1 General Introduction

Faience in Egypt

The term »faience«, misleading as it is – for it derives its name from the Italian town of Faenza and its widely-imitated product tin-glazed earthenware –, is used to describe the material employed from the earliest times in both Egypt and Mesopotamia for the making of small aesthetically significant objects. »Egyptian faience« is now accepted as the clearest and most unambiguous nomenclature for the substance as manufactured in the Egyptian sphere, although some museum collections and literature prefer the terms »glazed composition« or »glazed quartz frit«[1]. It is an aceramic material, that is not made from clay, or alternatively a protoceramic, formed from silica-rich sand/ground pebbles, combined with a small amount of lime, and sodium salts, either the naturally occurring natron, which combines sodium carbonate and bicarbonate, or plant-ash, which produces potassium-potash. It acquires its brilliant colouring from metallic oxides. The earliest objects were beads, small amuletic symbols and, by extension, the flat surface of tiles. Later, it proved possible to make small vases both open and closed. In Egypt, during the second millennium and especially the New Kingdom, even more ambitious shapes were made with faience, such as elaborate inlays, fine vessels, and small statuettes. Some exceptionally large objects have also survived, which demonstrate the technical possibilities[2].

1 I do not intend to make any discussion or analysis of the early development of faience and the interrelationships between Mesopotamia, the Near East and Egypt, which may have contributed to this development. See Stone – Thomas 1956, 37–84 for a general survey, and the introductory chapters of Foster 1979 for additional material. For the Egyptian material, Lucas – Harris 1962 is still a basic handbook, but much of the analysis is now superceded. The analysis of the chemical components of a dated sequence of faience objects from Egypt by Kaczmarczyk – Hedges 1983, throws much light on the changing nature of the technology in Egypt. Kaczmarczyk 1986, 369–376; multi-author articles in Bimson – Freestone 1987 for valuable contributions on faience and Egyptian Blue, and Webb 1987a, 145–150 on discontinuity in glass in the Aegean; Nicholson 1993; Vandiver 1998; see now articles in Friedman 1998a, 15–64, and Nicholson – Shaw 2000; in particular Nicholson – Peltenburg 2000, 177–194 and Kaczmarczyk 2005, 29–37; Jackson – Wager 2008, and Tite – Shortland 2008 for up-to-date discussions of the state of research and bibliographical material.

2 Evidence in form of moulds and fragments of faience objects from the factories at Tell el Amarna illustrate this well, Petrie 1894, 25–30 pls. 16–20. See Nicholson 1998, 51 f. 60 f. for discussion of the use of cores and moulds and the location of actual kilns, Nicholson 2007, and Nicholson 2013.
The elaborate *Was* sceptre dating from the reign of Amenhotep III found at Nubt (Naqada) in 1894, was made in sections, and is one of the largest faience objects known, H. 215.8 cm. Petrie – Quibell 1896, pl. 78 (London, Victoria and Albert Mus. inv. 437.1895); Nicholson 1998, 61 fig. 36; one should also add the faience lions and other statuary in faience from Qantir-Piramisses, Hamza 1930, 31–68, especially 46–51 e. g. »Semitic Captive being bitten by a lion«. Much evidence of faience manufacture also found here.

Faience was used extensively as a substitute for precious stones in inlay work in the New Kingdom and earlier, and this ability to mimic the colour and bright surface of materials such as turquoise, lapis lazuli and cornelian gave it its lasting appeal and high prestige, though it was also used in early times to mimic the green of the reeds see the tiles which covered Djoser's pyramid complex (Dynasty III). Its name in Egyptian is *tjehnet* which means brilliant, or shining[3]. Its makers were honoured, and master craftsmen are depicted in Egyptian funerary art – see the tomb of an overseer of faience workers at Lisht, funerary texts relating to such individuals, who are described as director or overseer of faience makers, and the possible scene of faience craftsmen at work in Tomb of 'Ibi[4].

In New Kingdom Egypt its manufacture existed side by side with that of glass[5] which was a much more recent invention/importation, and it shared a high degree of development with this newly created glass industry. Like glass, it required only the use of commonly found, naturally occurring mineral substances, while, unlike glass, the techniques used in its manufacture had been the subjects of continuing experimentation and change over many centuries. Moreover, it was not necessarily a royal monopoly, unlike glass, although the royal workshops were no doubt the centres which in many cases pioneered new processes[6].

Faience, however, was not affected by the eclipse which overcame glass-working at the end of the New Kingdom although certain techniques and colours became less popular, or disappeared altogether: for instance yellow (lead antimonate) and an intensifier for blue (cobalt), both of which apparently do not reappear until the Saite period, second half of the seventh century into the sixth century[7]. A similar process affected Late Period glass, when red – a very difficult to reproduce colour – reappears after a long absence[8]. Such changes suggest a reorientation in supply sources, possibly linked to new access to areas of supply in the Near East, as well as increasing sophistication in the manufacture of faience.

In fact, faience became ever more popular, especially for the manufacture of the newly fashionable amulets[9] and for the small exquisitely modelled perfume and unguent containers which, in the New Kingdom, had been more frequently made in precious substances such as ivory, rare woods and calcite, and more rarely in faience. Such substances were now largely unobtainable or, we may suggest, prohibitively expensive; while faience, with its brilliant colours, hard surface and comparative ease of manufacture, became ever more popular[10]. A similar change in materials from precious stone or metals to faience can be seen in the manufacture of chalices. A comparison between such New Kingdom pieces as the chalices found in the Tomb assemblage of Tut-ankhamun and the later production of so-called Tuna ware in faience, with its brilliant colour and low-relief decoration, demonstrates this clearly[11].

There has been much renewed interest in faience, with detailed studies of the history and technical development of the material in Egypt[12] and a number of well-

3 Gardiner 1999, 15; Friedman 1998b, 20 n. 3; Nicholson 1998, 55 f.

4 Nicholson 1998, 55 f. fig. 31. In the funerary papyrus of *Qn-hr* (XIXth Dynasty), he is referred to as *imy-r irw hsbd* – the director or overseer of faience –, and in a scene from *Ibi*'s tomb – the chief steward of the Divine Adoratrice of Amun at Thebes, in the reign of Psammetichos I – there appears a possible depiction of the manufacture of faience.

5 Development of glass, see Nicholson – Henderson 2000, 195–224 for evidence of glass making at Malkata, a palace temple complex at Thebes, belonging to Amenophis III; at Tell el Amarna, Akhenaten (Amenophis IV): Petrie 1894, and Nicholson 2007; at Qantir-Piramesses: discussed in Rehren et al. 2001, 223–238; Rehren – Pusch 2008, 14–31. Non-palatial workshop sites also exist from the XXth Dynasty, at Lisht and Menshiyeh. There was some difference in oxides used – cobalt in Palatial Workshops, copper at Lisht.

6 For example, the faience objects from the Dynasty I Royal Tombs from Abydos show a degree of experimentation, with certain features which are not found in the majority of faience until a much later period, see Kaczmarczyk – Hedges 1983; Vandiver 1998, 121–139.

7 Kaczmarzcyk 2007, 30–33, and references to earlier discussion in Kaczmarczyk – Hedges 1983, especially 259.

8 See reference by Nicholson 1993, 61 to comments made by J. D. Cooney on the reappearance of New Kingdom colours in glass on a glass shrine door with the name of Amasis and another with name of Darius both of which use the distinctive red and other colours typical of New Kingdom glass. For Darius shrine door London, BM inv. 1891.0525.1, and EA 37496, see <http://www.britishmuseum.org/research/collection_online/collection_object_details.aspx?objectId=111444&partId=1&searchText=darius&page=31> (22.02.2015); Bianchi 1983; Myśliwiec 1988, 67; Curtis – Tallis 2005, 173 no. 266; <http://www.britishmuseum.org/research/collection_online/collection_object_details/collection_image_gallery.aspx?assetId=24411&objectId=111444&partId=1> (22.02.2015); Nicholson – Henderson 2000, 196; Allen 2005, 110; Tait 1991, 61; Yoyotte 1972, 220 f. pl. 19 A.

9 Petrie 1974, 25. The increased use of such amulets in the ritual wrappings of the mummy was an important change, see diagrams in Petrie 1972, pls. 50–53 which include the lay-out of disc beads used in a network to cover the mummy. See the discussion by Webb 1996, 599 f., on the distribution and use of disc beads in Early Iron Age Cyprus, Greece (Lefkandi and Athens) and Crete.

10 Wallert 1967, 39 notes tendency in Late Period to use faience, in place of more difficult to work and expensive (?) ivory. This trend had already been established in the Third Intermediate Period, when rarer, more expensive, and less accessible materials ceased to be used.

11 von Bissing 1941b; Tait 1963, 93–139; although James 1963/1964, 74–79 denies the developmental link. These develop from the lotus chalices originally made in the more precious calcite and glass from the New Kingdom, see examples from the tomb assemblage of Tutankhamun.

12 Lucas – Harris 1962, 155–178, still stands in its typology of certain types of faience, but see now a number of analytical studies, beginning with Kaczmarczyk – Hedges 1983; Vandiver 1998, 121–142; Nicholson 1998; Nicholson – Peltenburg 2000, 177–194; Tite – Shortland 2008; Jackson – Wager 2008.

illustrated and scholarly exhibitions and catalogues[13]. Outside Egypt, there have been thorough studies of Bronze Age faience from Crete and Mycenaean Greece, with an increasing level of cultural and scientific analysis[14], and for the Near East, with its distinctive traditions, similar comprehensive study and analysis[15].

The Iron Age faience material found in the Greek world and the West has been the subject of increasingly detailed study since John Pendlebury collected his material for his *Aegyptiaca*, and Friedrich Wilhelm Freiherr von Bissing studied the glazed wares and faience from Cerveteri[16].

Continuity and Discontinuity between Bronze Age and Early Iron Age in Egypt, Near East and the Aegean

Egypt and, it appears, the Near East, continued their traditions of faience working through the difficult times at the end of the second millennium and the beginning of the first millennium. But in Greece itself faience production – such as had existed in the great palaces of Crete at Knossos, Mallia, and Zakros, and in Greece at Mycenae and other centres – disappeared with the breakdown of the Palace economies of the Late Bronze Age. We can state with certainty that no native tradition of workshop practice survived into the Early Iron Age, since the existence of these highly specialised crafts, like others such as ivory working, were supported and monopolised by the palace patron[17].

The only faience objects found in contexts of the intervening period in Greece are stray scarabs, amulets and disc beads which had been brought to Greece from the East, along with gold jewellery and Egyptian bronzes, for instance at Lefkandi[18] and on Crete, the Idaean Cave, as well as at Knossos, Fortetsa and the North Cemetery[19]. An exception to this paucity is the group of faience vessels found at Lefkandi, now with a parallel find from Skyros[20], (an island closely linked through trade and proximity with Euboea) which demonstrate the erratic nature of the contacts with centres in the East. These vessels, with their thick walls and simplified decoration, cannot claim to have any close link with Egyptian traditions of faience manufacture but must belong to a Near Eastern workshop which carried on from the Bronze Age into the early years of the Iron Age. A related, though later, phenomenon are the imported faience vases in the form of crouching lions found in Crete and Rhodes, with identical pieces from Megiddo. They must have been imported from North Syria and the Southern Levant[21].

13 Friedman 1998a; Schneider 2003; Hölbl 2005, 115–132; Mandel 2005, 138–153; Bubenheimer-Erhart 2005, 154–162; Caubet 2005; Caubet et al. 2007; Nicholson 1998.

14 Foster 1979, and now Panagiotaki 2008, 34–63, and Foster 2008, 173–186.

15 East Mediterranean: Peltenburg 1974; Peltenburg 2002. – Mesopotamia: Moorey 1994, 166–186. – Near East: Caubet et al. 2007; Tite et al. 2008f (production of glazed pottery and brickwork). – Near East and Indus Valley: Tite et al. 2008d (faience production).

16 Pendelbury 1930; von Bissing 1941a; James 1962; Webb 1978; Skon-Jedele 1994 (an extremely full survey of all the Egyptian and Egyptianizing material from sites in East Greece, the Islands and the Mainland: unfortunately she was not able to include the Greek sites on the coast of Asia Minor, now Turkey); Hölbl 1979; Hölbl 1981; Gamer-Wallert 1978, 242–245; Padró i Parcerisa 1980. 1983. 1985. – Two important sites in Rhodes still await full publication: Camirus and Ialysus. For preliminary comments on Ialysus see Martelli 1988, 104–120; Kousoulis – Morenz 2007; for Camirus see Higgins 1954, 21–24; Webb 1978, 136–143. Skon-Jedele 1994, nos. 2337–2644 gives a thorough description of all the Egyptianizing objects found in the Votive Deposit at Ialysus, and attempts the same for Camirus, Skon-Jedele 1994, nos. 1987–2204.

17 See for example the discussion by Bennet 2008, 151–172. See also Webb 1987a, 145–150 on glass technology in the same period.

18 Popham et al. 1979/1980, 218. 223 f. pls. 173. 178. 184. 189. 235 (with disc beads); 418–420 (Appendix A) tables 1–3, for distribution through time of faience and glass. Noteworthy is the necklace of seated deity pendants which appear to confuse two Egyptian types, Popham et al. 1979/1980, 179 f. T Tomb 22 no. 28 pl. 233 d. e. (PG). Peltenburg 2002, 90–92 comments on the possible source for these.

19 Brock 1957. For Egyptian or Phoenician imitation Bronze jugs, see extensive literature discussed by Catling 1996, 565; Stampolidis et al. 1998, 228 f. nos. 268–270; 229 f. nos. 271. 272; Carter 1998, 172–177; Stampolidis – Kotsonas 2008, 346 f. (for survey of recent literature).

20 A set of four flasks, and related pieces from other burials, Popham et al. 1982; Popham et al. 1988/1989; Popham 2004, 23 fig. 2.9; and Popham – Lemos 1996, pl. 141. Cf. the neck fragment of faience flask from Skoubris T. 59, Popham et al. 1979/1980, 133 pl. 110. SPG III = MG II. For an identical flask to Popham et al. 1979/1980, pl. 141 see Sapouna-Sakellaraki 1998, 25 fig. 38 c. These all show thick walls, and the confident, if slightly messy use of secondary colouring, and have a well integrated glaze surface. See now Peltenburg 2002, 75–103 pl. 3.

21 For Near Eastern faience see Moorey 1994; Peltenburg 2002 and Caubet et al. 2007. – For specific finds in Crete, see set of three glazed amphoroid juglets, Stampolidis et al. 1998, 144 nos. 237. 238 with figs. (from Eleutherna); in Cyprus/Rhodes (?), see Stampolidis et al. 1998, 144 no. 239 with fig. – There is also a group of pointed base juglets, with one example found at Mogador, Jodin 1957a, 9 f. Both these groups, however, have a thick glaze covering of one colour. – A group of couchant lion offering vases, in faience, from

By the middle to end of the eighth century, the increasing importation of a variety of small faience objects confirms the revival of more widespread contacts with the Near East and Egypt. There is increasing trading interest in such objects on the East-West trade route, as the finds in Rhodes[22] in particular, and Crete make clear[23]. Nikolaos Stampolidis and Alexandra Karetsou present a survey of the links between Crete, Cyprus and the Dodecanese from the Bronze Age to the sixth century[24]. Another route to the West is posited by the plentiful dedications made at Perachora[25]. While in the West itself, Pithecussae[26], Campania and Etruria[27] yield rich Oriental objects in the final years of the eighth century. Scarabs from a variety of sources in both faience and glazed steatite are widespread throughout the Mediterranean and certain parts of the Greek world in the same period[28]. Amulets are another common imported object, although in some places they are still noted for their rarity and a high value is given to them[29]. Because of the finds of Greek pottery and inscriptions from Pithecussae and elsewhere, we can be confident that by this time Greeks were involved with trade in the West, together with their Eastern counterparts, Cypriots, Syrians and Phoenicians. The track of these trade routes is suggested by the finds of these and other exotic objects. The study of the distribution, and questions concerning the source of this material, scarabs, amulets and small vessels which make up an important part of a larger group of objects called *Aegyptiaca* (*Aigyptiaka*) for short, is a field which is attracting increasing interest. However, the term is misleading, as so many of the objects are of Near Eastern origin and betray their non-Egyptian origin by their crudity and the confusion of their design[30].

Most importantly for the purposes of this present work, there is little or nothing amongst the faience material found at the Samos Heraion which belongs to this early phase of trade between East and West.

A different type of object begins to appear in around 700 B.C. – small containers for precious oils – and these infrequent finds herald the appearance, in Greek sanctuary deposits and graves, of a discrete group of significant cultural objects in faience of Egyptian or Egyptianizing appearance from the middle of the seventh century onwards. They derive from the late developments in the history of faience in Egypt (at the end of the New Kingdom and the Third Intermediate Period) outlined above. These objects (small vases, statuettes, unguent spoons, bracelets etc.) are widespread in the Greek world, in particular East Greece, and are either produced in secondary centres in Delta Egypt or in East Greece itself. The greater part of the faience objects which are found in the excavations at the Samian Heraion belong to these industries. They fall into three main phases as categorised by Virginia Webb (Phases I, II, and III)[31].

Megiddo (Tell el Mutesellim), and Crete (Idaean Cave, and Knossos, North Cemetery), with local imitations in terracotta, are a later eighth to seventh century part of this movement of exotic objects. Examples from Knossos, North Cemetery, see Webb 1996, 220 no. 219.f62; 606 f. fig. 180 pl. 299. 300 (Tomb 219: a context dated to mid-eighth century or later); Webb 1996, 138 no. 100.f41; 606 f. pl. 298 (Tomb 100: a fragmentary piece from a disturbed context); Webb 1978, 72–74. – Peltenburg 2002, 83 discusses the chronology of the examples from Megiddo. See also discussion under couchant lion vase **67** in Chapter 2, below. – Add an example now in New York, Rochester Mus. of Time, which was assumed by its purchasers to be a method of marking time. The central tube is used to deliver its contents to the small vase held between the lion's paws.

22 See in particular, London, BM Camirus Well Deposit, Higgins 1954, 24; Webb 1978, 137: faience scarabs and amulets, including Nefertum and Sekhmet figurines, date 700–650 B.C. approximately.

23 Fortetsa: Brock 1957, 208; Webb 1996, 604–608, see especially Tomb 78 child's grave with faience figurines and beads. – Amnisos (port of Knossos): Stürmer 1992, see corrective comments by Webb 1999, 304–307. – Kommos: Shaw – Shaw 2000, 189 nos. AB 85. AB 86 pls. 3.30. 3.31 (for an exceptional find of faience figurines in their ritual context). – Other finds at Eleutherna: Stampolidis et al. 1998, 146 f. nos. 251. 259. 260 and the Cave at Inatos dedicated to the goddess of childbirth Eileithyia: Davaras 1976, 85 (Heraklion, National Mus., unpublished); Hoffman 1997, 45 (Bes figurine, Heraklion, Mus., Metaxas Collection inv. 864). – Add references in Skon-Jedele 1994, 1663–1804.

24 See and add to examples above, Stampolidis et al. 1998, 146 f. no. 251 with fig. (Eleutherna, Middle [?] to Late Geometric); 259. 260 with figs. (Bes amulets from Amnissos and Gortys).

25 James 1962, 451–516 pls. 165. 193; Gorton 1996, 166–168.

26 Bosticco 1957, 215–229; De Salvia 1993, 767–891 Appendix II; Ridgway 1992, 65 f. 161; Boardman 1994, 1. 96; Gorton 1996, 159 f.

27 Smith 1965, 242 fig. 76; Hencken 1968; Hölbl 1979; Hölbl 1981.

28 Many types are now usefully systematised in Gorton 1996.

29 Isis figurine, Eleusis grave (MG II): Skias 1898, 109 f. – Two lions, Dipylon Grave 13 (LG IIa): Coldstream 1968, 83 for references. – In addition Ptah-Seker in Sounion Deposit (seventh century): Pendlebury 1930, 83 nos. 183. 184 pl. 4. – Isis and Horus, Eretria votive deposit, Huber 2003, I 69 f. 88–90. 96–100; Huber 2003, II 47 nos. O 1 – O 4; 57–60 nos. O 161 – O 181; 63–66 nos. O 202 – O 227. These are only a selection, see in the following note for detailed listings.

30 Pendlebury 1930; Skon-Jedele 1994; Hölbl 1978; Hölbl 1979 with bibliography; Hölbl 2014, 181 f.; Hoffman 1997, 38–49; Phillips 1998.

31 Webb 1978, 6 f. (summary); 8 (distribution maps). Phase I objects, Webb 1978, 11–80 are elaborate containers for some precious liquid, and certain types are plentiful, as are those of Phase II, Webb 1978, 81–107 which are amuletic figurines and small statuettes, of humans, animals and birds (falcons). Phase III, Webb 1978, 108–135 are aryballoi in a variety of forms, only one of which is found in the Heraion. Webb classifies and establishes a chronology for this material, and gives a list of the faience vases, figurines and amulets of these types from the Samian Heraion, N. B. faience objects from the Heraion of genuine Egyptian origin were excluded from the Catalogue in Webb 1978. – Discussed below p. 49–62.

Manufacture of Egyptian Faience Objects

As a material for making small closed shapes, faience is not ideal. Its manufacture requires traditional craft techniques, taught by example and first-hand contact. It is not possible to reproduce a faience object exactly (except perhaps with the help of modern analytical chemistry) and such attempts which do occur in the Mediterranean world, e. g. from Cerveteri, Circolo dei Leoncini d'argento[32], demonstrate what the difficulties would have been.

Therefore, when such objects are found outside Egypt, it must be proposed that they either belong to a different tradition of faience manufacture (such as grew up in the Near East, especially Northern Mesopotamia, and Syria, as well as Cyprus, and Crete during the Second Millenium) or, if they are indistinguishable from Egyptian products, that they are (a) imports from the Egyptian workshops or (b) come from derivative workshops set up with close knowledge of and contact with Egyptian techniques (the third possibility, that they are Egyptianizing products of imitative workshops set up by Phoenicians or other Near Eastern craftsmen should not be set aside for the main production, and secondary influence is clear at a later stage). These alternatives are the ones we are dealing with when we discuss the faience material found in East Greece. Also of great value is the analysis of the glazing techniques of the different groups found in Rhodes which was put forward by Günther Hölbl[33]. Edgar Peltenburg discusses such difficulties with reference to the Egyptianizing/Egyptian faience vessels from Late Bronze Age Cyprus, especially Kition, while Philip Rawson also has some very interesting comments to make on the imitation of the symbols of one culture by another for reasons of prestige[34]. Recent work on the problems of assigning workshop groups to Late Bronze ivories in the Mediterranean koine, may suggest further criteria for analysing the faience production[35]. Although the faience objects found in Archaic East Greece share some of the problems of attribution with the Egyptianizing faience from Late Bronze Age Cyprus, we can be certain that no strong tradition of faience working had survived from the Bronze Age Aegean into early Archaic times, and thus the techniques and material must have been introduced from outside. All the indications of technique and style point to an Egyptian origin for the faience objects made by the East Greek industry.

Constituents

The major components of Egyptian faience are *silica-rich quartz sand* or *ground quartz*, *natron*, and *lime* in small amounts.

Silica rich quartz, in the form of silica sand, or more likely the pebbles which were ground to produce a similar powder, is the main constituent of the desert lands on either side of the fertile strip of the Nile valley. This substance constitutes up to 99 % of the faience object[36]. Frederick Matson[37] kindly told me that it needs to be freshly ground for the chemical processes to work and for sufficient adhesion to be developed. This seems to be borne out by microscopic examination of Egyptian faience[38] and more recent work appears to confirm it. Quartz pebbles, found with the debris from faience workshops at Tell el Amarna, may have been intentionally used in the firing furnaces to facilitate their break-up[39]. As far as New Kingdom glass in Egypt is concerned, Thilo Rehren and Edgar Pusch[40] have established beyond doubt that crushed quartz was the main source of silica, and one would assume that such techniques would have been transferred from the older tradition of faience working. Egyptian skills in working with hard stones, including grinding, would suggest this. Outside Egypt, in Bronze Age Crete, Karen Pollinger Foster has suggested that the faience workshop at Knossos[41] would have been situated near that of the lapidary workers. Even if sand were used, it

32 Talocchini 1963a, 67–89 fig. 3 pls. 15. 16; Talocchini 1963b, 450; Hölbl 1979, I 57–64 pl. 24; Webb 1978, 145 f. no. C 7 fig. 29. This vase attempts to imitate a perfume vase in the form of a kneeling mother and baby. But the crudity of the design and modelling, in glazed terracotta, shows the result, when there is no native tradition of technical »know-how« to draw on. The tomb context is dated to last quarter of the seventh century, which ties in well with the dating for the original prototype.

33 Hölbl 1987.

34 Peltenberg 1974, 106 on the distinction between faience used as »an imitative cheap substitute tendency« and as »independent modes of expression«; Rawson 1971, see introductory discussion, and in particular, 8 f.

35 Rehak – Younger 1998.

36 Vandiver 1982, 167; Nicholson – Peltenburg 2000, 186.

37 Personal communication.

38 Kühne 1969. But see recent discussion of analyses of Egyptian faience, Tite et al. 2008c, 60 f., where a case is put forward for both ground sand, and ground pebbles.

39 Petrie 1894, 26; Nicholson 1998, 50. 254 nos. 173–175; colour pls. on p. 166.

40 Rehren – Pusch 2008, 30.

41 Foster 1979, 59 f. – At Zakros, in southern wing of palace, grinding stones and tools were found near partially vitrified pieces and other fragments, Platon 1971, 218. However, the published account is confused, and it is not clear whether the findplaces were in fact adjacent.

would need to be ground more finely before it could be used in the manufacture of faience. A final consideration is that quartz pebbles are a pure source of silica, while sand contains trace elements which produce discolouration of the core material and glaze.

Lime: this apparently makes up between 1 % and 5 % of the faience and its source is naturally in limestone or chalk. It is not clear whether it was exploited on purpose or added as an accidental impurity if sand were used[42].

Natron: this makes up between 0.3 % and 5 % of the faience, and is a vital ingredient in the manufacture. A substitute is *plant ash/potash* (see below). In Egypt, the *natron* salts occur in underground deposits which were/are leached to the surface each year to leave easily harvested layers – such natron lakes occur in several parts of Egypt but most usefully in the Wadi Natrun, which lies south-west of the Nile Delta. Natron was also used in the embalming process and neatly-tied bags containing the remainder left from the funeral ceremonies of Tut-ankh-amun were found buried in a funerary cache[43]. This material was analysed and used by workers at the Metropolitan Museum in New York to attempt a facsimile of Egyptian faience[44]. A substitute for natron in the form of *plant ash* – as the most easily available source of potash – was also commonly used, as new analytic work has shown. It seems that faience manufactured in Lower Egypt more commonly uses natron, no doubt because of the proximity of the natron deposits. Potash comes from halophytic plants of the *salicornia* family, certain of which grow in Greece[45]. Whether it will be possible to use this information to help us in establishing the location and origin of the Archaic Greek faience production, which produced so much of the faience found in the Samos Heraion and other archaic Greek sanctuaries and cemeteries, remains to be established.

Modelling or Moulding of Objects

In the case of faience, the two fundamental ingredients mixed with water (and a little clay?) formed a paste which could be shaped, moulded or even in certain circumstances thrown on a wheel. However, since the made-up material has little natural plasticity, and moreover is *thixotropic*, which means that it becomes softer and starts to flow as it is deformed, it was normally found necessary to adopt special techniques to assist the manufacture of the objects from faience[46]:

Modelling by hand: a self-evident process, identifiable in all periods of faience manufacture.

The earliest objects were first roughly shaped and then worked by abrasion.

Later on, cutting, shaping, and impressing were used.

Shaping a flat element with no moulded features:

cut out of a flat sheet of material and set to dry on a stretched surface of cloth[47].

Moulding over a form or core – which also served to support the object as it dried:

For an open vessel or object, a shaped »form« would give a specific shape to the internal area of the vessel, and be withdrawn before firing[48].

For a closed shape, like a flask:

a) Shaped over a cloth bag filled with sand or chaff/straw. This could be emptied and removed after drying was completed and before firing[49].

42 Nicholson 1998, 50 with n. 10 on p. 63 on Kiefer – Allibert 1971.

43 Natron in bags found by Theodore M. Davis in 1907/1908, and numbered KV 54, see Davis – Reeves 1990, 38 f. Blocks of Natron are still sold in the markets in Cairo, and were used by Salima Ikram in her experiments with the mummification of small animals, Ikram 2005, 16–43.

44 Noble 1969.

45 Kaczmarczyk – Hedges 1983, 280; Tite et al. 2008b, 38 f.

46 See the discussion of different methods of manufacture by Reisner 1923, 134–175, debris from workshops 135, and Riefstahl 1968, 3. For extensive material from New Kingdom workshops see Petrie 1894, 25–30 pls. 16–20; »Shaping technology« in Nicholson 1998, 51 f.; Vandiver 1998 gives a very thorough and insightful discussion of the progress of ideas on manufacture, to which add her joint article with Tite in Tite et al. 2008b, 37–55, especially 46, and Tite et al. 2008c, 57–91.

S*tretched cloth pad*. See for example, Nicholson 1993, 33 fig. 26; Nicholson 1998, 254 no. 176 with fig.; colour pl. on p. 166; 256 no. 183 with fig.; colour pl. on p. 166 (tile fragment).

47 Nicholson – Peltenburg 2000, 184; such traces are commonly observed on flat elements like tiles and amulets. Plaster trays have been found amongst the material excavated by Petrie at Tell el Amarna, and these show similar impressions, presumably because they were used as drying trays. See also comments by Petrie 1886, 22. 38 on finds made in the scarab factory waste of »pilgrim flasks« made on a bag. See the bases of »Leopard Spot Group« vase Samos **46**–**49** pl. 4, 5; Webb 1978, 17 nos. 52–55 pl. 1 for the same traces of woven textile.

48 *Using a shaped form*. Vandiver 1998, 121–142; Nicholson 1998, 52 table V (after Vandiver 1982, 172); 61 describes this as in use in the Middle Kingdom, continuing into the New Kingdom. Traces can be found on Tell el Amarna tiles, while New Kingdom »marsh bowls« were formed on a shaped form. The »Leopard Spot Group« double vases show evidence of a well-shaped and sophisticated internal form, which must have been withdrawn before the base was attached, secured by luting with additional material and/or quartz slurry, and the whole vessel fired.

49 *Cloth bag filled with sand or chaff.* Methods of forming, see Tite et al. 2008b, 46 f. See Webb 1978, 4 figs. 1. 2, for a number of examples of the devices used to provide temporary internal support. Add for Saite Dynasty New Year flasks (found at Naukratis), and other similar products (tiles) which show the same or similar traces, Petrie 1886, 37 f. The mud/sand core used for Iron Age glass is related to these.

b) Shaped by modelling round a tightly-bound wad of reeds or straw, which burnt out during firing[50].
For external features: open-face moulds[51], or two part moulds (evidence of the failure of two-part [?] moulds can be seen, although no independent material evidence of their existence has survived).
Separate elements luted together with extra material[52].
There are indications in the Archaic Greek faience objects of a similar range of techniques in use.

Glazing

When fired, the material consists of two distinct parts: the core or central body, which has a texture which varies from fine and smooth to grainy and rough, and which can be coloured although it is normally colourless; and the glaze which is a layer of glassy, smooth and coloured material on the surface. Sometimes a third layer can be found: of fine white quartz which lies over the core and underneath the glaze proper, giving a finer appearance to the glaze[53].

The creation of the glaze itself is due to one of three main processes. The research and resulting diagram created by Pamela Vandiver make these practices clear[54]. Analysis carried out for Hölbl by the British Museum Laboratory illustrates the different structures visible under SEM, and these clearly demonstrate which method has been used[55]. A new programme of analysis is being carried out on behalf of the Louvre, which concentrates on the constituents of the surface glaze[56].

Efflorescence: the earliest method, which continued to be commonly used throughout the history of the material, where the separation between the interior core and the surface glaze is caused by the migration of salts to the surface during drying. Here they act catalytically to lower the melting point of the silica so that it will fuse at a much lower temperature at the surface, and cause the creation of the glass-like glaze layer. Objects glazed in this way often show incomplete glazing where the drying effect of air has not reached out of the way surfaces. Tiles from the Pyramid complex of Djoser at Saqqara (Dynasty III) show exactly the same »peppered« effect on their undersides as vases in our »Leopard Spot Group«[57]. Evidence of the integral relationship between core and glaze can be seen in SEM analysis, as in Hölbl and Robert Hedges above.

50 *Tightly wound wad of grass/reeds*. This technique was commonly used in Egyptian faience. Cf. the comparable piece in form of squatting ape, which has marks of wound material clearly visible inside the body, Webb 1978, 144 no. C 2 pl. 2. For similar evidence in Archaic Greek faience, see the couchant lion vase, Samos **67**, Webb 1978, 73 no. 261 and compare with Camirus, Webb 1978, 73 no. 260 pl. 10, London, BM inv. GR 1864,1007.948 probably from the »Well«. For redating of Well see on the ivories found there Schofield 1992, 175 and Marangou 1969, 197 f.

51 *Open face moulds*. Vandiver 1998, 121–142; Nicholson 1998, 52 table V (after Vandiver 1982, 172) lists this as one of the common methods used in New Kingdom faience. See Nicholson – Peltenburg 2000, 182, for rings, amulets and beads. But there are also elements for architectural decoration, like moulded »bunch of grapes« 5 cms high, Friedman 1998a, 189 f. nos. 36–38 with figs.; colour pls. on p. 89, found as decorative elements at Tell el Amarna, Petrie 1894, 25–30 pls. 14–20. 35; Nicholson – Peltenburg 2000, 183 comments on their use. See larger elements illustrated on Petrie Museum website by the University College London, UCL Petrie Collection Online Catalogue <http://petriecat.museums.ucl.ac.uk> (22.02.2015), especially UC 1700. From the scarab factory »waste« Petrie 1886, 36–38 pl. 38 nos. 1–19 came many scarab moulds. Gorton 1996, 177–180 fig. 35 illustrates impressions from the open moulds which were for the back of the scarab only. These had no outflow channels to allow excess material to escape, so were used as an open, one-piece mould, while the lower surface was cut off with a knife and then cut out with the motif by hand (Petrie 1886, 37) or stamped with a separate mould (Gorton 1996, 178–180). However, Gorton believes that the faces of the scarabs were also mass-produced, and emphasises this feature as an indication of Greek involvement.

52 *Luting together separately moulded sections*. This is a standard method used whenever constructing a complex object, particularly a vase. See Vandiver's analysis of the manufacture of a lotus chalice, Vandiver – Kingery 1987, where foot made separately and attached with extra material; and comments in Nicholson – Peltenburg 2000, 182 on both Tell el Amarna rings, and larger objects, such as the famous *Was* sceptre, which was built up in this way. See also the indications of such a process in the separate sections of the tall, slender vase, Riefstahl 1968, 37 no. 34 with fig.; 100, and also the Egyptian Blue »cage« or double vessel, Riefstahl 1968, 52 no. 51 with fig.; 104 f. pl. 1 frontispiece. See Webb 1978, 13 fig. 7 for the process (theoretical) used to construct »Leopard Spot Group« vases.

53 *Glazing methods*: Hölbl 1987, 115–126; Tite et al. 1987b, 127–132; Nicholson 1993, 11. 26.

54 Discussion of the complexities of the subject in Vandiver 1998; and Vandiver – Kingery 1987, 79–90; Tite et al. 2008b, 47–54; Tite et al. 2008c, 57–91. Diagram of different methods, in Kaczmarczyk – Hedges 1983, A 145 fig. 23; Nicholson 1998, 53 fig. 27. See Vandiver's work on the development through time of different techniques, in particular, Vandiver 1998, 121–139 and her timetable of these changes in Nicholson 1998, 52 table V. See relevant sections in Tite et al. 2008b, fig. p. 48; Busz – Gercke 1999, passim.

55 Use of SEM to distinguish different methods of glazing Hölbl 1987, 123–125 and Tite et al. 1987b, 129 table 1.

56 The two catalogues of Faience Exhibitions at the Louvre contain analyses, largely by Kaczmarczyk, who uses his method of energy-dispersive X-ray fluorescence spectrometer (XRF), in air, with alternative use of Atomic absorption, or XRF under vacuum, see Caubet – Pierrat-Bonnefois 2005; Caubet et al. 2007. Now a new programme of analysis using PIXE (particle-induced X-ray emission) and PIGE (particle-induced gamma-ray emission) has been initiated by Genevieve Pierrat-Bonnefois, Juliette Becq, Anne Bouquillon and Patrice Lehuede, and is discussed in Pierrat-Bonnefois et al. in press. These methods are non-destructive, usually used at the surface, and are able to distinguish discrete groups of glaze constituents.

57 Nicholson 1993, 20 fig. 11; Friedman 1998b, 18 fig. 4; Nicholson 1998, 52 f. fig. 27 A for efflorescing technique. See the underneath of bases, **46**–**49**, Chapter 2, below.

Application: a second method consisted of preparing and applying additional material as a paste or powder to lay on another colour or create the glaze effect[58]. This appears commonly in our Phase I where the addition of details in a different colour is effected by a faience paste coloured with a different metallic oxide which forms a discrete raised layer where applied. The black-brown dots, and yellow applied to leopard-skin and jewellery, on the »Leopard Spot Group« (below, Phase I) show clearly that they have been applied separately, as have the coloured overlays on certain of the pyxides and alabastra[59]. In addition, signs of dipping in a glazing medium are apparent, where it has overrun into the interior of a pyxis[60], and a pronounced drip runs down from the rim inside.

In Phase II figurines, the glaze is wholly created by *application*. In particular, the humans, animals and birds are modelled in the core material and then dipped in a paste or powder of glazing medium[61]. There is no sign of an integral glaze developed from the body of the core (*efflorescence*), and the glaze, though thick and shiny, is much less integrated with the core and is easily detachable. This is clearly visible in microscopic analysis by SEM conducted for Hölbl above.

Cementation: a third main technique is to cause glazing by surrounding the prepared quartz object completely in the glazing powder. This is a method identified as being used for the manufacture of beads in Iran[62]. Whether this method is applicable to more complex shapes is not yet known.

Colouring

The colour was obtained by the admixture of metallic oxides or salts in the quartz powder itself or in the applied material. The addition of the metallic oxides only affects a colour change in the surface glaze.

The most common additive used in *efflorescence*, mixed in with the quartz material of the body, was the green-blue shade given by copper oxide. Earlier Egyptian faience shows the over-riding importance given to the significance of the colour blue[63]. The additives used to make bronze, like tin and antimony, appear in certain analytic samples, showing that the copper oxide was obtained from reused copper-rich metals.

Other colours were applied in separate, additional glazing material (*application*), and their study can introduce us to differences between New Kingdom and Late Period sources of supply and usage.

Cobalt was used in the New Kingdom to enhance the blue colour effect of copper oxide, but its use died out in the Third Intermediate Period, to be revived with the Saite renaissance in the Late Period[64]. It certainly appears in Phase III objects[65], and may well have been used to give the intense blue colouring in Phase II human, animal and bird figurines typical of many of the finds from the Heraion. Further analysis will confirm whether we are correct.

Cobalt was also used in incised detail (incuse) of New Year flasks.

The black-brown commonly seen in our objects comes from the use of manganese dioxide. This is clearly identified in three amuletic figurines from Rhodes in the analysis carried out by Alexander Kaczmarczyk[66]. The use of iron oxide – a new alternative – seemed to Kaczmarczyk to imply the knowledge of, and skill in using, the reducing atmosphere in the kiln to produce the black/brown colour from iron oxide which was the process commonly used by Greek potters[67]. But we have only one example of this phase III from the Heraion, and it is too worn to yield any information on colouring.

58 Only the copper oxides will migrate to the surface (*efflorescence*), so other colours must be applied on the surface (*application*).

59 Webb 1978, 41 f. nos. 158. 159 pl. 7, and colour frontispiece.

60 Webb 1978, 42 no. 160 pl. 8.

61 Nicholson 1998, 53 fig. 27.

62 Wulff et al. 1968, 98–107. This is the first report of the cementation process, as identified in Qom, Iran, and used in the manufacture of beads. According to Nicholson the process is still not understood, Nicholson 1998, 53. See now Edalatian 1999, 188–191.

63 Friedman 1998b, 20 n. 5, and Bianchi 1998, 25. 30 n. 61. See especially Lavenex Vergès 1992, 15–20; Aufrère 1991, 492–505. 534–537. But use of green, as in the reed wall tiles for the Pharaoh Djoser's Pyramid Complex, IIIrd Dynasty, appears to be quite specific, and to relate directly to the watery context of the marshland associated with the creation myths, etc.

64 Cobalt use discussed in Kaczmarczyk – Hedges 1983, 149–154. 267–269 and elsewhere; Kaczmarczyk 1986, 369–376, and lastly Kaczmarczyk 2005, 32 f.; Tite et al. 1998; Tite – Shortland 2008, 44. 75 f. 85 f.

65 Kaczmarczyk – Hedges in their analysis of three closely related aryballoi of Phase III (Kaczmarczyk – Hedges 1983, 273 f. C-50), found that a spherical aryballos from Memphis in Egypt: Oxford, Ashm. Mus. inv. 1911.358; Webb 1978, 120 no. 794, dated around 575–550 B.C.) showed a very high level of cobalt, comparable to that in New Kingdom faience, and not in any way similar to the levels found in the other two aryballoi analysed (locust in Oxford, Ashm. Mus. inv. 1910.784, from Memphis, Webb 1978, 135 no. 950, and hedgehog in Oxford, Ashm. Mus. inv. 1872.298, from Thebes, Webb 1978, 133 no. 907). For technical data see Kaczmarczyk – Hedges 1983, 50 Appendix C analyses nos. 262-32-480, 262-32-799, 262-32-476, and 262-118-501.

66 Kaczmarczyk 2007, 280 f. nos. 290. 291, while no. 288 also has traces of iron, and a divergent type no. 298, with blue-black hair, contains 0.2 % cobalt oxide, with a little manganese oxide and nickel, indicating a very different source of manufacture.

67 In Late Period faience found in Lower Egypt and the Delta, *iron oxide* gradually takes over from *manganese oxide* as the colouring matter used for black. Our faience objects can show approximately

The third colour with a significant history is the yellow produced by the application of antimoniate of lead/lead antimonate. This metallic oxide was introduced to New Kingdom Egypt together with the new technology of glass from the Near East, and was used in the royal workshops for both glass and faience, continuing in use until the XXth Dynasty. At this period, the source of the lead antimonate was apparently in Egypt near the Red Sea, at least for those objects produced at Tell el Amarna. It is not found in the intervening Third Intermediate Period. When it reappears in the early Iron Age, new analysis suggests that it could have been sourced from the Caucasus[68]. Its use, like that of cobalt, died out in the period of unrest and economic collapse after the New Kingdom (in the Third Intermediate Period) but was revived in Saite period faience (see the material discussed here) and in the later, sixth century, glass production in Rhodes. Von Bissing in his ground-breaking studies of the faience found in Cerveteri was incorrect when he suggested that the use of yellow was a-typical for Late Period Egyptian faience[69].

Like the revival of use for cobalt, and the new source in the Near East for lead antimonate, the history of both these substances should alert us to the complexity of changes that were taking place in the faience industries of Egypt and the Levant.

equal proportions of both elements see Kaczmarczyk – Hedges 1983. Ptolemaic faience uses only iron oxide. This change implies a different atmosphere in the firing process, a change from an oxidising to a reducing atmosphere, perhaps influenced by the skill of Greek potters in using both in their kilns. See Kaczmarczyk – Hedges 1983, 269–271, and especially the earliest example found by them, a cylinder/rod bearing the cartouche of Necho II, *We'hem ib re*, ca. 600 B.C., University College London, Petrie Collection, UC 16538. See also Nicholson 1993, 39. The faience makers of Upper and Middle Egypt to the South, for instance at Thebes, continued to use *manganese oxide*. This was presumably because they were not influenced by the external example of the Greeks. – See also comments on iron working at Naukratis, Petrie 1886, 39, and Tell Defenneh, Petrie 1888, 79, and see Ogden 2000, 166 f.; Tite et al. 2008c, 76–78.

68 Kaczmarczyk – Hedges 1983, 94–106. 269–273 nos. A 131. C 50. Tite et al. 2008c, 78 f. discuss either a source linked with lead ores from Gebel Zeit on Red Sea in New Kingdom, or from the Caucasus – where a primary source of pure antimony has been identified, which would have been accessible via the Assyrian control of trade routes in that area, during the first millenium.

69 von Bissing 1941a, 5 n. 9.