuracy of its determination in doubt.

The earliest archaeological occurrences of turquoise along the Nile Valley of Egypt consist of several beads and pendants included within a number of Neolithic Badarian graves in Middle Egypt (see **Table 1**). These graves were excavated in the Qau-Matmar region during fieldwork directed by Guy Brunton in the early twentieth century. The region covers the districts of Badari (including the smaller Qau el-Kebir, Hemamieh, and Badari regions), Mostagedda, and Matmar. The archaeological remains of these districts were published in separate volumes (Brunton & Caton-Thompson 1928; Brunton 1937; 1948). It is on the basis of these remains that the existence of the Badarian archaeological unit was recognized for the first time. Their initial discovery was followed by other Badarian(-like) findings in the Qau-Matmar region (Gabra 1930; Holmes 1993: 21-22; 1994: 22; 1996: 187-188; Holmes & Friedman 1994: 139, 141), along the Nile Valley to the south (Myers & Fairman 1931: 228-229; Brunton 1932: 274; Mond & Myers 1937: 7-8, 61, 163ff; Kaiser 1961: 20-21; Vermeersch 1978: 139-144; Hays 1984: 72; Hassan 1988: 153; Ginter & Kozlowski 1994: 134-135; Holmes & Friedman 1994: 136; Adams 1995; Hendrickx et al. 2001; Claes et al. 2014), and in the Eastern and Western Desert (Murray & Derry 1923: 129-131; Debono 1951: 66-69, 74; Darnell 2002: 156-169; Hope 2002: 46-48). Following Dee et al. (2013)[2], the Badarian period can be situated between 4407-4308 BC (68% hpd range) or 4489-4266 BC (95% hpd range), and 3800-3667 BC (68% hpd range) or 3896-3616 BC (95% hpd range).

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2. This article and its supplement refer to earlier publications on the absolute dating of the Badarian period (e.g. Hassan 1985; Hendrickx 1999; Hendrickx 2006).

Burial	Burial condition	Bead			Bibliographical reference
		Type	Material	Quantity	
Badari 5106	Quite disturbed	86K28	‘turquoise?’	?	Brunton & Caton-Thompson 1928: pl. L
Badari 5107	Quite disturbed	86R14	‘turquoise (?)' / ‘turquoise?’	1	Idem: 7, pls. V, L
Badari 5111	Quite disturbed	89C6	‘turquoise (?)'	1	Idem: pls. V, L
Badari 5364	Undisturbed	75C9	‘turquoise (?)' ‘turquoise?’	S	Idem: 10, pls. VI, XLIX
Badari 5397	Quite disturbed	75C3 75C9 86K26	‘turquoise?’ ‘turquoise?’ ‘turquoise?’	S 1 S	Idem: pls. VI, XLIX Idem: pls. VI, XLIX Idem: pls. VI, L
Badari 5403	Quite disturbed	75B15 75B18 75C12 75C15 86K30 86P18	‘turquoise?’ ‘turquoise?’ ‘turquoise?’ ‘turquoise?’ ‘turquoise’ ‘turquoise’	S S S S 1 ?	Idem: pls. VI, XLIX Idem: pls. VI, XLIX Idem: pls. VI, XLIX Idem: pls. VI, XLIX Idem: pls. VI, L Idem: pl. L
Badari 5403 and/or 5407	Quite disturbed Quite disturbed	86L10	‘turquoise?’	F	Idem: pls. VI, L
Badari 5403 or 5407	Quite disturbed Quite disturbed	86K18	‘turquoise’	1	Idem: pls. VI, L
Badari 5413	Undisturbed	75B15	‘blue glazed steatite or turquoise’ / ‘turquoise?’	S	Idem: 12, pls. VII, XLIX
Badari 5418	Quite disturbed	75C3	‘green glazed steatite or turquoise’ / ‘turquoise?’	S	Idem: 12, pls. VII, XLIX
		86P18	‘green glazed steatite or turquoise’ / ‘turquoise’	S	Idem: 12, pls. VII, L
Badari 5449	Quite disturbed	75B15	‘turquoise?’	S	Idem: pls. VII, XLIX
Badari 5738	Undisturbed	86K26 (?) and/ or 86L10 (?)	‘white glazed steatite (?) and turquoise (?)’ / ‘wh. gl. steat.’	S F	Idem: 16, pls. VIII, L Idem: 16, pls. VIII, L
Badari 5740	Quite disturbed	86M16	‘turquoise (?)’ / ‘turquoise?’	?	Idem: 16, pl. L
		86P12	‘turquoise (?)’	F	Idem: 16, pl. VIII
		86R14	‘turquoise (?)’	?	Idem: 16, pl. L
Matmar 3094	Quite disturbed	89C6	/ ‘turquoise?’ ‘turquoise’	2	Brunton 1948: pl. LXX

Table 1
Badarian ‘turquoise’ beads and pendants: burial, burial condition, bead type, material designation(s) and quantity, bibliographical reference. ‘F’ and ‘S’ denote ‘few’ and ‘string’.

The Qau-Matmar region not only revealed the presence of Badarian cemeteries, but also that of Badarian occupation areas. Though poorly published, these areas have recently been interpreted to be the remains of seasonal camps of mobile herding groups. The pastoral emphasis of these 'primary pastoral communities' was supplemented by seasonal pursuits of hunting, fishing, foraging, as well as cereal cultivation (Wengrow 2001: 95-96; 2003: 129; 2006: 26-29, 46-47; Wengrow et al. 2014: 102-104; cf. Hendrickx et al. 2001: 103-104). As noted by Wengrow (2003: 127, 133; 2006: 27, 54; Wengrow et al. 2014: 107; cf. Majer 1992), their mobile lifestyle allowed them to roam the landscape, and to partake in the acquisition and circulation of raw materials. It is in the context of such practices that the presence of turquoise in Badarian graves may be appreciated. Its acquisition by Badarian peoples could have been achieved through private mining missions, or through mechanisms of exchange with other groups. In the latter case, turquoise might have been obtained either as a raw material or as a (semi-)finished product.
Recently, however, the use of turquoise in the Badarian period has been questioned by Hendrickx and Bavay (2002: 60-61, 72), who suggest that the reported 'turquoise' is most probably a misidentification of glazed steatite (cf. Hartung 2001: 270-271). As turquoise finds are lacking for the Naqada I to IIB period, Hendrickx and Bavay (2002: 60-63, table 3.2) propose that its earliest presence in Egyptian contexts should, instead, be shifted to the Naqada IIC period. This article will, therefore, address the grounds on which Hendrickx and Bavay have questioned the existence of turquoise beads and pendants during the Badarian period. Secondly, it wishes to further add to this debate by discussing some preliminary results of ongoing investigations into the production techniques of Badarian glazed steatite beads. To this end, arguments will be forwarded in order to support the notion that the said turquoise beads are misidentifications of glazed steatite beads. Conversely, it will advocate in favour of the possible existence of turquoise pendants during the Badarian period and, thus, against the notion that turquoise began to be used only from the Naqada IIC period onwards.

Material characterizations

This article focuses on a number of Badarian beads and pendants that, according to the excavation reports in which they were published (Brunton & Caton-Thompson 1928; Brunton 1948), are made of turquoise, steatite, soapstone, and glazed steatite. A short review of each of these material categories is deemed necessary as a basis to the following discussions.

Turquoise

Turquoise consists of a hydrated phosphate of copper and aluminium. It has an opaque blue-green to pale sky blue colour and a value of 5-6 on the Mohs hardness scale. Several sources of turquoise are known from the southwestern side of the Sinai Peninsula (Aston et al. 2000: 10, fig. 2.2, 15, table 2.2, 62).

Steatite or soapstone

Steatite (or soapstone) is a homogeneous rock consisting of the mineral talc. This mineral has a platy structure and consists of hydrated magnesium silicate. It is very soft (1 on the Mohs hardness scale), has a soapy feel and a greasy shine, and comes in a variety of colours that range from grey to greenish grey and even brown or black. Steatite occurs naturally in the central and southern parts of the Eastern Desert (Tite et al. 2008: 23; Aston et al. 2000: 20, 58-59; De Putter & Karlshausen 1992: 140-141). Curiously, Brunton employed both steatite and soapstone as separate material categories, although the two are currently used as synonyms (cf. Brunton 1937: 51). As he does not stipulate his reasons for differentiating them, they will be treated as a single material category in the analyses below. This is except for those cases in which reference is made to specific 'soapstone' or 'steatite' beads that have been identified by Brunton.

Glazed steatite

Badarian glazed steatite beads represent the earliest known vitreous objects in Egypt. Tite and Bimson (1989) have shown that steatite beads were glazed via the so-called cementation method, whereby the objects were fired whilst buried in a glazing mixture. This process caused the mineral talc to convert into a white and much harder material composed of enstatite and cristobalite. The addition of a copper compound to the glazing mixture gave the outer glaze of the beads a blue to green, sometimes turquoise-like colour (Tite & Bimson 1989; Tite et al. 2008: 23-29).

Unfortunately, Badarian bead production areas have not been located as yet. A production of glazed steatite beads within Egypt does, however, seem to be supported by the availability of both steatite and copper sources in the Eastern Desert as well as by the presence of the necessary pyrotechnical skills, evidenced by the presumed production of Badarian pottery within Egypt (Hartung 2001: 269; Hendrickx & Bavay 2002: 60; *contra* Brunton & Caton-Thompson 1928: 41; Finkenstaedt 1983: 27).

Past critique on Badarian turquoise objects

The turquoise beads and pendants in question were attested in a total of 13 Badarian graves, of which twelve come from three cemeteries in the Badari district and one from a single cemetery in the Matmar district. For each individual burial, **Table 1** lists the types, material designations and quantities of the beads and pendants in the way in which they were published by Brunton (see the table for the relevant bibliographical references). The types themselves consist of a number followed by a capital letter and a second number. The first number refers to particular classes of shape: 75 standing for cylinder-shaped, 86 for ring-shaped and 89 for pendant-shaped. The capital letter and second number refer to specific types within these classes. The quantities of the different bead types were not given in exact amounts when these reached numbers above 2 or 3. Instead, terms like 'few' (F) and 'string' (S) were used, the exact quantities of which remain obscure (cf. Dubiel 2008: 12). In comparison with the data published previously by Hendrickx and Bavay (2002: 61, table 3.1; see also **Table 2**), **Table 1** shows some minor alterations and additions with respect to the graves of origin and the bead types.

Recently, Hendrickx and Bavay (2002: 60-61) have challenged the notion that turquoise objects were used within Egypt as early as the Badarian period. From their point of view (Hendrickx & Bavay 2002: 60), there are several factors that cast doubt on Brunton's identification of turquoise beads and pendants in a

Badarian context. Most of these issues are discussed without referring to the specific burials they are applying to. This information needs to be gleaned from a table in which the problems surrounding the turquoise objects are specified for each individual burial (Hendrickx & Bavay 2002: 60-61, table 3.1). The data stored in this table has been reproduced in **Table 2**. The next few paragraphs will explore and evaluate each of the key issues cited by Hendrickx and Bavay. The problems that have been specified for the individual graves will serve as examples in the course of these reviews.

Brunton's uncertainties in identifying turquoise

In his publications, Brunton makes it obvious that the identification of turquoise was surrounded with uncertainty and doubt. This is demonstrated by his addition of a question mark to the 'turquoise' determination, or by his indecisiveness between turquoise or glazed steatite (cf. **Tables 1 & 2**). Brunton is actually quite clear on the latter by such remarks as: '(steatite) *has probably always been glazed, blue as a rule, but sometimes green. In the latter case, it may be confounded with turquoise´* or '*Turquoise was most probably used, but it is difficult in the field to distinguish it from glazed steatite*' (Brunton & Caton-Thompson 1928: 27, 56). Only in a limited amount of cases does Brunton not seem to doubt on his turquoise identifications. This relates to a few beads from graves 5403 and/or 5407, and the pendants from graves 5111 and 3094 (see **Tables 1 & 2**).

Table 2
Problems identified by Hendrickx and Bavay (2002: 61, table 3.1) for identifying turquoise beads and pendants in Badarian graves. The italicized parts in this table are statements that are either incorrect or are unusable as evidence to support Hendrickx and Bavay's claim.

Burial	Problems identified by Hendrickx and Bavay
Badari 5106	• Brunton questions his turquoise identification (cf. Table 1). • The turquoise beads are not mentioned in the tomb register.
Badari 5107	• Brunton questions his turquoise identification (cf. Table 1). • *Andrews (1981: 23-24, no. 60) has identified bead material as steatite instead of turquoise*. (Andrews' comment actually applies to a pendant from grave 5111) • The turquoise beads come from the fill of the tomb.
Badari 5111	• *The turquoise pendant is not mentioned in the tomb register nor in the description of the grave.*
Badari 5364	• Brunton questions his turquoise identification (cf. Table 1).
Badari 5397	• Brunton questions his turquoise identification (cf. Table 1).
Badari 5403	• Brunton questions his turquoise identification for part of the beads (cf. Table 1). • Barbara Adams (pers. com.) has identified the bead material as steatite. • Bead type 86P18 is not mentioned in the tomb register for this grave.
Badari 5407	• Brunton questions his turquoise identification for part of the beads (cf. Table 1). • The turquoise beads are not mentioned in the tomb register.
Badari 5413	• In the grave description, Brunton doubts between a blue glazed steatite and a turquoise identification. In the bead corpus, on the other hand, the material of the beads is tentatively identified as turquoise (cf. Table 1).
Badari 5418	• In the description of this grave, Brunton doubts between a green glazed steatite and a turquoise identification. In the bead corpus, on the other hand, the material of the beads is identified as turquoise (cf. Table 1).
Badari 5449	• Brunton questions his turquoise identification (cf. Table 1). • Andrews (1981: 24, no. 61) has identified the bead material as glazed steatite instead of turquoise.
Badari 5738	• Brunton questions his turquoise identification (cf. Table 1).
Badari 5740	• Brunton questions his turquoise identification (cf. Table 1). • Andrews (1981: 19, no. 1) has identified the bead material as glazed steatite instead of turquoise.
Matmar 3094	• *Pendant is not mentioned in the description of the grave.*

Contradictions regarding the material identification and presence of objects within Brunton's publications

The uncertainties in identifying turquoise are not only shown in the material identifications themselves, but also in the presence of different determinations of one and the same object. Multiple determinations are possible due to the fact that the publications contain several sections in which the material substances of the beads and pendants are described, namely:
1. the individual grave descriptions within the main text;
2. the general discussion of beads and pendants within the main text;
3. the tomb register, providing details on the graves, the interred and the grave goods;
4. the bead and pendant corpora: these include the drawings of the bead and pendant types, the materials from which the beads and pendants assigned to this type are made and the graves in which these objects have been found;
5. the bead register: this is essentially a list of graves, where the bead types, their materials, their quantities and their positions in relation to the body are stated per individual grave. This is only present in the *Matmar* volume.
The above sections occasionally appear to not fully correspond with each other when it comes to the material identification of some of the beads discussed here. Clear examples of this include the material determinations of the beads found in burials 5413, 5418 and 5738 in the Badari region (see **Table 1**). In the individual descriptions of burials 5413 and 5418, Brunton mentions '*a few beads of blue glazed steatite or turquoise*' and '*a string of small green glazed steatite or turquoise cylinder beads*' respectively, whilst the beads are dubbed '*turquoise?*' or, in the case of bead type 86P18, a more assured '*turquoise*' in the bead corpora (Brunton & Caton-Thompson 1928: 12, pls. XLIX-L). Likewise, '*beads of white glazed steatite (?) and turquoise (?)*' are cited in the individual description of burial 5738, whilst only *´wh. gl. steat.´* beads appear in the bead corpus (Brunton & Caton-Thompson 1928: 16, pls. VIII, L). These examples further confirm Brunton's doubts surrounding the identification of turquoise.
The sections within the individual publications do not only provide contrasting information with regard to the material identifications of beads, but also, more generally, to the actual presence of beads or pendants themselves. In other words, whilst some sections explicitly claim the presence of certain beads or pendants within a grave, others seem to claim their absence by not referring to them at all. Nevertheless, the latter suggestion seems to be dependent on the type of section that is being dealt with. On the one hand, there are sections that are meant to give complete and accurate information regarding the beads and pendants present within the graves (cf. Brunton & Caton-Thompson 1928: 2; Brunton 1937: 2; 1948: 2). These sections correspond with the tomb registers, the bead and pendant corpora and/or the bead register. Internal contrasts between these sections create significant problems in re-assigning the objects to the right grave. It is, for example, unclear whether bead types 86L10 and 86K18 should belong to grave 5403 or grave 5407 due to the fact that the tomb register and the bead corpus provide contrasting information regarding this matter (cf. **Table 1**; Brunton & Caton-Thompson 1928: pls. VI, L).
The second group of sections, consisting of the individual grave descriptions and the general bead and pendant discussions, was not meant to provide full information on the beads and pendants within the graves. Brunton (1948: 7) has, for instance, clearly stated that the individual grave descriptions were only meant to supplement the information given in the sections of the first group.

The fact that beads and pendants are not discussed in these descriptions is, therefore, not to be interpreted as evidence for their absence in the graves. In spite of this, Hendrickx and Bavay (2002: 61, table 3.1; cf. Hartung 2001: 271) name the absence of the turquoise pendants in the descriptions of graves 5111 and 3094 as a reason to doubt on the Badarian origin of these pendants (cf. **Table 2**). The turquoise pendants from grave 3094, for example, are listed in the bead register, but are not mentioned in the description of this grave (Brunton 1948: 8, pl. LXX). Even so, the objects are clearly allocated to this grave in Brunton's general discussion of Badarian beads (Brunton 1948: 10). This strongly supports the fact that the absence of a turquoise pendant in the description of grave 5111 should not similarly be interpreted as a contradiction to its presence in the tomb register and in the corpora of beads and pendants (*contra* Hendrickx & Bavay 2002: 61, table 3.1, who incorrectly state that the pendant from grave 5111 was not mentioned in the tomb register).

Badarian turquoise objects: material re-identifications by other scholars

For obvious reasons, the material determinations given by Brunton have not remained undisputed amongst scholars (cf. Hendrickx & Bavay 2002: 60-61, table 3.1). Andrews (1981), for instance, has discussed the beads and pendants from graves 5107, 5449 and 5740 that are housed in the British Museum (AN EA59704, 59649 and 59687). In contradicting Brunton, she claims that the beads from graves 5449 and 5740 are not made of turquoise, but of green glazed steatite (Brunton & Caton-Thompson 1928: pls. VII-VIII, XLIX-L; Andrews 1981: 19, no. 1, 24, no. 61, pls. 11, 14). Andrews (1981: 23-24, no. 60, pl. 13) further discusses a number of beads and pendants that were identified by her as coming from grave 5107. However, in comparing these objects with the data provided in Brunton's tomb register, they should actually be identified as belonging to grave 5111 (cf. **Table 1**; Brunton & Caton-Thompson 1928: pl. V). This error has been rectified by the online collection database of the British Museum, where the objects have been assigned to this latter grave. One of the objects that Andrews mentions for this grave is a turquoise pendant, showing that in this case Andrews acknowledges Brunton's former claim (*contra* Hendrickx & Bavay (2002: 61, table 3.1), who states that Andrews identified it as 'steatite'; see **Table 2** under grave 5107). Finally, the turquoise beads from grave 5403, present in the Petrie Museum, have been recognized as being of steatite by Adams (cited in Hendrickx & Bavay 2002: 60-61, table 3.1; see also the Petrie Online Catalogue, AN UC9190).

Badarian turquoise objects: chronological issues

Hendrickx and Bavay (2002: 60) further questioned the use of turquoise objects during the Badarian period on the basis of the uncertain chronological position of a number of the graves that contained them. Although this statement is not further explained, it most probably refers to those burials lacking objects that are representative of the Badarian archaeological assemblage (e.g. pottery). These graves can, therefore, not be safely assigned to the Badarian period on the basis of their burial goods. Similar types of burials from the subsequent Naqada period are, for instance, also known in the Badari and Matmar districts (Brunton & Caton-Thompson 1928: 50-52; Brunton 1948: 12-16; Hendrickx & van den Brink 2002: 353-356, table 23.1). Nevertheless, the 'turquoise'-containing burials in the Badari district are lying within cem-

eteries that have only shown the presence of Badarian burials (Brunton & Caton-Thompson 1928: pls. IV-VIII; Hendrickx & van den Brink 2002: 355-356). It is, therefore, unlikely that the 'undatable' graves date to an altogether different period.
Grave 5407 might, however, be excluded as its spatial position within cemetery 5300-5400 could not be verified on the basis of the cemetery plan (Brunton & Caton-Thompson 1928: pl. IV). Another possible exception is burial 3094, located within cemetery 3000-3100 in the Matmar district. This cemetery includes both Badarian and Naqadian burials. Although a cemetery map has not been provided by Brunton, he does note that both grave groups were spatially separated from each other: the Badarian graves were lying to the east and south, whilst the Naqadian burials were located to the north and west (Brunton 1948: 3, 7-9, pls. I, III, IX-X). If this was a strict spatial separation, this could also vouch for a Badarian date for grave 3094. Nevertheless, the inability to check such a division, as well as the spatial location of burial 3094 within the cemetery, leaves such a claim unsubstantiable.

Badarian turquoise objects: contextual issues

The last issue cited by Hendrickx and Bavay (2002: 60) is the fact that some turquoise objects were discovered in the fill of a disturbed burial, and should, therefore, be regarded as being out of context. According to the table published by them (2002: 61, table 3.1; see also **Table 2**), this scenario only seems to apply to a single bead found in grave 5107. Brunton (& Caton-Thompson 1928: 7) clearly mentions this detail in his description of this grave. As a consequence, it is uncertain whether the bead was part of the originally interred burial goods or somehow ended up in the fill of the grave at a later stage. While the tomb registers mention that burials 5106, 5111, 5397, 5403, 5407, 5418, 5449, 5740 and 3094 were also quite disturbed (see **Table 1**), it is unknown whether this should automatically suggest an out of context situation for their beads and pendants as well (Brunton & Caton-Thompson 1928: 7, 11, 12, 16, pls. V-VIII; Brunton 1948: 8, pl. III).

A short evaluation of Hendrickx and Bavay's hypothesis

The review above has shown that the issues that have been put forward by Hendrickx and Bavay are largely valid and in support of their hypothesis. Nevertheless, some of the problems they mention in relation to the individual graves turn out to be unusable as evidence or to be incorrect. These problems, italicized in **Table 2**, are those cited for burials 5111 and 3094. These burials represent the single two Badarian burials in which turquoise pendants were identified by Brunton (**Tables 1 & 2**). This, therefore, shows that the issues put forward by Hendrickx and Bavay are only capable of questioning the material identification of Brunton's turquoise beads. As discussed later in this article, this may be related to the fact that the material composition of Brunton's 'turquoise' beads is different to that of his 'turquoise' pendants.

A comparison of glazed steatite, turquoise and soapstone/steatite bead attributes

Introduction

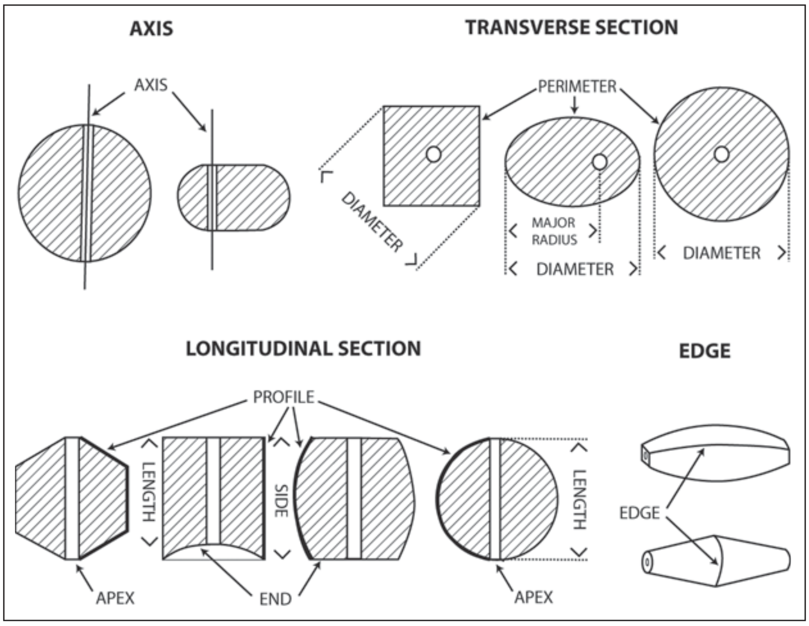
Even though the earlier stated arguments place serious doubt on the use of turquoise during the Badarian period, they do not definitely prove its absence. This, in fact, can only be fully accomplished by a macro- and microscopic analysis of the objects themselves, or, for example, by the use of X-ray fluorescence (XRF) or X-ray diffraction (XRD) analyses. The possibility that Brunton mistook glazed steatite for turquoise can, on the other hand, be further substantiated by an investigation into the production techniques used for beads of both materials. The following will present some of the preliminary results from a study of the production technology of Badarian glazed steatite beads that have been obtained on the basis of the data provided in Brunton's publications (Horn 2010). They form a precursor to ongoing investigations into the production technologies of beads and other body ornaments during the Badarian period in the Qau-Matmar region.

Brunton's published data and its use for a study of technology

The data published by Brunton does not permit a full investigation into the production technology of glazed steatite beads. Without the actual objects at hand, one is basically left with Brunton's descriptions and the type drawings in the bead and pendant corpora (Brunton & Caton-Thompson 1928: pls. XLIX-L; Brunton 1937: pl. XXXIX; 1948: pl. XV; see various parts of these corpora in **fig. 3-6**). Each type drawing is accompanied by a list of materials from which the beads, assigned to this type, are made. A list of graves is further added to each material category in order to show the specific find spots of these beads. The type drawings themselves present a scaled side view of the bead and pendant types. Front views are only added when the objects lack circular transverse sections (cf. **fig. 1**). Although surface design is shown in these drawings, indications of finishing techniques are neither described nor depicted. In this sense, only the shape and size of the beads and pendants can be studied in order to reveal more about the production techniques used. Since the morphology of the perforations is also rendered in the bead and pendant drawings, a study of perforation techniques forms an additional possibility.

The following pages present the results of an analysis and comparison of the perforation morphology, shape and size of Brunton's glazed steatite, soapstone, steatite and turquoise beads in order to demonstrate that the techniques used to produce them show a large number of similarities[3]. These

Fig. 1
Terminology of different bead parts. Modified after Beck 1981 [1928]: 3, figs. 1-4.



3. As stated above, 'soapstone' and 'steatite' are different terms for one and the same material. This paper will, nevertheless, refer to soapstone or steatite as separate categories when dealing with Brunton's material identification(s) of a specific bead or bead group.

similarities can be used to support the notion that most of these beads are, in fact, made from glazed steatite. This idea is, nevertheless, based on the assumption that Brunton's material identification of glazed steatite is correct. This hypothesis finds some support in the fact that his identifications have, until now, not been challenged in other studies of Badarian glazed steatite beads (Beck 1934; Andrews 1981; Vandiver 1983; Tite & Bimson 1989; Tite et al. 2008: 23-29). Since these studies only considered part of the total amount of Badarian glazed steatite beads, however, this hypothesis cannot be fully verified as yet. This thus means that the following analyses will be specifically focussed at evaluating Brunton's identifications of turquoise and soapstone/steatite in Badarian contexts.

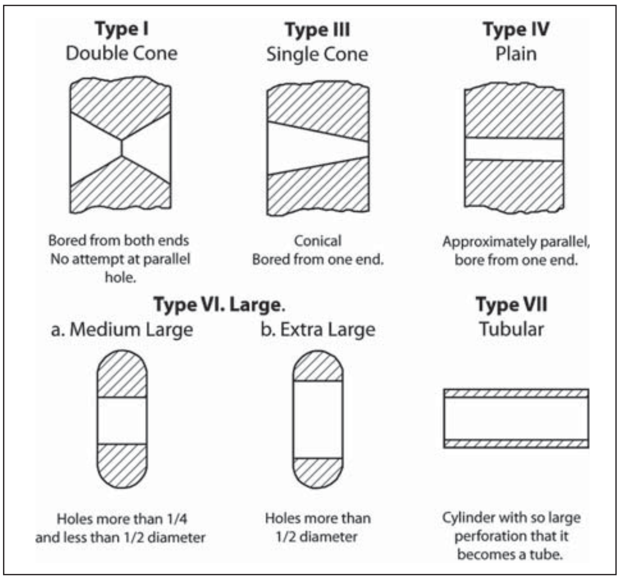


Fig. 2
A selection of Beck's single perforation types in beads. Modified after Beck 1981 [1928]: pl. IV.

As an aid to the discussions, **Tables 3 to 6** list the bead and pendant types that occur for each material category identified by Brunton. For each type, information is given on its particular shape (according to Brunton's nomenclature) and on whether its sides or ends run parallel to each other (for an explanation of bead terminology, see **fig. 1**). The tables further include a second categorization of the type's shape, consisting of a classification term and code, which is based on the more widely used bead and pendant classification system of Beck (1981 [1928]: 22, pls. II-III). This will allow for a comparison with beads from other archaeological sites. Finally, Beck's classification system has also been employed in order to describe the specific perforation morphology of the bead and pendant types (Beck 1981 [1928]: pl. IV; for a selection of the perforation types used here, see **fig. 2**; the bead and pendant types are represented in **fig. 3-6**).

Bead attributes: perforation morphology

The type drawings published by Brunton allow for a study of perforation morphology that can provide information on how beads and pendants of particular materials were perforated. Potential patterns can, nevertheless, be distorted by material misidentifications, a lack of type indication, type drawing or perforation representation (only in very few cases), or by the fact that type drawings often represent a range of beads made out of various materials. Regarding the latter, there is no firm evidence to suggest that similarly shaped beads of different materials were subdivided into different types on the basis of perforation differentiation alone. This is mainly due to a lack of information concerning how Brunton actually came to formulate his different bead types. As a consequence, a bead type drawing might show a kind of perforation that is only applicable to a certain number of beads assigned to that type. This might also have happened in those cases where in later publications Brunton classified beads by referring to specific bead types in earlier publications, even though the corresponding type drawings could have been made for beads of a different material with a different perforation.

The foregoing shows that an investigation of the perforation morphology of glazed steatite beads should commence with a study of the drawings of those bead types that only include glazed steatite beads. In other words, beads of other materials should not have been assigned to these bead types. The perforation morphologies shown in the drawings of this delimited set of bead types should then fully correspond with those of glazed steatite beads. Furthermore, the possibility should be taken into account that different perforation techniques were in use during different periods. It, therefore, seems better to only include those bead types to which Badarian glazed steatite beads have been assigned. This is complicated by the fact that the bead corpora contain bead types for both the Badarian and the Naqadian period. As such, only a few bead types fit both conditions, namely 86F25, 86K20 and 86K22 (**fig. 3**; Brunton & Caton-Thompson 1928: pl. L; Brunton 1937: pl. XXXIX). Their corresponding drawings show a type of perforation that conforms to what Beck has called

Table 3
Badarian glazed steatite bead types and their characteristics. Bead classification term, classification code and perforation morphology are provided after Beck 1981 [1928].

Glazed Steatite Beads						
Type	Shape	Sides parallel?	Ends parallel?	Classification term of Beck	Classification code of Beck	Perforation morphology
75B12	Cylinder	Yes	Yes	Long cylinder	I.D.2.b.	Plain
75B13	Cylinder	Yes	Nearly	Long cylinder	I.D.2.b.	Plain
75B15	Cylinder	Yes	Yes	Long cylinder	I.D.2.b.	Plain
75B18	Cylinder	Yes	Yes	Long cylinder	I.D.2.b.	Plain
75C3	Cylinder	Yes	Yes	Standard cylinder	I.C.2.b.	Plain
75C4	Cylinder	Yes	Yes	Standard cylinder	I.C.2.b.	Plain
75C8	Cylinder	Yes	Yes	Standard cylinder	I.C.2.b.	Plain
75C9	Cylinder	Yes	Yes	Standard cylinder	I.C.2.b.	Plain
75C12	Cylinder	Yes	Yes	Standard cylinder	I.C.2.b.	Plain
75M16	Cylinder	Unknown	Unknown	Unknown	Unknown	Unknown
78H12	Barrel	No	Yes	Short truncated convex bicone	I.B.1.f.	Plain
86B16	Ring	Unknown	Unknown	Unknown	Unknown	Unknown
86F25	Ring	No	Yes	Short barrel	I.B.1.b.	Plain
86K20	Ring	Yes	Yes	Short cylinder	I.B.2.b.	Plain
86K22	Ring	Yes	Yes	Short cylinder	I.B.2.b.	Plain
86K24	Ring	Yes	Yes	Short cylinder	I.B.2.b.	Plain
86K26	Ring	Yes	Yes	Short cylinder	I.B.2.b.	Plain
86K27	Ring	Yes	Yes	Short cylinder	I.B.2.b.	Plain
86K28	Ring	Yes	Yes	Short cylinder	I.B.2.b.	Single cone
86K29	Ring	Yes	Yes	Short cylinder	I.B.2.b.	Plain
86K30	Ring	Yes	Yes	Short cylinder	I.B.2.b.	Plain
86L10	Ring	Yes	Yes	Short cylinder	I.B.2.b.	Plain
86L11	Ring	Nearly	No	Short cylinder	I.B.2.b.	Plain
86L13	Ring	Nearly	Nearly	Short cylinder	I.B.2.b.	Plain
86P10	Ring	Yes	Yes	Cylinder disc	I.A.2.b.	Plain
86P12	Ring	Yes	Yes	Cylinder disc	I.A.2.b.	Plain
86P14	Ring	Yes	Yes	Short cylinder	I.B.2.b.	Plain
86P16	Ring	Yes	Yes	Short cylinder	I.B.2.b.	Plain
86P18	Ring	Yes	Yes	Cylinder disc	I.A.2.b.	Plain?
86R11	Ring	No	No	Short cylinder	I.B.2.b.	Plain
86R14	Ring	Yes	No	Short cylinder	I.B.2.b.	Plain
86R16	Ring	Yes	Nearly	Short cylinder	I.B.2.b.	Plain

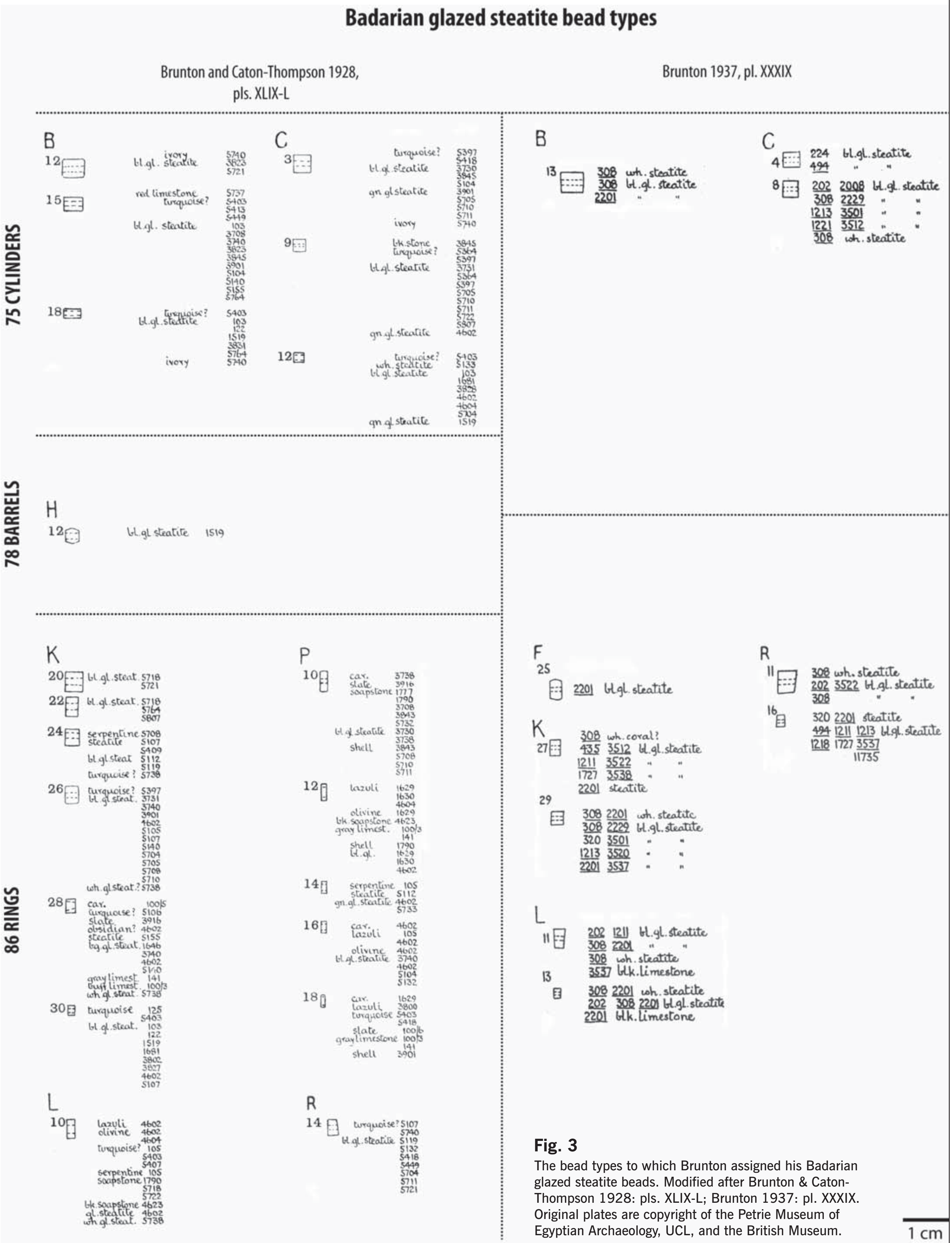


Fig. 3

The bead types to which Brunton assigned his Badarian glazed steatite beads. Modified after Brunton & Caton-Thompson 1928: pls. XLIX-L; Brunton 1937: pl. XXXIX. Original plates are copyright of the Petrie Museum of Egyptian Archaeology, UCL, and the British Museum.

Turquoise Beads and Pendants						
Type	Shape	Sides parallel?	Ends parallel?	Classification term of Beck	Classification code of Beck	Perforation morphology
75B15	Cylinder	Yes	Yes	Long cylinder	I.D.2.b	Plain
75B18	Cylinder	Yes	Yes	Long cylinder	I.D.2.b.	Plain
75C3	Cylinder	Yes	Yes	Standard cylinder	I.C.2.b.	Plain
75C9	Cylinder	Yes	Yes	Standard cylinder	I.C.2.b.	Plain
75C12	Cylinder	Yes	Yes	Standard cylinder	I.C.2.b.	Plain
75C15	Cylinder	Yes	Yes	Long cylinder	I.D.2.b.	Plain
86K18	Ring	Yes	Yes	Short cylinder	I.B.2.b.	Plain
86K26	Ring	Yes	Yes	Short cylinder	I.B.2.b.	Plain
86K28	Ring	Yes	Yes	Short cylinder	I.B.2.b.	Single cone
86K30	Ring	Yes	Yes	Short cylinder	I.B.2.b.	Plain
86L10	Ring	Yes	Yes	Short cylinder	I.B.2.b.	Plain
86M16	Ring	No	Yes	Short barrel	I.B.1.b.	Plain
86P12	Ring	Yes	Yes	Cylinder disc	I.A.2.b.	Plain
86P18	Ring	Yes	Yes	Cylinder disc	I.A.2.b.	Plain?
86R14	Ring	Yes	No	Short cylinder	I.B.2.b.	Plain
89C6	Pendant	No	No	Drop pendant	XXII.B.2.a.	Double cone

Table 4
Badarian turquoise bead and pendant types and their characteristics.
Bead and pendant classification term, classification code and perforation morphology are provided after Beck 1981 [1928].

Table 5
Badarian steatite bead types and their characteristics.
Bead classification term, classification code and perforation morphology are provided after Beck 1981 [1928].

Steatite Beads						
Type	Shape	Sides parallel?	Ends parallel?	Classification term of Beck	Classification code of Beck	Perforation morphology
75B13	Cylinder	Yes	Nearly	Long cylinder	I.D.2.b.	Plain
75C9	Cylinder	Yes	Yes	Standard cylinder	I.C.2.b.	Plain
75C12	Cylinder	Yes	Yes	Standard cylinder	I.C.2.b.	Plain
75C15	Cylinder	Yes	Yes	Long cylinder	I.D.2.b.	Plain
80C3	Barrel	No	Yes	Long barrel / crenelated bead	I.D.1.b. / XXIII.A.1.b.	Plain
86F27	Ring	No	Yes	Short barrel	I.B.1.b.	Plain
86K12	Ring	Yes	Yes	Short cylinder	I.B.2.b.	Concave
86K24	Ring	Yes	Yes	Standard cylinder	I.C.2.b.	Plain
86K27	Ring	Yes	Yes	Short cylinder	I.B.2.b.	Plain
86K28	Ring	Yes	Yes	Short cylinder	I.B.2.b.	Single cone
86K29	Ring	Yes	Yes	Short cylinder	I.B.2.b.	Plain
86L13	Ring	Nearly	Nearly	Short cylinder	I.B.2.b.	Plain
86M22	Ring	Yes	Yes	Short cylinder	I.B.2.b.	Double cone
86P8	Ring	Yes	Yes	Cylinder disc	I.A.2.b.	Double cone
86P12	Ring	Yes	Yes	Cylinder disc	I.A.2.b.	Plain?
86P14	Ring	Yes	Yes	Short cylinder	I.B.2.b.	Plain
86R11	Ring	No	No	Short cylinder	I.B.2.b.	Plain
86R16	Ring	Yes	No	Short cylinder	I.B.2.b.	Plain

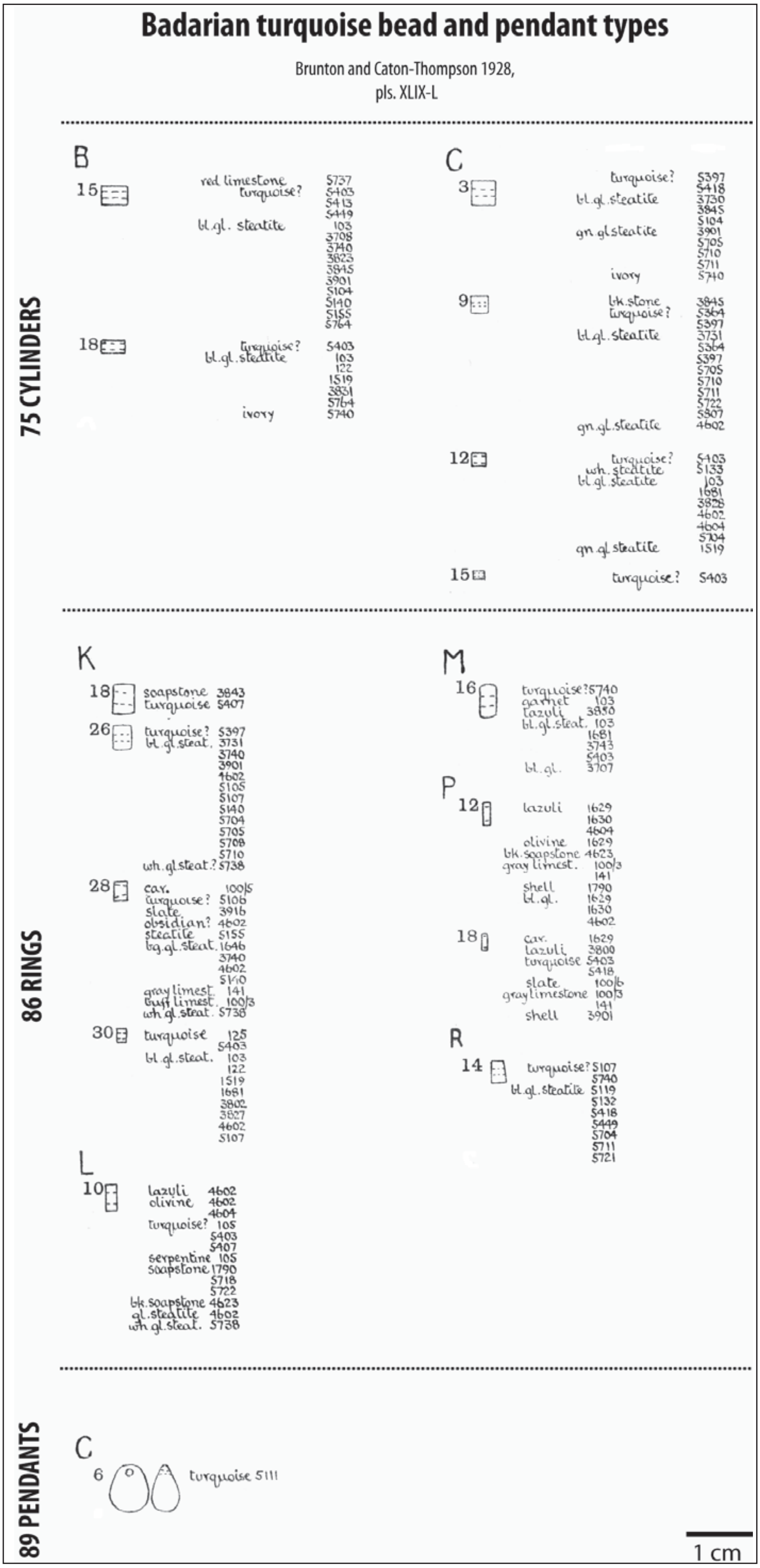


Fig. 4
The bead and pendant types to which Brunton assigned his Badarian turquoise beads. Modified after Brunton & Caton-Thompson 1928: pls. XLIX-L. Original plates are copyright of the Petrie Museum of Egyptian Archaeology, UCL.

'plain', 'large' and, in some cases, perhaps even 'tubular' perforations: in all cases a hole is present, which is parallel from one end to the other as seen from a side view (**fig. 2**; Beck 1981 [1928]: pl. IV, Types IV and VI). These types merely differ to the extent that their diameters cover a larger or smaller portion of the overall bead diameter (**fig. 1 & 2**; Beck 1981: 51, pl. IV). Since it is difficult to differ between these perforations on the basis of the published drawings, the term 'plain perforation' will be used to refer to all three (**Table 3**).

In extending our evidence base, plain perforations also seem to be present with those bead types that not only include Badarian glazed steatite beads, but also Brunton's (unglazed) steatite or soapstone beads (types 75B13, 75C8 and 86R11, see **fig. 3, 5 & 6**; Brunton 1937: pl. XXXIX). A similar pattern is established for bead types consisting solely of steatite beads (types 75C15 and 86F27, see **fig. 5**; Brunton 1937: pl. XXXIX). This shows that soapstone/steatite and glazed steatite beads could have been perforated in a similar way during the Badarian period (**Tables 3, 5 & 6**). Plain perforations even remain visible in those bead types that do not only include Badarian but also Naqadian glazed steatite, soapstone or steatite beads (bead types 75C4, 86K29, 86P10 and 86R16, see **fig. 3, 5 & 6**; Brunton 1937: pl. XXXIX). The glazed steatite beads from the Naqadian period will not be further studied here.

An interesting change in perforation morphology becomes apparent when those bead types are considered that do not only include Badarian beads of glazed steatite, soapstone or steatite, but also beads of other materials. On the one hand, plain perforations remain visible in those bead types that show a relatively higher amount of (graves with) beads of glazed steatite, soapstone or steatite than those of other materials (types 86P14 and 86P16, see **fig. 3 & 5**; Brunton & Caton-Thompson 1928: pls. XLIX-L). On the other hand, when bead types include relatively higher amounts of beads of, for instance, shell or harder stone materials, such as carnelian, the type drawings tend to show a single cone or double cone perforation (see for example bead types 86F10 and 86F19 in **fig. 6**; Brunton & Caton-Thompson 1928: pl. L; Brunton 1937: pl. XXXIX; for the perforation types, see **fig. 2**; Beck 1981 [1928]: pl. IV, types I, III and IV; it is unknown whether 'shell' refers to ostrich egg-shell, marine or freshwater shell or even land-snail shells, see Horn 2010: 215). Glazed steatite,

Table 6
Badarian soapstone bead types and their characteristics. Bead classification term, classification code and perforation morphology are provided after Beck 1981 [1928].

Soapstone Beads						
Type	Shape	Sides parallel?	Ends parallel?	Classification term of Beck	Classification code of Beck	Perforation morphology
86C8	Ring	No	No	Short barrel	I.B.1.b.	Double cone
86F10	Ring	No	Yes	Barrel disc	I.A.1.b.	Double cone
86F19	Ring	Yes	Yes	Cylinder disc	I.A.2.b.	Double cone
86F23	Ring	Nearly	Yes	Short barrel / short cylinder	I.B.1.b. / I.B.2.b.	Double cone
86L10	Ring	Yes	Yes	Short cylinder	I.B.2.b.	Plain
86P10	Ring	Yes	Yes	Cylinder disc	I.A.2.b.	Plain
86P11	Ring	Yes	Yes	Cylinder disc	I.A.2.b.	Plain?
86R6	Ring	No	No	Long barrel	I.D.1.b.	Double cone
86S6	Ring	No	Yes	Short cylinder with one convex end	I.B.4.d.b.	Double cone

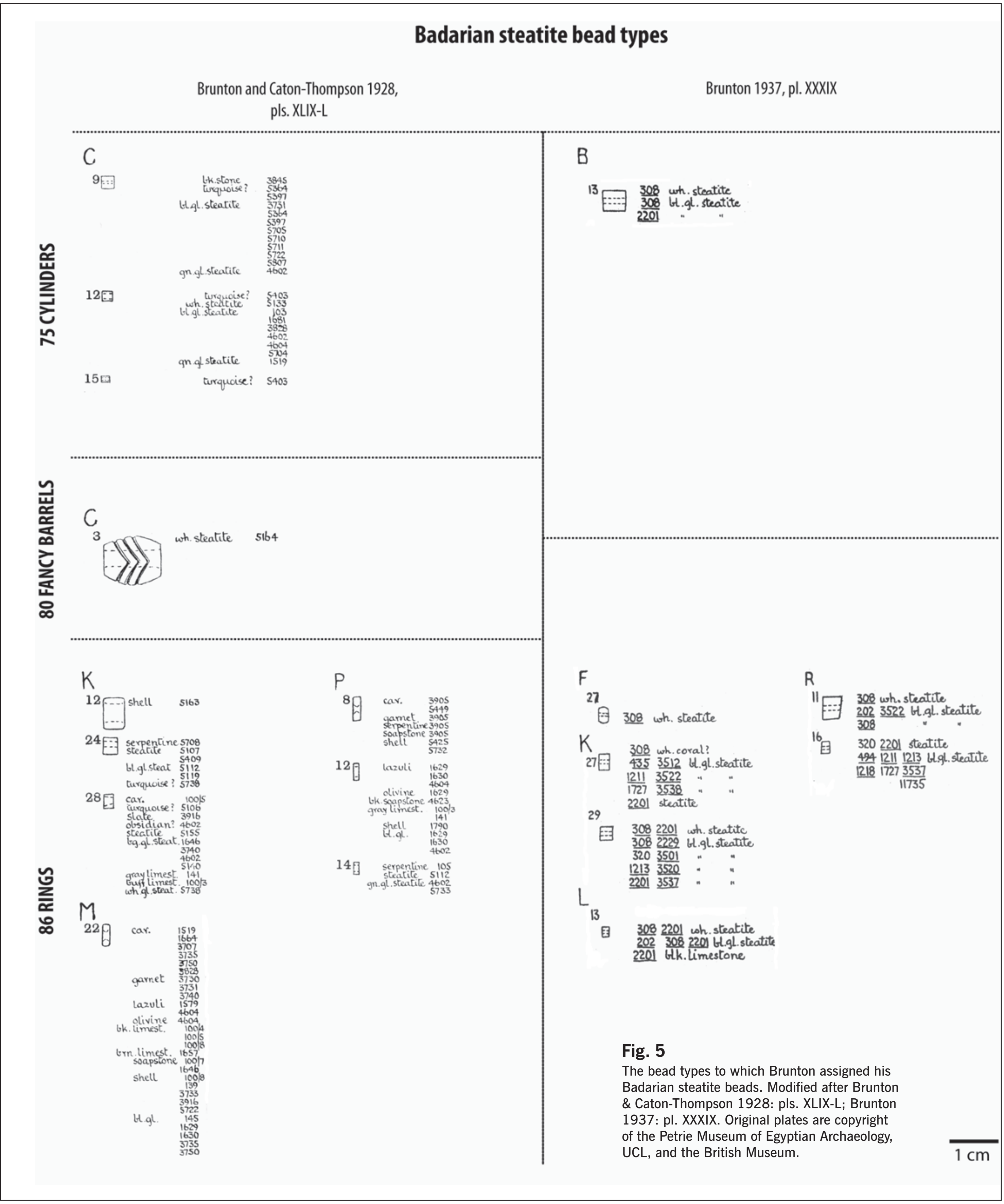


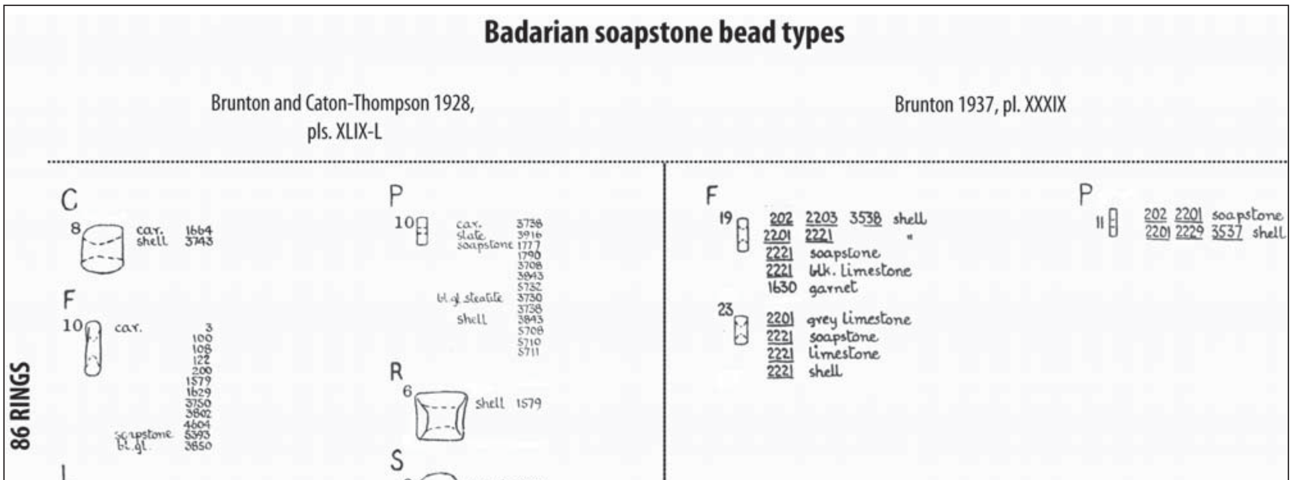
Fig. 5
The bead types to which Brunton assigned his Badarian steatite beads. Modified after Brunton & Caton-Thompson 1928: pls. XLIX-L; Brunton 1937: pl. XXXIX. Original plates are copyright of the Petrie Museum of Egyptian Archaeology, UCL, and the British Museum.

soapstone or steatite beads can also appear to have single cone or double cone perforations due to the fact that they were assigned to a type that was already published by Brunton in an earlier publication. In case this bead type predominantly included beads of hard stone materials, it would contain a type of perforation that would be at odds with that of the glazed steatite, soapstone or steatite bead (cf. type 86C8 in grave 2013, see **fig. 6**; Brunton & Caton-Thompson 1928: pl. L; Brunton 1948: pls. III, LXX). These cases suggest that perforation morphology was not considered a primary factor in determining the bead type categories; if it was, a new type would have been created altogether.

On this basis, it is possible to address the specific perforation morphology of the Badarian turquoise beads and pendants. Of the types cited in **Table 4**, there is but one bead type (75C15) and one pendant type (89C6) that consist of turquoise beads or pendants only. Whilst the drawing of bead type 75C15 shows a plain perforation, the one of pendant type 89C6 seems to depict a double cone perforation (see **fig. 4**). A plain perforation is also present in the drawings of the other bead types mentioned in **Table 4**. Most of these types mainly include beads of glazed steatite, soapstone or steatite that date to either the Badarian or Naqadian period. An exception is 86K28, where, instead of a plain perforation, a single cone perforation is present (see **fig. 2 & 4**). This anomaly could be explained by the fact that this bead type not only corresponds to beads of turquoise or (glazed) steatite, but also to those of 'limestone', 'carnelian', 'slate' and 'obsidian' (material identifications by Brunton). In this case, it might be possible that only the beads of the latter stated materials contain a single cone perforation. Brunton's glazed steatite, soapstone, steatite and turquoise beads would, in this way, only conform to the overall shape of the bead type itself.

The plain perforations of beads of glazed steatite, soapstone, steatite and turquoise do not appear to have a one-to-one relationship with beads or pendants of any other type of material. Instead, these tend to show single cone, double cone, (large) tubular or more concave perforations (see **fig. 2**; see type 86K12

Fig. 6
The bead types to which Brunton assigned his Badarian soapstone beads. Modified after Brunton & Caton-Thompson 1928: pls. XLIX-L; Brunton 1937: pl. XXXIX. Original plates are copyright of the Petrie Museum of Egyptian Archaeology, UCL, and the British Museum.



in **fig. 5** for a concave perforation, which possibly represents a worn down tubular or double cone perforation; Beck 1981: pl. IV, types I-III, VII). This is especially so when only those bead types are taken into consideration that do not include glazed steatite, soapstone, steatite or turquoise beads (Horn 2010: 75-77). In this respect, it seems plausible that the plain perforations should be interpreted as the result of a perforation technique that is specific to the Brunton's glazed steatite, soapstone, steatite and turquoise beads. Since the turquoise pendants appear to have a double cone perforation, a different perforation technique needs to be considered for these pendants.

Bead attributes: shapes and sizes

The outward shape of the beads further confirms the similarity in production techniques used for Brunton's glazed steatite, soapstone, steatite, and turquoise beads (see **fig. 1** for an explanation of the different bead features). The study of this feature utilised Brunton's typological bead classes as its main variables of analysis, since these classes provide an ordering of the beads and pendants according to their shape. In cross-tabulating Brunton's bead materials and classes, glazed steatite beads seem to occur almost exclusively with cylinder (75) and ring (86) classes (see **Table 3**, **fig. 3**). Although the exact difference between these classes is not explained by Brunton, an analysis of the drawings of their respective types seems to indicate that a ring bead has an axis which is less than its diameter, whilst a cylinder bead has an axis which is equal to or longer than its diameter (cf. Brunton & Caton-Thompson 1928: pls. XLIX-L; Brunton 1937: pl. XXXIX). An axis, in this case, refers to '*an imaginary line through the centre of the perforation*' (**fig. 1**; Beck 1981 [1928]: 2). Both bead classes are similar in that they have circular transverse sections, or, in other words, sections that have been taken at right angles to the beads' axes (**fig. 1**; Beck 1981 [1928]: 2).

A study of the specific bead types further reveals that Brunton's glazed steatite beads have straight and angular profiles, and only show differences in their length, diameter and/or in their ends, which are not always perpendicular to their sides (**fig. 3**; cf. Brunton 1937: 51). The dimensions of Badarian glazed steatite beads are ranging from ca. 0.1 to 0.4 cm in length and from ca. 0.2 to 0.5 cm in diameter. These dimensions are by approximation only as they are based on the scaled drawings of the bead types. An exception to the stated patterns is formed by a green glazed steatite bead of type 78H12, which was found in burial 3094 in the Matmar district (see **fig. 3**; Brunton 1948: pl. LXX). This bead type lacks the straight-sided profile that is present with the cylinder and ring beads and, instead, shows a curved, 'barrel'-shaped profile. Another anomaly is represented by bead type 86F25, found in grave 2201 in the Mostagedda district, which contains a slightly curved or convex profile (**fig. 3**; Brunton 1937: pls. IX, XXXIX). In theory, both types of beads could represent reshaped versions of ring-shaped beads with straight and angular profiles. Contrariwise, their shapes could also have been attained during a specific stage in the manufacturing sequence of ring-shaped beads, and thus reflect the shapes of unfinished glazed steatite beads.

The turquoise beads identified by Brunton appear to be associated with cylinder and ring classes only (**Table 4**), demonstrating shapes that are consistent with those of glazed steatite beads. Both bead groups also correspond in size: the dimensions of turquoise beads range from ca. 0.1 to 0.4 cm in length and from ca. 0.2 to 0.5 cm in diameter. In fact, most of the turquoise beads have been assigned to bead types that also include Badarian glazed steatite beads (except for types 75C15, 86K18 and 86M16). This may suggest that turquoise beads are to be identified as glazed steatite beads. A further indication of this is the fact that turquoise beads were found in association with glazed steatite beads in four out of nine graves (graves 5107, 5418, 5449 and 5738, Brunton & Caton-Thompson 1928: pls. V, VII-VIII, XLIX-L). The turquoise pendants, on the other hand, do not match the shape and size of the turquoise and glazed steatite beads (see type 89C6 in **fig. 4**). This shows that different techniques were employed to produce these pendants, as indicated earlier in relation to their perforation. Since glazed steatite pendants are not present amongst the Badarian bead assemblage either, the possibility increases that these pendants are not made from glazed steatite, but from turquoise or perhaps yet another material.

Brunton's 'soapstone' and 'steatite' beads also appear to be closely linked to ring and cylinder classes (**Tables 5 & 6**). A closer inspection of their bead types, however, reveals that the soapstone and steatite ring-shaped beads do not always fully correspond to the shapes and sizes of glazed steatite beads. A white steatite bead of type 86F27, found in grave 308 in the Mostagedda district, differs in the fact that it has a slightly curved profile (**fig. 5;** Brunton 1937: pls. VII; XXXIX). Two beads of type 86F10, consisting of a yellow soapstone bead from grave 5393 in the Badari district and a green soapstone bead from grave 2013 in the Matmar district, measure about 0.2 x 0.8 cm and show a curved profile (**fig. 6**; Brunton & Caton-Thompson 1928: pls. VI, L; Brunton 1948: pl. LXX). A few other beads of green soapstone appear to be oversized, irregularly shaped and to have a curved profile. These beads belong to types 86C8 (0.6 x 0.7 cm), 86R6 (0.7 x 0.7 cm), and 86S6 (0.6 x 1.2 cm), and were found in graves 2013 and 2503 in the Matmar district (**fig. 6**; Brunton & Caton-Thompson 1928: pl. L; Brunton 1948: pl. LXX). These differences could indicate that these beads are not made of glazed steatite, but possibly of the cited soapstone/steatite. Unfortunately, the perforation morphology of the stated bead types cannot be used to shed more light on their material constituencies. This is the result of the fact that Brunton mostly assigned beads of harder materials to these bead types. As stated earlier, beads of harder materials seem to be concomitant with single or double cone perforations. Moreover, since the beads from the graves in the Matmar district were assigned to bead types published in one of Brunton's earlier volumes, it is not possible to indicate here whether the perforation morphology shown in these types was also present in the beads from Matmar.

In addition to the ring and cylinder-shaped beads just cited, there is also a 'fancy barrel'-shaped bead of white steatite (bead type 80C3), which was found in grave 5164 in the Badari district (**fig. 5**; Brunton & Caton-Thompson 1928: 27, pls. VI, XLIX). Besides having a barrel-shaped profile, this bead contains incised grooves that form a double chevron pattern. These features are clearly different to those of glazed steatite beads. This is also borne out by the bead's size (ca. 1.1 x 0.9 cm), which is lying outside of the range of dimensions attested for glazed steatite beads. The so-called 'fancy' bead classes, to which this bead belongs, are present either in the form of cylinders (76) or barrels (80). They consist of beads that display surface markings or undulating surfaces. Only eight fancy beads have been recovered from a total of five Badarian graves, and include several segmented beads, a melon or gadrooned (i.e. with convex banding) bead, and beads with cross-hatched or chevron incisions (Brunton & Caton-Thompson 1928: pls. XLIX-L, nos. 76A3, 80C3; Brunton 1937: pl. XXXIX, nos. 76B3, 76B6, 80B4; 1948: pl. XV, nos. 7-9; cf. Beck 1981 [1928]: 10, fig. 11a, 13-14, fig. 15, A.1.a). Most fancy beads appear to have been fashioned out of ivory and bone, presumably because of their easy workability. The white steatite bead represents the only exception.

Similarities between glazed steatite, soapstone/steatite and turquoise beads

The above-presented results demonstrate that the Badarian glazed steatite beads identified by Brunton are comparable in a number of ways. Not only do they show similarities in the morphology of their perforation hole and in their general size, but their outward shapes also appear to be restricted to those of the ring and cylinder classes and to share many attributes. This seems to indicate that similar production techniques were utilized to manufacture glazed steatite beads. Interestingly, Brunton's turquoise beads, and, to a certain extent, his soapstone/steatite beads, show the same shapes, sizes and perforation morphologies as the glazed steatite beads. In light of the fact that Brunton already admitted to having difficulties in separating glazed steatite from turquoise, there is a high likelihood that the turquoise beads need to be re-identified as glazed steatite beads. In theory, however, glazed steatite beads could have been used in order to imitate the rare turquoise beads, and worn with them in order to simulate their abundance. A similar practice has been described for faience beads in non-elite graves in Cemetery E at Abydos; these beads might have been used in order to emulate turquoise beads in elite graves in Cemetery U (Stevenson 2009: 26; 2011: 70). Yet, the production of glazed steatite marks a major pyrotechnical feat that only emerged during the Badarian period. It seems unlikely that this new material was specifically developed and valued for its quality to emulate turquoise. This is supported by the fact that both Badarian (glazed) steatite and 'turquoise' beads contain a plain perforation that does not seem to occur with beads of other materials, nor with the supposedly turquoise pendants.

Matters become more difficult in considering Brunton's 'soapstone' or 'steatite' beads. While some beads appear similar to glazed steatite beads in shape, size and perforation morphology, others demonstrate features that are not shared by glazed steatite beads. In analogy to the turquoise beads, the former group of beads is likely to be of glazed steatite. Their misidentification could possibly have been caused by the chemical weathering of their glazed outer layer (cf. Beck 1934: 75; Tite & Bimson 1989: 92, pl. 1). From a different point of view, they could also have been produced in the same way as the glazed steatite beads, except for the fact that they were not fired and glazed. The second, 'aberrant' group of soapstone/steatite beads contain beads, whose types merely show a different perforation morphology. As stated earlier, a different perforation morphology need not have been caused by its actual presence, but could instead have been the product of typological issues. Shape and size seem to have been crucial in assigning a bead to an existing bead type, or in producing a new type altogether. Perforation morphology, on the other hand, was not considered a crucial attribute. This indifference has led to a situation in which beads were classified to a bead type with a different perforation. In this respect, it is possible that these beads should also be identified as being of glazed steatite or unfired soapstone/steatite. A similar interpretation does not seem to apply to the soapstone/steatite beads with different shapes and sizes. These objects were either produced out of soapstone/steatite with the use of different techniques, or belong to a different material group altogether.

Glazed steatite bead production techniques

Introduction

Previous investigations into the production techniques of Badarian glazed steatite beads have focussed mainly on glazing techniques (Beck 1934; Vandiver 1983; Tite & Bimson 1989; Tite et al. 2008). Considering the fact that these beads are some of the earliest vitreous materials in the world, the importance of these investigations cannot be overstated (Tite & Shortland 2008: 17). Even so, glazing techniques in themselves do not constitute the full breadth of techniques necessary to manufacture glazed steatite beads. On account of the data presented earlier in this article, the following sections will, therefore, deal with the techniques that produced the specific shapes and perforations of glazed steatite beads. Previous research on this topic will firstly be explored in relation to the earlier acquired patterns in shape and perforation morphology. Lastly, these patterns will be compared to a production technique that has been proposed for Levantine glazed steatite beads dated to the Chalcolithic period.

Production techniques according to Brunton

'*The piercing of the steatite beads is remarkably regular. In the great mass of them from* (grave) *592 the piercing is truly cylindrical, with at least three sizes of bore. In* (grave) *472B it is also cylindrical ; but in* (grave) *308 the hole narrows from one side to the other. The regularity of the piercing can only have been effected by a metal tool. These steatite beads often have ends which are not parallel to each other, though the sides are. Their lengths also vary very much, and their general appearance strongly suggests that they were sliced from longer cylinders*' (Brunton 1937: 51).

This statement shows that Brunton was already well aware of some of the regularities in the shape and perforation morphology of glazed steatite beads. Brunton's observations on the cylindrical (or 'plain'), but differently sized perforation holes are consistent with the results presented earlier in this article. He also seems to implicitly acknowledge the regular shapes of the beads. Interestingly, these observations were only published in his second volume on Badarian finds (i.e. Mostagedda district). This corresponds well with the fact that whilst turquoise beads were identified in the first volume (i.e. Badari district), they were no longer referred to in the second and third volume (i.e. Matmar district). Even though two turquoise pendants appear in the third volume, these objects do not appear to bear any relation to glazed steatite beads (see below). As such, it seems plausible that Brunton had come to realize that the turquoise beads he identified in his first volume were actually made from glazed steatite.

Brunton was the first to pay attention to the ways in which glazed steatite beads were shaped and perforated. According to him, the plain perforations could only have been produced by metal tools, although he does not explain the reason for this. Nevertheless, there is a virtual dearth of this category of objects in Badarian contexts. Only one copper pin has actually been attested, but was recovered from a disturbed context (Brunton & Caton-Thompson 1928: 33, pl. XXVI). Putting aside any doubts on its chronological position, the diameter of this pin appears too large to have created the small perforation holes in the glazed steatite beads. The published type drawings reveal that their diameters usually revolve around ca. 0.1 cm, but can go up to ca. 0.2 cm or down to ca. 0.05 cm. In this respect, it can either be assumed that the thin metal tools that produced these holes have never been located, that tools of a different type of material were used or that another production technique was employed altogether. In any case, the different diameters of the perforation holes do indicate that these tools had varying thicknesses. On an interesting note, Brunton informs us that the beads from grave 308 contain conical instead of plain perforation holes. This description, however, stands in direct contrast to the plain perforations shown in the bead type drawings (Brunton 1937: pls. VII, XXXIX). This again confirms the idea that a divergent perforation was not considered important enough to form a new bead type.

Brunton provides more convincing evidence on how glazed steatite beads were shaped. His notion that the beads were cut from longer cylinders corresponds well with the fact that the glazed steatite beads are restricted to ring and cylinder shapes. It is further evidenced by the fact that whilst the sides of the beads usually run parallel to each other, the ends do not always seem to do so. These nonparallel ends would have been caused by the fact that the beads were not cut in straight angles to the cylinder's axis. The beads' parallel sides, on the other hand, demonstrate that each cylinder was regular and straight, and showed a consistent diameter throughout. The size of the diameters could, however, vary with each individual cylinder. The fact that beads of varying diameters co-occur with each other within single graves thus implies that these beads were produced in multiple sequences. All in all, the varying lengths and diameters of the beads, as well as the nonparallel ends of certain of these, indicate that the production process of glazed steatite beads was not yet standardized.

Production techniques according to Vandiver

The production techniques of glazed steatite beads have been more thoroughly evaluated by Vandiver (1983: A64-A69, fig. 28). Two girdles of several hundred glazed steatite beads were examined by her, the first coming from grave 5735 in the Badari district (Ashmolean Museum AN 1925.551a-e; *contra* Vandiver (1983: A-64), who describes it as coming from grave 5710), the other from grave 592 in the Mostagedda district (British Museum AN EA62150). The beads from these girdles are discussed together with glazed steatite beads from Naqada II graves at Naqada, El Amrah and Gerzeh. Since all beads are considered by her as a single group, it is not always possible to determine which descriptions apply to the Badarian beads and which to the Naqada II beads. Most perforation holes in steatite beads are, for example, mentioned to be '*concave from each end*', indicating that drilling had taken place from both ends of the bead. Only few beads, however, were apparently drilled from one end, resulting in a conical perforation hole (Vandiver 1983: A-65). Unfortunately, it is not pointed out which beads contained what type of perforation. Moreover, both types of perforation seem to be in direct contrast to the plain perforations described and illustrated by Brunton.

Vandiver (1983: A-65) further theorizes that the unfired and unglazed steatite beads would have been produced by '*grinding a rod, chipping or cleaving discs from the rod, drilling holes in the discs and then in some cases abraiding to the final shape*'. Chipped off edges and scratch marks on the bead surfaces underneath the glaze bear witness to the production techniques used prior to firing and glazing (Vandiver 1983: A-65; cf. Beck 1934: 73). These are, however, not further explicated. A number of factors seem to be at odds with the production techniques proposed by Vandiver. The first relates to her suggestion that a piece of raw steatite was ground down into the shape of a rod, from which discs (or rings) would subsequently be cut. Although the evidence does indeed indicate that both cylinder and ring beads were cut from longer cylinders, it remains peculiar that beads of other shapes were not carved out as well. If a socio-cultural restriction on other shapes is to be excluded, the limited range of shapes can most probably be related to constraints imposed by the particular production techniques used. These constraints do not appear to be present when a rod is simply carved out of a piece of steatite. It should, therefore, not be ruled out that the rod was produced via an overall different procedure.

A second point of critique is on how and when the perforation of steatite beads took place. If these plain holes are indeed the results of perforation, they can only have been accomplished by the use of a cylindrical or (hollow) tubular drill (cf. Kenoyer 2007: 270-274). As the diameters of the holes do not exceed 0.2 cm, quite thin drills must have been used. Furthermore, the holes seem to have been perforated from one side only. This is best exemplified in the longer cylinder beads: the axes of their perforation holes are straight and do not show the change in angle that one would expect with a perforation from both sides of the bead. Lastly, Vandiver assumes that perforation only took place after the beads were cut from the longer cylinders. Since the lengths of these cylinders are still unknown, it is also possible that these were perforated before they were divided into multiple beads.

Levantine production techniques

The emergence of glazed steatite beads during the second half of the fifth millennium was not an event isolated to the Qau-Matmar region in Egypt. The roughly contemporaneous emergence of glazed steatite beads in the southern Sinai, the Levant, Mesopotamia and the Indus Valley indicates that it was, instead, part of a far wider, interregional trend (Tite et al. 2008: 23; Bar-Yosef Mayer & Porat 2009: 112, 117). Since glazed steatite production first occurred in these regions during the Chalcolithic period, it appears that the context of copper production could have led to its discovery and subsequent adoption (Hauptmann et al. 2000; Tite et al. 2008: 18-19). Differences in glazing methods show that this was most likely an independent event for the regions of Egypt and the Indus Valley (Tite et al. 2008: 35).

Of interest to the present article is a collection of short cylinder-shaped 'glazed steatite paste' beads discovered in a Chalcolithic burial cave at Peqi´in in the Upper Galilee (Bar-Yosef Mayer et al. 2004; Bar-Yosef Mayer & Porat 2009). This burial cave dates to the second half of the fifth millennium BC and is, therefore, contemporaneous to the Badarian period (Hendrickx 1999: 63-64; Bar-Yosef Mayer & Porat 2009: 112, 118). The absence of any steatite sources in the Levant has resulted in some scholars questioning the origin of the raw material of the beads, as well as the location of their manufacture (Bar-Yosef Mayer et al. 2004: 497-500). Although Egypt has been cited as a possible candidate, recent analyses have shown that the production techniques used for the Peqi'in beads were different from those used for the Badarian beads. This significantly diminishes the possibility that these beads, and perhaps by extension their raw material, originated in Egypt. The 'Levantine' production techniques will be discussed here in order to provide more insight on the Badarian production techniques that were used before firing and glazing.

Bar-Yosef Mayer and Porat (2008: 118-119) have proposed the following technological procedures for the production of the 'glazed steatite paste' beads from Peqi'in, as well as for those from other sites in the Levant and the southern Sinai:

'*First a paste was prepared from powdered talc, water and perhaps an organic binding material and/or a flux containing alkalis (to lower the temperature of sintering) as well as copper powder for glazing. The paste was then shaped into long rods, probably along a thin core (possibly of straw), the tube was sliced to form beads and then fired at a high temperature. This firing hardened the paste and transformed the talc into enstatite and cristobalite. Because glazing* (…) *was apparently done by the efflorescence technique, the slicing must have taken place before firing* (…)' (Bar-Yosef Mayer & Porat 2009: 118)

What immediately stands out in this quotation is the fact that the short cylinder beads were created by slicing them from long tubes. This specific production technique is similar to the one suggested for the Badarian beads. The tubes themselves were moulded around a thin core, possibly made of straw. The plain holes left by this core have a diameter ranging from 0.5 to 1.7 mm, the average being 1.05 mm (Bar-Yosef Mayer & Porat 2009: 113). These holes correspond in shape and size to those of Badarian glazed steatite beads. This could, as a consequence, suggest that Badarian beads were produced by preparing a paste from powdered talc, water and a binding material, moulding this paste into a long tube along a thin core and by slicing this tube into multiple beads. The paste could not have contained a flux as the Badarian beads were glazed by using the cementation method instead of the efflorescence method (Tite & Bimson 1989; Bar-Yosef Mayer & Porat 1989: 115). This hypothetical sequence of production techniques would explain the shapes and perforation morphology of the Badarian glazed steatite beads. Even so, Tite has recently determined that the Badarian beads were made from solid steatite, and not from steatite paste (Tite on citation in Bar-Yosef Mayer & Porat 2009: 117). This observation shows that the Badarian tubes could not have been shaped by moulding a paste around a thin core. As a consequence, the small holes in the Badarian beads could only have been produced by means of drilling.

Discussion

Turquoise beads and the production of glazed steatite beads

The provided evidence strongly suggests that the Badarian turquoise beads, and possibly a number of soapstone/steatite beads, identified by Brunton are misidentifications of glazed steatite beads. This evidence amounts to a combination of specific attributes (relating to shape, size and perforation morphology) that is demonstrated by each of these bead groups. As a consequence, the presence of turquoise beads during the Badarian period needs to be rejected. This outcome seems to be in line with earlier claims made by Hendrickx and Bavay who questioned whether turquoise objects were actually in use during the Badarian period. Despite the arguments presented by them, the presence of three turquoise pendants could still reflect this use during the Badarian period (see further below).

The patterned features of glazed steatite beads have also given rise to an investigation of their production techniques. This has resulted in the confirmation of earlier theories by Brunton and Vandiver who have stated that the beads were cut off from longer tubes. The use of such a production technique is borne out by the fact that the shapes of the beads are restricted to those of ring and cylinder classes. Furthermore, the occasional non-parallel ends of the beads prove that these beads were not always cut off in a straight angle to the axis of the tube. A different matter concerns the production of the tubes themselves. The straight, parallel sides of the beads seem to point to the fact that these tubes had a true cylindrical shape. Although Vandiver (1983: A-65) has argued that these tubes were grinded out of steatite, she does not further elaborate on the exact technological procedure. Needler (1984: 309) has been more specific in stating that Predynastic and Early Dynastic steatite disc beads were sliced from a steatite cylinder that had previously been worked in a grooved grinding stone. This is possible, although such an object need not have been used: rough steatite ring and cylinder beads could also have been strung or loaded on a thin rod and subsequently been rolled on a grinding slab until the desired shape and diameter were obtained (this is known as the 'heishi technique', see Francis Jr. 1990: 47; examples of its use in the Near East are, for example, found in two Neolithic sites in the Wadi el-Jilat, Eastern Jordan, see Wright et al. 2008: 141, 148). The curved profile of some beads could then be explained as 'works-in-progress' that had not yet been fully abraded to a ring or cylinder bead (cf. Vidale 1995).

Another option is that the tubes were obtained by boring them out of a piece of steatite with the help of a hollow, tubular drill. If this technique was used to the exclusion of others, it would explain why (nearly) only ring and cylinder beads have been produced. The soft nature of steatite (Mohs hardness of 1) would not necessarily have required the use of copper drills, tools that have not been attested amongst Badarian remains. In fact, experiments have shown that reed tube drills with an added abrasive could have produced the same results (Stocks 2003: 111-112, table 4.1). In any case, the differences in the diameters of the beads could point towards variations in the diameters of the tubes, and hence in those of the supposedly used drills. The observation that beads of different diameters co-occur within a single grave could then be used as evidence for the fact that these were manufactured in separate acts of production, in which drills of different diameters were employed. Whilst this procedure does clarify the manufacture of ring and cylinder beads, it still does not fully explain why beads of other shapes were not produced as well. Could such beads not simply have been cut or grinded out of a raw piece of soft steatite? Glazed steatite bead types with a deviating, curved profile (78H12, 86F25, 86M16; see **fig. 3 &** 4) have been attested, but were only reported for one grave each. If these represent reshaped or unfinished glazed steatite ring beads, they did not necessarily require a fundamentally different production process. In this respect, the limited range of shapes and sizes of glazed steatite beads might not only be due to technological, but also to socio-cultural and perhaps still other factors. Since the exact causes for this restriction are as yet unclear, it is not yet possible at this time to determine the technique that was used to produce the steatite tubes with any certainty.

Plain perforations appear to be peculiar to glazed steatite beads, although the specific technique that was used to produce them is still largely elusive. The fact that these beads were made out of solid steatite instead of a steatite paste seems to suggest that the plain perforations were created through drilling. Since the holes are straight and show no change of angle, it is probable that the perforation took place from just one side of the bead (or tube). The cylindrical shape of the plain holes further indicates that either a solid, cylindrical or hollow, tubular drill was employed. The use of a solid drill seems to be suggested by the small diameters of the holes (ca. 0.05 to 0.2 cm). This line of thought can find further support in Brunton's comment on the conically shaped perforation holes in the beads from grave 308 in the Mostagedda district (Brunton 1937: 51). If a perforation was not carried out completely, the point of the drill could have left a similar shaped hole.

The pre-firing production techniques proposed here will need to be further investigated by a macro- and microscopic analysis of glazed steatite beads, now located in various museums. Such an analysis is currently being formulated within a larger investigation into the technologies of Badarian body ornaments, or 'dress items'. As part of this, it will be necessary to identify the materials of the beads[4], to take measurements of their various dimensions and to verify the actual numbers of beads per grave. The acquired data could then be used in order to provide more clarity on matters relating to, for instance, the lengths of the individual tubes, or to whether beads of different lengths were manufactured out of a single tube. Additional examinations could focus on the chipped-off edges and the residual scratch marks beneath the glaze that have been described by Vandiver (1983: A-65). These traces are likely to be the result of production techniques carried out before firing and glazing (Vandiver 1983: A-65). Their study could enable a verification of the proposed production techniques and has the potential to reveal more details about them. This would not only involve information on each, individual production technique, but also on the chaîne opératoire or the particular sequence(s) in which these techniques were employed.

Turquoise pendants

Whilst the turquoise beads identified by Brunton seem to be misidentifications of glazed steatite beads, the same analogy cannot be drawn for the turquoise pendants from graves 5111 and 3094. Their shape and perforation morphology do not challenge Brunton's material determination, something that seems to be supported by the apparent lack of Badarian glazed steatite pendants. It is, therefore, possible that these pendants were indeed fashioned out of turquoise. This would certainly agree with the determination made by Andrews for the pendant from grave 5111 (Andrews 1981: 23-24, no. 60). Even if the other two pendants from grave 3094 would also prove to be of turquoise, the pendants themselves remain rare amongst Badarian burial goods. In combination with the observation that these objects were discovered in 'quite disturbed' graves (cf. Hendrickx & Bavay 2002: 60), the question can be raised as to whether the pendants were actually part of the original sets of Badarian grave goods. In case of burial 3094, the question can even be posed as to whether it actually belongs to the Badarian period. Unfortunately, the answers to these questions cannot be provided on the basis of the information given in Brunton's publications.

Yet, the possibility that the pendants were part of the original grave assemblages may find support in the results from a recent excavation of three

4. At the time of writing this article, the author is involved in performing handheld X-Ray Fluorescence (XRF) analyses on the Badarian glazed steatite, turquoise and soapstone/steatite beads and pendants in the Ashmolean Museum in Oxford, as well as the British Museum and Petrie Museum in London. The results of these analyses will provide more information on the material composition of these artefacts.

Final Neolithic cemeteries at Gebel Ramlah in the Egyptian Western Desert (Kobusiewicz et al. 2010). Two of these cemeteries, termed E-01-2 and E-03-2, revealed a total of nine turquoise objects: three beads with double cone perforation, four lip plugs and a single nose plug (Kobusiewicz & Kabaciński 2010: 33, fig. 1.27:7, 35, 75, 79, fig. 1.86:7, 90, 92, fig. 1.103: 5a-c, 98, 100, 104). Unfortunately, the method that was used to identify turquoise, as well as other minerals and rocks, has not been indicated. The excavation report also does not include photographs of the objects in question. The finding of turquoise artefacts would certainly be remarkable, as both cemeteries in Gebel Ramlah have been dated to a period preceding or shortly overlapping with the oldest radiocarbon dates obtained for the Badarian remnants in the Qau-Matmar region (Kobusiewicz & Kabaciński 2010a: 119-120; 2010b: 251; Dee et al. 2013). Their discovery would, therefore, stand in direct contrast to the theory that places the earliest use of turquoise in Egypt in the Naqada IIC period (cf. Hendrickx & Bavay 2002: 60). Furthermore, the location of the cemeteries is situated at a far greater distance from the turquoise sources in the Sinai Peninsula than the Badarian cemeteries in the Qau-Matmar region. Assuming that the use of turquoise in Gebel Ramlah is correct, this shows that turquoise pendants could equally have been part of the Badarian archaeological assemblage in the Qau-Matmar region. The only way to solve this issue is by a material analysis of the pendants housed in the British Museum in London and the Metropolitan Museum of Art in New York[5].

Conclusion

The results obtained in this article have, at the very least, demonstrated that caution must be taken in working with material identifications from excavation reports. The results themselves should, for this reason, also not be spared from the necessary scepticism, as they too are ultimately based on this very source. The material identifications proposed here are, therefore, not to be interpreted as definitive but rather as preliminary. The best way to solve this issue is by returning to the beads and pendants that are currently housed in various museums around the world. Their scientific analyses, which are currently being formulated, intend to not only bring more clarity on their material compositions, but also on the chaînes opératoires by which they were produced and the manners in which they were used.

5. Professor of Geology J.A. Harrell of the University of Toledo has very recently inspected the pendant from grave 5111 in the British Museum in London, and has verified that it is indeed made of turquoise. Handheld XRF analyses are momentarily being carried out in order to verify this identification.

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