"Stone . . . That Flows": Faience and Glass as Man-Made Stones in Egypt

Paul T. Nicholson

IN 1987, Edgar Peltenburg published an influential paper discussing the relationship between faience and glass.[1] In it, he argued that one of the essential differences between the two materials was that faience was essentially a "cold" technology, while glass was a "hot" one. Notably, faience was shaped while cold, but glass needed to be heated in some way in order to make it into a useful artifact.

Although this distinction is certainly one worth making, I have been uncertain about its significance, not least because, in the Egyptian New Kingdom (1550–1069 B.C.), faience- and glassworking seem to have taken place in close proximity, a phenomenon first noted by Petrie at Amarna[2] and subsequently confirmed by excavations at Site O45.1 in the same city.[3] However, in examining the importance of color in these materials, I have recently become more conscious of the role of these man-made materials as "stones." That glass and, to a lesser extent, faience could be referred to as if they were stones is not a new idea,[4] particularly insofar as they could be used to represent semiprecious stones such as turquoise, lapis lazuli, and green feldspar. This article attempts to explore the possibility that glass and faience were not only thought to imitate the appearance of semiprecious stones, but that they may also have been regarded as types of stone, and that this may be reflected in the way they were integrated into the range of Egyptian crafts.

It must be admitted at once that the Egyptians and other peoples of the Near East were well aware that faience and glass were in some sense man-made,[5] but in a time before the mechanisms of rock formation were understood, this does not preclude the view that these artificial materials could have been regarded as a kind of stone. A key ingredient of both faience and glass was silica, derived either from crushing quartz pebbles or from collecting quartz sand. The process

Acknowledgments. I am grateful to Prof. Ian Freestone and Janine Bourriau for commenting on earlier drafts of this article, and to Dr. Ian Shaw for providing useful references on the organization of stone quarrying. Prof. Stephen Quirke kindly commented on some of the linguistic points raised in the article. I have also benefited from discussions with Panagiota Manti, who has conducted experimental work in faience glazing.

This article was developed from an invitation to speak on color symbolism in ancient Egyptian glass and faience at the Maison de l'Orient et de la Méditerranée in Lyons, France, and I am grateful to Dr. David Warburton for extending that invitation.

1. E. J. Peltenburg, "Early Faience: Recent Studies, Origins and Relations with Glass," in *Early Vitreous Materials*, ed. M. Bimson and I. C. Freestone, Occasional Paper No. 56, London: British Museum, 1987, pp. 5–23.

2. W. M. Flinders Petrie, *Tell el Amarna*, London: Methuen, 1894, esp. p. 25.

3. Paul T. Nicholson, *Brilliant Things for Akhenaten: The Production of Glass, Vitreous Materials and Pottery at Amarna Site O45.1*, London: Egypt Exploration Society, and Oakville, Connecticut: David Brown Book Co., 2007.

4. Cf. Diana Craig Patch, "By Necessity or Design: Faience Use in Ancient Egypt," in *Gifts of the Nile: Ancient Egyptian Faience*, ed. Florence Dunn Friedman, London and New York: Thames and Hudson, 1998, pp. 32–45.

5. As noted by John R. Harris, *Lexicographical Studies in Ancient Egyptian Minerals*, Berlin: Akademie Verlag, 1961, pp. 110 and 137.

of making these materials into faience or glass evidently changed one form of stone into another.

Since at least as early as Petrie's work at Amarna,[6] it has been observed that the making and working of glass on New Kingdom sites are often found alongside faience production. It is not surprising, therefore, that researchers have tended to assume that glassmakers, as craftsmen newly introduced to Egypt, would have been assigned to the same workshops as the more established makers of faience.[7] However, my view is that the link between these two crafts is not simply that they made items that were imitations of semiprecious stones, but that they may also have been regarded as aspects of stoneworking.

The modern view of materials tends toward division, a process fueled by the need to protect formulas by patent. In ancient societies, however, new materials were protected by confining them to royal workshops or to informal arrangements of craftsmen. Under such a regime, the tendency may well have been toward a descriptive group name rather than something very specific.

It must be noted, too, that there are links to metallurgy,[8] at least insofar as the colorant used for much faience and glass is copper, and that the glass- and faience-making processes require heat. However, the linguistic evidence for glass does not seem to place it among the metals (see below).

STONE AND FAIENCE

Faience and glass have long been recognized as sharing properties with semiprecious stones. Most notably, the ancient Egyptian word for faience, *tjehnet*, means "brilliant or scintillating."[9] These properties were also associated with the skies; "Himmel der Strahlt"[10] is one of the reasons why turquoise and faience were materials associated with Hathor in her role as "Lady of the Sky."[11] These heavenly properties made blue and blue-green minerals special to the Egyptians; they may have been perceived, by association, as solidified pieces of the heavens and thus as appropriate offerings even for a goddess.[12]

It is no common thing to be able to hold in one's hand something that has the property of the sky, a region that was impossible to reach or touch. How significant, then, must have been the discovery that these same properties of dazzling brilliance could be created by humans, by taking an ordinary quartz pebble and turning it into turquoise, lapis lazuli, or green feldspar.

The first glazed products in Egypt and the Near East were not faience, but glazed quartz or steatite. In other words, they were stones, just like the turquoise, lapis, and feldspar that they sought to imitate.[13]

Remarkably, given the length of time archaeologists have been aware of glazed quartz in Egypt, there appear to be no detailed studies of the glaze composition used on it,[14] and even the

6. Petrie [note 2].

7. E.g., A. J. Shortland, "The Number, Extent, and Distribution of the Vitreous Materials Workshops at Amarna," *Oxford Journal of Archaeology*, v. 19, no. 2, May 2000, pp. 115–134; Nicholson [note 3].

8. See J. L. Mass, M. T. Wypyski, and R. E. Stone, "Malkata and Lisht Glassmaking Technologies: Towards a Specific Link between Second Millennium BC Metallurgists and Glassmakers," *Archaeometry*, v. 44, no. 1, February 2002, pp. 67–82.

9. Florence Dunn Friedman, "Faience: The Brilliance of Eternity," in *Gifts of the Nile* [note 4], p. 15; Sydney H. Aufrère, *L'Univers minéral dans la pensée égyptienne*, v. 2, *Les Minérais, les métaux, les minéraux et les produits chimiques*, Cairo: Institute Français d'Archéologie Orientale, 1991, pp. 523–526; Adolf Erman and Hermann Grapow, *Wörterbuch der aegyptischen Sprache* (Deutsche Akademie der Wissenschaften zu Berlin), v. 5, Berlin: Akademie-Verlag, 1971, v. 5, p. 390.

10. *Ibid.*

11. George Hart, *A Dictionary of Egyptian Gods and Goddesses*, London and Boston: Routledge & Kegan Paul, 1986, pp. 76–82.

12. Geraldine Pinch, *Votive Offerings to Hathor*, Oxford: Griffith Institute, Ashmolean Museum, 1993.

13. Harris ([note 5], p. 109) rightly notes that glass and faience imitated turquoise but did not contain it as an ingredient, as earlier authors believed.

14. M. S. Tite, A. Shortland, and A. Bouquillon, "Glazed Steatite," in *Production Technology of Faience and Related Early Vitreous Materials*, ed. M. S. Tite and Andrew J. Shortland, Monograph no. 72, Oxford: Oxford University School of Archaeology, 2008, pp. 23–36, esp. p. 23.

relative chronologies of glazed quartz versus steatite are uncertain. Beck places both materials beginning sometime around 4000 B.C.,[15] and although little work on the dating of these objects has been done subsequently, it is possible to push their origin further back into the Badarian period (5500–4000 B.C.), as both Peltenburg[16] and Moorey[17] have noted. One can certainly say that both seem to have been current in the fifth millennium B.C. One of the difficulties in building a chronology has been that of distinguishing genuine turquoise from its glazed stone imitations with only the naked eye.[18]

Both materials have certain features in common, especially that they can be blue glazed. However, while quartz is very hard (Mohs scale 7), steatite is a hydrated magnesium silicate essentially composed of talc,[19] which has a Mohs hardness of 1 (because steatite is not pure talc, the hardness can be somewhat higher), and so it can be much more easily carved. Its softness in carving is not a disadvantage for the finished product, since the process of firing increases its hardness to 6 or even 7 on the Mohs scale.[20] These two materials, then, have the properties of brilliance and, when fired, hardness. Even without the addition of glaze, it would be possible to harden steatite by the use of heat (which causes loss of water and the conversion of the soft, friable talc into the harder pyroxene enstatite), a process that is well known for the production of objects in Egypt well into the pharaonic era.

Moorey suggests that the glazing of stones may have come about as a result of stones coming into contact with the alkaline ashes of halophytic plants and some copper, possibly the cosmetic malachite.[21] (Lucas has offered other suggestions.[22]) It is not difficult to envisage the heating of steatite in order to harden it in a workshop environment where copper was present, resulting in a blue-green glaze—although experiments by Lucas[23] did not provide satisfactory results. Nevertheless, there is a demonstrable relationship between the working of stone (perhaps initially without glaze) and heat. With the introduction of alkali-glazed stones, stoneworkers would have been regarded as the producers of these artificial pieces of "dazzling brilliance."[24]

Peltenburg has noted that it is often assumed that the blue color imitates lapis lazuli, which was imported into Mesopotamia long before it reached Egypt.[25] However, following Hermann,[26] he discounts this view, since blue-glazed objects appeared in Mesopotamia before the trade in lapis reached the area. Peltenburg believed that turquoise was the inspiration for the blue glaze because it was present earlier than lapis in both Egypt and Mesopotamia.[27]

Lucas conducted experiments in glazing and found that it was possible to glaze quartz using only potassium carbonate from wood ash or

15. Horace C. Beck, "Notes on Glazed Stones, Part I, Glazed Steatite," *Ancient Egypt and the East*, 1934, pp. 69–75; *idem*, "Notes on Glazed Stones, Part II, Glazed Quartz," *Ancient Egypt and the East*, 1935, pp. 19–37. A similar date is given by Tite, Shortland, and Bouquillon [note 14], which also provides analyses of the steatite glazes.

16. Edgar Peltenburg, "Some Early Developments of Vitreous Materials," *World Archaeology*, v. 3, no. 1, June 1971, pp. 6–12, esp. p. 6.

17. P. R. S. Moorey, *Ancient Mesopotamian Materials and Industries: The Archaeological Evidence*, Oxford and New York: Clarendon Press, 1994, p. 168.

18. S. Hendrickx and L. Bavay, "The Relative Chronological Position of Egyptian Predynastic and Early Dynastic Tombs with Objects Imported from the Near East and the Nature of Interregional Contacts," in *Egypt and the Levant: Interrelations from the 4th through the Early 3rd Millennium B.C.E.*, ed. Edwin C. M. van den Brink and Thomas Evan Levy, London and New York: Leicester University Press, 2002, pp. 58–80.

19. S. Paynter and M. S. Tite, "The Evolution of Glazing Technologies in the Ancient Near East and Egypt," in *The Social Context of Technological Change: Egypt and the Near East, 1650–1550 B.C.*, ed. Andrew J. Shortland, Oxford: Oxbow Books, 2001, pp. 239–254, esp. p. 241.

20. Moorey [note 17], p. 169.

21. *Ibid.*, p. 168.

22. A. Lucas, *Ancient Egyptian Materials and Industries*, 4th ed., rev. and enl. by J. R. Harris, London: E. Arnold, 1962, p. 169.

23. *Ibid.*, p. 170.

24. Friedman [note 9].

25. Peltenburg [note 16], p. 7.

26. Georgin Hermann, "Lapis Lazuli: Early Phases of Its Trade," *Iraq*, v. 30, 1968, pp. 21–57, esp. p. 21.

27. Peltenburg [note 16], p. 7. See also Hendrickx and Bavay [note 18], p. 61, which notes lapis lazuli in predynastic Egypt.

powdered natron mixed with a small proportion of powdered malachite. Both of these mixtures resulted in "a beautiful blue glaze . . . every time."[28] That the quantity of copper was indeed very small is graphically illustrated in a film that was produced to accompany the exhibition "Gifts of the Nile" when it was presented in Providence, Rhode Island, in 1998.[29] The film shows makers of scarabs for the tourist market scraping corroded copper from a cooking vessel onto a bed of charcoal and calcined, salinated bone, among which are placed steatite scarabs. The relatively small quantity of copper is sufficient to adequately glaze the scarabs.

However, Lucas found the glazing of ground quartz, "faience," to be more difficult.[30] His best results came from first glazing solid quartz, then chipping off that glaze and powdering it before adding the powder to the unfired faience object and then heating it.[31] Lucas notes that this may not have been exactly the method used in the ancient world, but it does suggest a means by which the earliest application glazes for faience may have been produced. Again, this process could have been discovered and developed by stoneworkers who thus came to be the makers of what Vandiver and Kingery have called "the first high-tech ceramic": faience.[32] These same authors also note that there is a relationship between the carving of stone and the manufacture of faience.[33]

Stoneworkers, then, were in a position not only to shape both hard (quartz) and soft (steatite) stones but also to harden soft stones using heat and to crush hard stones into powder.[34] In doing this, they may well have employed repeated heating, as suggested by Petrie,[35] perhaps combined with grinding on a saddle quern or in a mortar. Having prepared the crushed quartz, they were able to recombine it, albeit mixed with some lime and soda, before applying to it a glaze that they had developed from these same materials and colored with the addition of a very small amount of copper.

The fact that only very small amounts of copper were necessary may be important. Copper was a precious commodity in ancient Egypt. It is known that the tools issued to the workers constructing tombs in the Valley of the Kings were weighed at the beginning and the end of each day to ensure that their weight was consistent with use rather than with pilfering.[36] Denys Stocks has suggested that stoneworkers collected the stone dust left from drilling with copper drills, and that this may have been used in the manufacture of faience.[37] While it is difficult to

28. Lucas [note 22], pp. 172–174. However, experiments in replicating the glaze on Badarian steatite beads suggests that they may have been glazed by cementation; see Tite, Shortland, and Bouquillon [note 14], pp. 24–29.

29. F. D. Friedman and M. Leveque, producers, *Gifts of the Nile* (video), Providence: Rhode Island School of Design/National Endowment for the Humanities, 1998; see also Friedman [note 9].

30. Lucas [note 22], p. 173.

31. More recent experimenters have not found the same difficulty, not least because much of the experimental work has been carried out using efflorescence and cementation glazing. See, for example, R. Busz and P. Gercke, *Türkis un Azur*, Wolfratzhausen: Edition Minerva, 1999; Friedman [note 9]; Patricia S. Griffin, "Reconstructing the Materials and Technology of Egyptian Faience and Frit," in *Materials Issues in Art and Archaeology*, v. 6, ed. Pamela B. Vandiver, Martha Goodway, and Jennifer L. Mass, Warrendale, Pennsylvania: Materials Research Society, 2002, pp. 323–355; Charles Kiefer and A. Allibert, "Pharaonic Blue Ceramics: The Process of Self-Glazing," *Archaeology*, v. 24, no. 2, April 1971, pp. 107–117; and Fabienne Lavenex Vergès, *Bleus égyptiens: De la pâte auto-émaillée au pigment bleu synthétique*, Louvain: Editions Peeters, 1992.

32. Pamela B. Vandiver and W. D. Kingery, "Egyptian Faience: The First High-Tech Ceramic," in *Ceramics and Civilisation*, v. 3, ed. W. D. Kingery, Columbus, Ohio: American Ceramic Society, 1987, pp. 19–34, esp. p. 20.

33. *Ibid.*, p. 20.

34. This process seems to be attested at Gola Dhoro in India. See K. K. Bhan and others, "Excavations of an Important Harappan Trading and Craft Production Center at *Gola Dhoro* (Bagasra), on the Gulf of Kutch, Gujarat, India," *Journal of Interdisciplinary Studies in History and Archaeology*, v. 1, no. 2, 2004, pp. 153–158.

35. Petrie [note 2], p. 26.

36. John Romer, *The Great Pyramid: Ancient Egypt Revisited*, Cambridge and New York: Cambridge University Press, 2007, p. 166.

37. Denys A. Stocks, "Derivation of Ancient Egyptian Faience Core and Glaze Materials," *Antiquity*, v. 71, no. 271, 1997, pp. 179–182.

envisage this material being regularly collected, particularly in windswept working conditions, it must be admitted that it would have been a source of copper particles sufficient to assist with glazing. Freestone has noted, however, that feldspar grains, which would be expected from drilling granite, are absent in faience bodies, making the process still less likely.[38] More important for the argument presented here is that the stoneworkers who drilled sarcophagi, vessels, and other objects may have belonged to the same group that made faience even though they did not share the stone powder. That is, the Egyptians may not have thought of faience workers as craftsmen in vitreous materials, but rather as makers and workers of artificial stone. There may have been divisions within the stoneworkers' craft (of which artificial stones may have been one), but some link does seem to be suggested.

It is worth noting that the artifacts produced in glazed quartz and steatite are not dissimilar to those that would have been produced in unglazed stone. They begin with the manufacture of beads and subsequently of figurines and other items.[39] A group of animal figurines described by Saleh and Sourouzian[40] illustrates this point well; although they came from several sites and are made from limestone, rock crystal, and faience, the range of animal forms is reproduced in other media in other collections. Similarly, when faience was introduced, it too served for making beads and figurines as well as vessels. Like beads and figurines, vessels draw heavily on the repertoire of shapes known in stone. It may seem logical that vessels popular in one medium might be reproduced in another—but how much better, perhaps, to have a vase made of (artificial) turquoise rather than calcite. As a material, however, faience has much greater possibilities than stone. It is not solid during the forming stages, it can be molded to make relatively intricate shapes quite quickly, and it can be built up in sections to make complicated forms.

Despite the special properties of faience and the opportunity to use it to make numerous "cheap copies" of vessels normally found in stone and to create new forms, this does not seem to have happened. As Patch has noted,[41] faience was not simply an inexpensive and mass-produced substitute for more costly materials, as many Egyptologists have tended to assume. Indeed, the use of molds, at least for amulets and jewelry elements, seems to have been introduced relatively late,[42] and vessels and many other objects were carefully crafted.

The introduction of faience permitted the artificial production of items that would once have been considered too large to make from turquoise or lapis lazuli. This artificial production may have gained additional prestige from the magical way in which it was made. Lacking modern knowledge of geology, the ancient Egyptians would have had no indication of how the rocks of the earth were made—although they were acutely aware of their properties. There was no reason to assume that turquoise and lapis lazuli were not created in much the same way as their faience counterparts, although it would have been known that these man-made items were "turquoise" or "lapis" only on the surface and that, if they were broken, a whitish core would be visible.

Relatively little is known about the organization of the makers of faience. The tomb of one Debeheni, an overseer of faience workers in the 13th Dynasty, was unearthed at Lisht in 1921,[43] but the environment in which he worked is not

38. Personal communication, May 2011.

39. Beck, "Notes . . . Part I" [note 15]; Hendrickx and Bavay [note 18].

40. Mohamed Saleh and Hourig Sourouzian, *Egyptian Museum, Cairo: Official Catalogue*, Mainz: Philipp von Zabern, 1987, entry 11.

41. Patch [note 4], p. 33.

42. The tiles used in the Third Dynasty Djoser Complex at Saqqara are probably molded, but their purpose and audience are radically different from those of the later molded jewelry and amulets.

43. His burial, from Shaft 879 at Lisht, is not yet fully published. For a summary, see Janine Bourriau, "The Dolphin Vase from Lisht," in *Studies in Honor of William Kelly Simpson*, ed. R. E. Freed, Boston: Museum of Fine Arts, v. 1, 1996, pp. 101–116.

known.[44] A more telling example comes from a faience funerary stele of a man called Rekhamun.[45] The stele is round-topped, and its inscription, in painted black hieroglyphs, reads: *Wsjr, jrw ḫsbḏ n Jmn, Rḫ-Jmn*. This can be translated as "the Osiris [i.e., deceased and thus united with Osiris] maker of [or worker in] faience for [the god] Amun, Rekhamun."[46] It may be significant that the term interpreted as meaning "faience" is actually *ḫsbḏ*, which is lapis lazuli. While an argument could be made that, in this instance, faience was used to produce a monument for someone who actually worked in lapis lazuli, because that material was too expensive for a craftsman, it seems much more likely that the term was being used here to refer to faience, and that this was the material in which this 19th-Dynasty (about 1295 B.C.) individual worked. It is worth noting, too, that although stelai are known in a variety of materials, they were most commonly produced in stone. Here, then, is an example in an artificial stone.

The Rekhamun stele is not unique. Other examples, dating from about the same period, are known for Kar, the servant of Amun,[47] and for Amenemheb, overseer of the artisans of Ptah, and his wife.[48] Ptah was a creator deity and the supervisor of craftsmen. It is not unlikely that Amenemheb was responsible for overseeing makers of faience on behalf of his god, and that he chose this artificial stone as something suitable for his elevated rank.

GLASS, FAIENCE, AND STONE

It seems, then, that an argument can be made for treating faience as an artificial stone. It is shaped cold, as Peltenburg noted,[49] but when heated it becomes truly solid and stonelike, and takes on its characteristic blue-green color. Could the same hold true for glass, a material that is both made through the action of heat and shaped by heat?

In the Near East, Moorey notes, "the distinction in Akkadian between the genuine stone ('lapis lazuli from the mountain') and its imitation in glass ('lapis lazuli from the kiln') begins to appear in the second half of the second millennium B.C. As the real thing was so difficult to obtain and consequently so highly priced, there was great incentive for artisans then pioneering new developments in glass manufacture in court workshops to produce imitations."[50] While the peoples of the Near East were clearly distinguishing the "genuine" from the man-made product, they still referred to it in relation to stone "lapis lazuli from the kiln." In other words, they did not automatically give it a new name as a new material. Beretta observes that "this clear distinction between the natural and the artificial is critical as it recognises the technical capability to create a *perfect imitation* of a natural object . . ." (emphasis added). He goes on to remark that "at a very early stage glass was not seen as an entirely artificial product but as a natural stone."[51]

Some caution is needed here. While the material was clearly thought of as a stone, lapis lazuli, its Near Eastern makers did not always regard it as having the blue color of genuine lapis lazuli. "Red lapis lazuli" was also referred to as a product of the kiln.[52] This was probably a way of denoting that an artificially produced red stone had the same properties as a blue one, and that those properties were the same as for the stone, lapis lazuli.

---

44. The presumed Middle Kingdom faience workshop at Lisht is now uncertain. Doubts about it have been raised by Dr. Dorothea Arnold of The Metropolitan Museum of Art, New York (personal communication, April 29, 2011) and by me.

45. National Museums of Scotland, Edinburgh (A.1956.153); for an illustration, see *Gifts of the Nile* [note 4], pp. 156 and 250.

46. *Ibid.*, p. 250.

47. National Museums of Scotland, Edinburgh (A.1956.152).

48. Rijksmuseum van Oudheden, Leiden (AD 37); see *Gifts of the Nile* [note 4], p. 250.

49. Peltenburg [note 1].

50. Moorey [note 17], p. 90.

51. Marco Beretta, *The Alchemy of Glass: Counterfeit, Imitation, and Transmutation in Ancient Glassmaking*, Sagamore Beach, Massachusetts: Science History Publications/USA, 2009, pp. 3–4.

52. A. Leo Oppenheim, "The Technology of Mesopotamian Glassmaking," in A. Leo Oppenheim and others, *Glass and Glassmaking in Ancient Mesopotamia*, Corning: The Corning Museum of Glass, 1970, pp. 69–86, esp. p. 78.

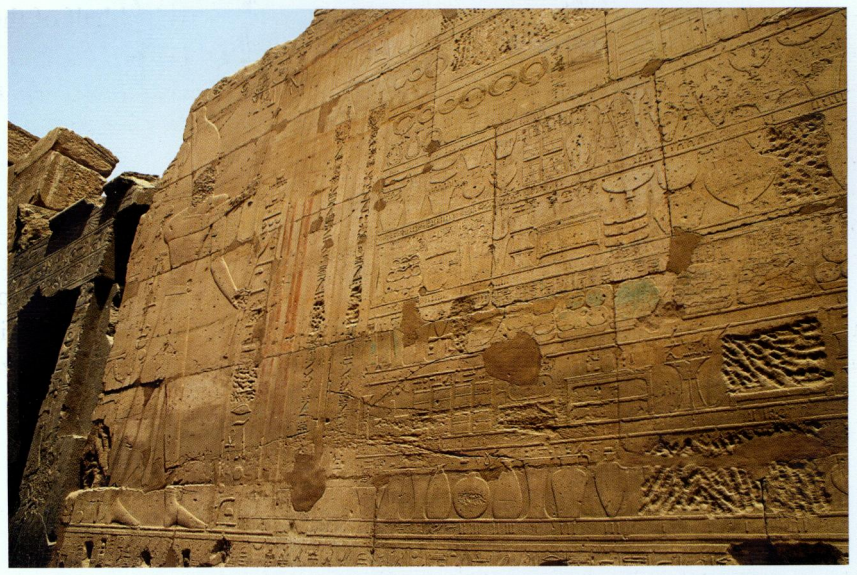

FIG. 1. *Hall of Annals at Karnak. Thutmose III* (far left) *offers exotic products, including glass ingots, to Amun. (Photo: author)*

FIG. 2. *Detail of Figure 1, showing what may be ingots of glass* (right) *whose blue color survives. (Photo: author)*

In recent years, there has been much debate over the origins of glass in Egypt, whether it was made by the Egyptians themselves or imported.[53] However, all are agreed that glass first appeared in Egypt around 1500 B.C.—a situation commented on by Beck[54]—and that one of the earliest records of this is to be found on the walls of Thutmose III's Hall of Annals at Karnak (Figs. 1 and 2). Here is recorded a substance known as "Menkheperre (i.e., Thutmose III) lapis-lazuli" as well as "Menkheperre Turquoise/malachite." Schlick-Nolte and Lierke note that both of these substances are regarded as likely to have been raw glass, and they add that "it is tempting to speculate that the pharaoh was so excited by this new rare material and its intensive lapis lazuli blue colour and considered it so precious that he labelled it with his own throne name >>Men-chepe-re-lapis lazuli<<."[55]

53. See, for example, Birgit Schlick-Nolte and Rosemarie Lierke, "From Silica to Glass: On the Track of the Ancient Glass Artisans," in *Reflections on Ancient Glass from the Borowski Collection: Bible Lands Museum Jerusalem*, ed. Robert Steven Bianchi, Mainz: P. von Zabern, 2002, pp. 11–40; Thilo Rehren and Edgar B. Pusch, "Late Bronze Age Glass Production at Qantir-Piramesses, Egypt," *Science*, v. 308, no. 5729, June 17, 2005, pp. 1756–1758; and Nicholson [note 3].

54. H. C. Beck, "Glass before 1500 B.C.," *Ancient Egypt and the East*, December 1934 and June 1935, pp. 7–21.

55. Schlick-Nolte and Lierke [note 53], p. 20.

There would need to be something very particular about a material for one of Egypt's greatest warrior pharaohs to become "excited" by it, and yet Thutmose III (1479–1425 B.C.) did indeed give his name to it. What might the properties of these new materials have been that they were so honored?

One might speculate that here were artificial stones that not only had great brilliance but, just like genuine turquoise and lapis lazuli, were also homogeneous throughout. When broken, they did not reveal a core of silica. Furthermore, if broken thinly, these materials were translucent. Indeed, these new materials had much in common with the properties of obsidian, which itself was worked for vessels in the Near East. Like obsidian and other stones, glass could be shaped to give sharply defined edges, and it could be inscribed after manufacture in the same way as stone. Unlike faience, it was not friable. A ruler who could control the production of these materials might well have chosen to dignify them with his name.

Intermediate between faience and true glass is the material that has been described as "glassy faience."[56] This material and its designation have been a cause of some concern, since "though it may be glassy, it is not faience."[57] Lucas describes it as an "imperfect glass," although he includes it as a type of faience (his Variant E) in his publication.[58] Lucas[59] and Kaczmarczyk and Hedges[60] could not date the material earlier than the 22nd Dynasty (945–715 B.C.), but work by Lilyquist and Brill on the marbleized goblet from the Wadi Qirud burial of the foreign wives of Thutmose III shows that the material was known from the 18th Dynasty.[61] However, the lead used in coloring parts of this piece yellow is from a non-Egyptian, presumably Near Eastern, source.[62] This transitional material was probably a forerunner of true glass, and its production in a marbled pattern serves only to highlight its deliberate imitation of stone. The overall shape of the Wadi Qirud piece is well known from stone vessels in New Kingdom Egypt.[63] It is possible that glassy faience developed from experiments with true faience and with fritted pigments such as Egyptian Blue, and that these were taking place against a background of what might be regarded as experimental stoneworking.

Petrie believed that the glass industry was established in Egypt as a result of bringing foreign craftsmen from Syria or elsewhere in the Near East,[64] an idea that was developed by Oppenheim.[65] He examined the meanings of the Akkadian words *ehlipakku* and *mekku*, which are known from the Amarna letters[66] and elsewhere. Generally, the first of these can be translated as "a kind of precious stone."[67] However, in a letter from Ugarit, the scribe requests a stone called *mekku*, but adds a gloss to say that what is meant is *ehlipakku*, thereby demonstrating the use of two words for the same thing.[68]

---

56. Lucas [note 22], pp. 164–165.

57. Alexander Kaczmarczyk and Robert E. M. Hedges, *Ancient Egyptian Faience: An Analytical Survey of Egyptian Faience from Predynastic to Roman Times*, Warminster, U.K.: Aris & Phillips, 1983, p. 212.

58. Lucas [note 22], p. 165.

59. *Ibid.*, p. 164.

60. Kaczmarczyk and Hedges [note 57], p. 213.

61. Christine Lilyquist and Robert H. Brill, *Studies in Early Egyptian Glass*, New York: The Metropolitan Museum of Art, 1993, pp. 13–15.

62. *Ibid.*, p. 64.

63. See, for example, Christine Lilyquist, *Egyptian Stone Vessels: Khian through Thutmose IV*, New York: The Metropolitan Museum of Art, 1995, p. 92, fig. 55; and Barbara G. Aston, *Ancient Egyptian Stone Vessels: Materials and Forms*, Heidelberg: Heidelberger Orientverlag, 1994, p. 151, no. 173.

64. W. M. Flinders Petrie, "Glass Found in Egypt," *Transactions of the British Newcomen Society*, v. 5, 1924–1925, pp. 72–76, esp. p. 72; *idem*, "Glass in the Early Ages," *Journal of the Society of Glass Technology*, v. 10, 1926, pp. 229–234, esp. p. 230.

65. A. Leo Oppenheim, "Towards a History of Glass in the Ancient Near East," *Journal of the American Oriental Society*, no. 93, 1973, pp. 259–266.

66. See William Lambert Moran, *The Amarna Letters*, Baltimore and London: The Johns Hopkins University Press, 1992.

67. *Ibid.*, p. 259.

68. *Ibid.*, p. 260.

Amarna letter EA148 confirms this observation. An Assyrian text dealing with glass uses *mekku*, which is clearly a local variant on the more commonly used *ehlipakku*.[69]

These terms were known in Egypt by the time of the Amarna letters (about 1350 B.C.), not least because the makers of these materials had been brought to Egypt, as Petrie suggested, probably from Mitanni, following the campaigns of Thutmose III, in order to establish the industry in Egypt. In Egypt, the terms used for glass were commonly *jnr n wḏḥ* and *ꜣt wḏḥt*,[70] meaning "stone of the kind that flows."[71]

Enough has been said to suggest that stoneworkers may have been the originators of faience and that the material was regarded as an artificial stone. Similarly, it has been shown that glass both in the Near East and in Egypt was regarded as a stone, and that its hot-working properties were emphasized by its name, "stone of the kind that flows." The question now arises as to where the workers of this new material, who had been brought to Egypt to establish an industry, would have been located.

Thutmose III, assuming that it was he who introduced the glassworkers of Mitanni into Egypt, had several options as to where to put them. They might have been set up as a distinct and independent craft, although this would mean that they would have needed to teach Egyptians who knew nothing of the new pyrotechnology. They could have been placed with potters, but pottery was not shaped hot, nor was it glazed. Metalworkers employed heat, and they formed items while they were hot, but these items changed rock, in the form of ore, into a workable metal. They, too, were perhaps not an obvious choice.

I have argued elsewhere that the most obvious link would have been with faience workers.[72] Like the output of glassmakers, their work imitated stone, usually in blues and greens, the colors of much of the earliest glass. These artisans were familiar with using heat to form glaze, but not with shaping hot materials. Nevertheless, they would have been—particularly in the eyes of officials unfamiliar with technologies—the most suitable candidates to adapt their art to that of glassmaking because they too could "make stone."

It can be argued that the faience workers were, in fact, a division among stoneworkers. Their products followed the forms of stone, and their most commonly produced colors were in imitation of stone. Their raw material was ground-up stone, either from pebbles or from silica sand, which was then reconstituted into a new type of stone. However, is there any evidence, other than linguistic links, that glassworkers were embedded among the stoneworkers who were charged with making faience, or is the argument purely a linguistic one?

There is good archaeological evidence to support the view that glass and faience were produced in close proximity. Petrie notes this at Amarna,[73] and it was confirmed in the excavations by Nicholson.[74] It is also documented at Qantir.[75] However, both of these sites belong to a time when glass seems to have been established in Egypt, and, in any case, it can be argued that these were not the only crafts within the relevant localities at these sites. At Amarna O45.1, for example, there is good evidence of pottery production and probably also of the making of pigments and the production of glass and faience. This link may be convincing, but it requires independent evidence.

That evidence, I believe, can be found in the earliest glass products themselves. The colorless

69. *Ibid.*, p. 261.

70. B. Nolte, "Glas," in Wolfgang Helck, *Lexikon der Ägyptologie*, v. 2, *Erntefest–Hordjedef*, Wiesbaden: Otto Harrassowitz, 1977, pp. 614–617, esp. p. 614.

71. Veronica Tatton-Brown and Carol Andrews, "Before the Invention of Glassblowing," in *Five Thousand Years of Glass*, ed. Hugh Tait, London: British Museum Press, 1991, pp. 20–61; Erman and Grapow [note 9], p. 165.

72. Nicholson [note 3].

73. Petrie [note 2].

74. Nicholson [note 3].

75. Mahmud Hamza, "Excavations of the Department of Antiquities at Qantir (Faqus District)," *Annales du Service des Antiquités de l'Egypte*, v. 30, 1930, pp. 31–68; Thilo Rehren and Edgar B. Pusch, "Glass and Glass Making at Qantir-Piramesses and Beyond," *Egypt and the Levant*, no. 9, 1999, pp. 171–179.

TABLE 1

Glass Vessels of the Time of Thutmose III (1479–1425 B.C.)[76]

Number	*Shape/Type*	*Body Color*	*Technology*
BM 24391	Kohl pot with lid	Light blue	Drilled and cold-worked
UC 19657	Kohl pot without lid	Light blue	Drilled and cold-worked
MMA 26.7.1179	Kohl pot without lid	Light blue	Drilled and cold-worked
Cairo 24959	Kohl pot (lid only)	Dark blue	Cold-worked
MMA 23.9	Lotus chalice	Light blue	Cast and cold-worked
Cairo 24961	Handled vessel	Light blue	Core-formed
Cairo 24960 and Brooklyn 53.176.4	Rounded vessel	Light blue	Core-formed
BM 47620	Jug	Light blue	Core-formed with powdered glass decoration
Munich ÄS630	Chalice	Light blue	Core-formed
Ashmolean E2451	Chalice	Light blue	Core-formed
Harrow E549	Chalice	Light blue	Core-formed
MMA 26.7.1175	Krateriskos	Marbleized	"Glassy faience," probably core-formed

name beads of Hatshepsut (1478–1473 B.C.) and her official Senenmut are products that could have been produced in rock crystal by stoneworkers.[77] Indeed, that is what Egyptologists originally believed them to be. It may reasonably be objected that beadmaking, albeit in stone, might have been considered a craft separate from that of making the stone vessels and figurines that have been discussed thus far. However, there are additional examples that clearly show the link between glass and stone.

While the chronology of the earliest glass in Egypt has not yet been finalized, it is evident that, among the group of vessels dating to the reign of Thutmose III, there are some that do not fully exploit the hot-working properties of glass. One of them is a cast and drilled kohl pot.[78] Not only was it made in a form that was well known in stone, but it was also worked like stone. Instead of being shaped around a core, this vessel seems to have been cast and then ground and polished on its exterior before its interior was drilled. Some other kohl pots were also drilled and cold-worked (Table 1). Moreover, the well-known lotus chalice from the Wadi Qirud[79] was cast before it was cold-worked. It

76. Paul T. Nicholson, "Glass Vessels from the Reign of Thutmose III and a Hitherto Unknown Glass Chalice," *Journal of Glass Studies*, v. 48, 2006, pp. 11–21, esp. p. 14.

77. C. N. Reeves, "Exhibits at Ballots: Two Name-Beads of Hatshepsut and Senenmut from the Mortuary Temple of Queen Hatshepsut at Deir el-Bahri," *The Antiquaries Journal*, v. 66, no. 2, 1986, pp. 387–388.

78. The British Museum, London (EA24391).

79. The Metropolitan Museum of Art, New York (23.9).

can be regarded as the making of a blank stone vessel, followed by decoration using stonecutting technology.

Such techniques for working glass may seem odd, but given that the earliest glassworkers brought to Egypt would have had to train apprentices and that the court would doubtless have wanted to see products quickly, it is perhaps not surprising to find that drilled and cold-worked pieces were made at this early stage, along with the pioneering hot-worked, core-formed vessels.

It did not take long for the core forming of vessels, a hot technology, to largely replace the casting and cold working, but the latter never died out. Even in the reign of Tutankhamen (1336–1327 B.C.), by which time glass was a well-established and prestigious material, casting and cold cutting were still employed. The best-known examples of them are the turquoise headrest with a gold band[80] and the lapis headrest with a gilded edge,[81] although there are many other pieces that were used as inlays in tomb furniture. That this technology survived in the face of hot-worked glass would not be surprising if its practitioners regarded themselves as, and worked alongside, makers of stone furniture, vessels, ushabtis, and other objects.[82]

Some caution is needed here, however. It is not necessarily the case that those who *made* glass from its raw materials were the same people who *worked* the glass into objects.[83] At Amarna O45.1,[84] the evidence is largely, perhaps exclusively, for the making of glass, although the raw glass may then have gone to other workshops in the city to be made into objects. This distinction between what may be called primary and secondary workshops does not invalidate the argument about how glass and faience may have been perceived. Indeed, it may have been the case that one group of stoneworkers made the glass and another group worked it into finished products. Since faience workers were present at O45.1 alongside the glassmakers, it is possible that glassworkers were also nearby, although beyond the limits of excavation.

The forms of both faience and glass followed those of stone. It is particularly telling that among the wooden dummy vessels from the tomb of Yuya and Thuya (TT46) are vessels that clearly imitate stone (they have the random streaking of calcite or the speckling of a conglomerate) and others that bear a more ordered pattern and are clearly imitations of glass.[85] Examination of the range of forms of stone vessels dating to the late Middle Kingdom/Second Intermediate Period and the New Kingdom published by Aston and by Lilyquist[86] clearly demonstrates how closely many of the glass and faience forms were related to stone. This is true not only of the kohl pots listed by Aston[87] but also of more elaborate vessels, such as the ribbed bowl and the lotus chalice.[88]

DISCUSSION AND CONCLUSION

This article has suggested that while my earlier view that glassmakers were embedded among faience workers in the earliest stages of the craft in Egypt[89] may be correct, it is not the whole picture. Petrie implies that faience and glass were made in close proximity,[90] and the same point is explicitly made by Shortland.[91] The modern tendency to subdivide industries leads us to think of glass and faience as separate materials. Although the ancient Egyptians knew

80. Tutankhamen find number 403a. See C. N. Reeves, *The Complete Tutankhamun: The King, the Tomb, the Royal Treasure*, London and New York: Thames and Hudson, 1990, p. 181.

81. Without tomb number; see *ibid.*, p. 183.

82. For glass sculpture in the round, see John D. Cooney, "Glass Sculpture in Ancient Egypt," *Journal of Glass Studies*, v. 2, 1960, pp. 11–43.

83. Rehren and Pusch [notes 53 and 75].

84. Nicholson [note 3].

85. Theodore M. Davis and others, *The Tomb of Iouiya and Touiyou: The Finding of the Tomb*, London: A. Constable, 1907, pls. XXVII and XXVIII.

86. See note 63.

87. Aston [note 63], nos. 163–165.

88. *Ibid.*, nos. 171 and 172.

89. Nicholson [note 3].

90. Petrie [note 2].

91. Shortland [note 7], p. 130.

glass and faience to be different from each other, the more important consideration for them was that both were (artificial) stones, and as such they were part of the province of stoneworking, although perhaps a separate group within it.

My interest in this aspect of the craft developed from a seminar on the symbolism of color in faience and glass, which was presented in Lyons in 2010. It seemed to me that while color was indeed important, the materials associated with that color might be of equal or greater significance, particularly in terms of placing them within the mind-set of Egyptian craftsmen.

Shortland has argued that the earliest glass in Egypt is mainly turquoise rather than the darker cobalt blue, which gave it a color resembling lapis lazuli.[92] During the reign of the pharaoh Amenhotep III (1390–1352 B.C.), the cobalt blue color had become more common. Also becoming common at that time was the well-known blue-painted pottery of the 18th Dynasty, which flourished at Amarna[93] under Akhenaten (1352–1336 B.C.). This pottery, like the dark blue glass, was colored with cobalt derived from the cobaltiferous alums of the Dakhla and Kharga oases.[94] Although Lilyquist and Brill have shown that cobalt from these oases was used as early as the reign of Thutmose III,[95] it may be suggested that it was not until the time of Amenhotep II (1427–1400 B.C.) that the source was extensively exploited, thus linking the large-scale use of this colorant to the production of both glass and pottery, and perhaps helping to explain the shift in glass color preference from turquoise to lapis lazuli. Lapis lazuli was always rarer than turquoise in Egypt, and so the ability to produce it artificially, without the need to trade it over long distances, might explain this change.

The *Mesopotamian* "blue lapis lazuli from the kiln" colored with copper was probably a paler blue than actual lapis, perhaps more like turquoise in appearance. Thus the lapis lazuli referred to in the Mesopotamian texts may indicate that the material was "like a precious stone" rather than the color of lapis. Some credence is lent to this view by the description of some lapis as "red."[96]

The situation in Egypt requires more explanation. If Menkheperre lapis lazuli is glass, as it appears to be, what was the source of the colorant in his time? Was this glass tribute from Mitanni and thus probably colored with copper, or does the scene in the Hall of Annals represent glass made in Egypt, using Egyptian cobalt but produced by glassworkers brought from Mitanni? The scene distinguishes between turquoise and lapis both in writing and by color, suggesting that, to the Egyptians, "lapis lazuli" probably referred to a direct imitation of the color of that stone and was not another term for any artificial semiprecious stone. This may be the reason why the king lent his name to the product. Because it is known that glass of the time of Thutmose III was colored with Egyptian cobalt,[97] it is possible that the Menkheperre lapis lazuli was made entirely from Egyptian materials.

---

92. A. J. Shortland, "Social Influences on the Development and Spread of Glass Technology," in *The Social Context of Technological Change* [note 19], pp. 211–222, esp. p. 213.

93. C. A. Hope, "Blue-Painted and Polychrome Decorated Pottery from Amarna: A Preliminary Corpus," *Cahiers de la Céramique Egyptienne*, v. 2a, 1991, pp. 17–93; *idem*, "Blue-Painted and Polychrome Decorated Pottery from Amarna," *Cahiers de la Céramique Egyptienne*, v. 2b, 1991, pp. 105–118.

94. A. Kaczmarczyk, "The Source of Cobalt in Ancient Egyptian Pigments," in *Proceedings of the 24th International Archaeometry Symposium*, ed. J. S. Olin and M. J. Blackman, Washington, D.C.: Smithsonian Institution Press, 1986, pp. 369–376; *idem*, "The Identity of *wšbt* Alum," *The Journal of Egyptian Archaeology*, v. 77, 1991, p. 195.

95. Lilyquist and Brill [note 61], pp. 42–43.

96. Oppenheim [note 52], p. 78.

97. Lilyquist and Brill [note 61], pp. 42–43. For a review of the origins and use of cobalt in Egypt and the Near East, see A. J. Shortland, M. S. Tite, and I. Ewart, "Ancient Exploitation and Use of Cobalt Alums from the Western Oases of Egypt," *Archaeometry*, v. 48, no. 1, 2006, pp. 153–168.

It is worth noting that quarrying expeditions were generally organized by the military, and thus they were demanded by the state.[98] Cobalt would probably have been collected by such state-sponsored expeditions, and the use of the material in making artificial lapis lazuli may have been closely controlled. While the making of glass vessels and other artifacts may have been relatively widespread, it has been argued elsewhere that glassmaking, from its raw materials, was the preserve of the state.[99] Analyses of the cobalt blue glass ingots from the Uluburun shipwreck has shown that their cobalt source was Egyptian,[100] while their sizes are consistent with manufacture in molds or crucibles known from Egypt,[101] not least from Amarna. This evidence suggests that the making of glass was under the control of the state. Those who made it may have been regarded as stoneworkers, but they were workers in stone of a particular kind, "stone of the kind that flows."

98. Thomas Hikade, *Das Expeditionswesen im ägyptischen Neuen Reiches: Ein Beitrag zu Rohstoffversorgung und Aussenhandel*, Studien zur Archäologie und Geschichte Altägyptens, v. 21, Heidelberg: Heidelberger Orientverlag, 2001, pp. 10–24; Ian Shaw, *Hatnub: Quarrying Travertine in Ancient Egypt*, London: Egypt Exploration Society, 2010. See also Elizabeth Bloxham, "Miners and Mistresses: Middle Kingdom Mining on the Margins," *Journal of Social Archaeology*, v. 6, 2006, pp. 277–303.

99. Nicholson [note 3].

100. C. M. Jackson and P. T. Nicholson, "The Provenance of Some Glass Ingots from the Uluburun Shipwreck," *Journal of Archaeological Science*, v. 37, no. 2, February 2010, pp. 295–301.

101. Paul T. Nicholson, Caroline M. Jackson, and Katharine M. Trott, "The Ulu Burun Glass Ingots, Cylindrical Vessels and Egyptian Glass," *The Journal of Egyptian Archaeology*, v. 83, 1997, pp. 143–153.