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AN ARCHER FROM THE PALACE OF NESTOR

A New Wall-Painting Fragment in the Chora Museum

Dedicated to Mabel L. Lang

ABSTRACT

The authors interpret two joining pieces of a brightly colored wall painting found at the Palace of Nestor in 1939. The fragment, removed from the walls of the palace prior to its final destruction, represents part of an archer, probably female. Alternative reconstructions are offered. Artistic methods and constituents of the plaster and paint are studied by XRD, PIXE-alpha analysis, XRF, SEM-EDS, PY/GC-MS, and GC-MS. Egyptian blue pigment was extensively employed. Egg was used as a binder for the pigments in a tempera, rather than a fresco, technique. The identification of individualized painting styles may make it possible to assign groups of wall paintings to particular artists or workshops.

Restudy of the many published and unpublished wall-painting fragments from the Palace of Nestor in Pylos that are stored in the Chora Museum began in 2000.[1] By 2002 it was possible to make a full assessment of the corpus and to define directions for future work. In the course of earlier examinations and the systematic arrangement of wall paintings in new storage cabinets, an unpublished piece of special interest was discovered.

1. A reexamination of the corpus of wall paintings from the Palace of Nestor is part of the program of the Hora Apotheke Reorganization Project (HARP), a series of interrelated research missions that have taken place at Pylos since the completion of the Pylos Regional Archaeological Project in 1996. The project as a whole has been directed by Sharon R. Stocker since 1998. Hariclia Brecoulaki assumed responsibility for the study of the wall paintings in 2000. This paper represents a genuinely collaborative effort on the part of its authors, but individual contributions are credited below as appropriate. We are grateful to James Muhly, former director of the American School of Classical Studies at Athens, and to Maria Pilali for facilitating our work in every way. The constant support that we have received from Xeni Arapoyianni, former director of the Olympia Ephoreia and now director of the Kalamata Ephoreia, and from Yioryia Hatzi, current director of the Olympia Ephoreia, has been critical to the success of this enterprise. We also take pleasure in recognizing the help we have received each year from Evangelia Malapani, Curator of Antiquities in the Kalamata Ephoreia, and the guards of the Chora Museum. Funding in support of the research described here has been provided by the Institute for Aegean Prehistory, the Semple Fund of the Department of Classics of the University of Cincinnati, and, most recently, the American School of Classical Studies, where Brecoulaki was Malcolm H. Wiener Visiting Research Professor (2005–2006). Other publications of HARP include Isaakidou et al. 2002 and Stocker and Davis 2004.

Additional color images of the fragment of wall painting presented here are freely available for viewing at http://dx.doi.org/10.2972/hesp.77.3.394. Captions for these supplementary images are listed below in Appendix 3.

This piece of plaster, part of what we call the Archer Fragment, lay on shelf 14 III of the first *apotheke* (storeroom) of the museum and had been deposited in a cardboard box labeled "ANAKTOPON 1939." The piece preserves the depiction of a white human arm, clothed in part by a garment with a short blue sleeve (Fig. 1, below). The subject seems to wear a bracelet (or bracelets) and holds an object, only partially preserved, that appears to be a bow. The style of the painting is similar to that of miniature frescoes, although its scale is somewhat larger. The representation is particularly detailed and refined in its execution.

The purpose of this paper is to present and examine the Archer Fragment in detail. The iconography of the wall painting seems to us to be of great importance in its own right. A lengthy publication also offers an opportunity to show what can be learned about the technique and style of prehistoric painters through the use of several scientific methods, as well as art historical analysis. We begin with a consideration of the excavated context of the fragment. We then describe and illustrate the piece itself and discuss its subject matter with reference to parallels in prehistoric Aegean art, presenting several tentative reconstructions of the scene portrayed. Finally, we examine the methods employed by the painter, the individual characteristics of his or her technique and style, and, in two appendixes, document the composition of the pigments and binders.

CONTEXT OF THE ARCHER FRAGMENT

In 1939, a first season of excavation at the Palace of Nestor was directed by Konstantinos Kourouniotis and Carl Blegen.[2] Blegen, as junior partner in the enterprise, took responsibility for overseeing the fieldwork, while William McDonald, then a young scholar in the process of completing his doctoral dissertation at Johns Hopkins University, supervised the excavation of trenches within the palace proper. Evidence of frescoed decoration was found in many places, and the locations of fragments are noted in McDonald's notebook.[3] Although it was not described accurately at the time of excavation, the Archer Fragment is clearly referred to by McDonald in a summary composed at the end of the excavation season. With regard to section A of trench III, he wrote:

> Courses of good room with fine walls. Just east of this room was found the best fragment of plaster with braceleted hand. Other fragments of painted plaster were numerous. This must be dug very carefully. Some walls in rest of trench but nothing of great importance found here.[4]

The context in which the fragment was discovered is thus indisputable.

2. Kourouniotis and Blegen 1939. This section of our paper represents the work of Davis, Stocker, and Brecoulaki.

3. WAM 1939, p. 20 (trench I, section D); p. 37 and plan on p. 53 (trench II, section A); pp. 66, 69–70, 80, 120 (trench II, section B and trench V); pp. 66, 121 (trench VI, section A); pp. 77, 79 (trench VII). Only the briefest reference is made to these finds in Kourouniotis and Blegen's preliminary report (1939, p. 561).

4. WAM 1939, p. 119.

More details can be gleaned from McDonald's daily accounts of excavation in trench III, section A.[5] He writes that, after removing a "mass of tumbled stones" at a depth of 40 cm below the surface, he found "a good corner of a room with a good deal of painted plaster." He further noted that "just east of its n.s. wall was discovered a large piece of plaster with human foot." It is obvious that he had uncovered the northeast corner of what was later defined as room 32 of the palace. The "human foot," which he must have subsequently understood to be a "braceleted hand," was found outside the outer ashlar wall of the palace.[6]

Once we determined that the Archer Fragment had been found outside room 32, a search among other fragments discovered in the vicinity eventually yielded a small joining piece showing more of the human figure that holds the bow and of the bow itself. This piece was stored in a drawer that contained finds from rooms 25–28. Individual fragments were not clearly labeled, but the drawer had been divided into three sections. The designation "room 27" was faintly legible on a slip of paper in the section where the relevant piece was found. Mabel Lang's publication of accompanying fragments as being from room 27 confirms that this context is correct:

> . . . many small bright pieces which could not have been exposed to the fire and so were perhaps in wall-fill. Other very similar pieces from just outside Room 27's southwest wall and outside the northeast wall of the palace have been added to these to make up a very fragmentary hunting scene on blue ground.[7]

The pieces that Lang describes, both published and unpublished, were stored together by Blegen's team.

It is impossible to determine which fragments were found inside the room and which outside. Stylistic and iconographical considerations allow us, however, to draw some general conclusions about which paintings were attached to the walls of rooms in the northeast area of the Main Building in the period immediately preceding its destruction. It is clear that the Archer Fragment belongs to the group of paintings that Lang called "bright pieces," and that it had, like them, been removed from the walls prior to the final destruction of the palace. These fragments are of a "small scale with detailed painting on a blue background." There is a significant concentration of fragments of this kind in the northeast section of the site. Pieces that are stylistically and thematically similar to the Archer Fragment include those in the group of associated fragments that Lang presumed to come from the hunting scene (originally in room 27?). It is possible that further fragments of the archer will be discovered as we widen our search radius around room 27.

5. The excavation of trench III, section A, is described in WAM 1939, pp. 36, 38, 44 (April 11); p. 80 (April 18); p. 88 (April 20); and p. 119. For the elevations of walls, see p. 129. Excavation of the trench is not explicitly discussed in the published preliminary report of 1939, but the trench and the exterior wall of room 32 are illustrated in Kourouniotis and Blegen 1939, p. 560, fig. 2.

6. For discussion of the finds from room 32, see *Palace of Nestor* I, pp. 156–160. No fragments of plaster with figural decoration are mentioned there.

7. *Palace of Nestor* II, p. 201.

Figure 1. Two joining pieces of the Archer Fragment. Photo. J. Stephens

DESCRIPTION AND CONDITION

The Archer Fragment is preserved in two joining pieces (Fig. 1).[8] The dimensions of the first piece (063.70) are p.L. 0.17, p.W. 0.135, p.H. 0.05–0.06 m, and those of the second (063.71) are p.L. 0.05, p.W. 0.02, p.H. 0.01–0.02 m.

A white-skinned outstretched arm, in profile to left, is preserved to the shoulder against a bright blue ground. Traces of a white band serve as a border on one short side of the fragment; our assumption is that this band marked the upper straight edge of the composition, and the fragment and figure have been so oriented. A red sketch line seems to define the form of the arm. The same red paint was employed to indicate

8. This section records observations by Brecoulaki. She acknowledges the indispensable collaboration that she has enjoyed with Rosemary Robertson since the beginning of the project, and she also thanks Jennifer and Arthur Stephens, whose photographs have added much to the success of this endeavor. In the course of reexamination of the wall paintings from the Palace of Nestor, each piece in the storerooms of the museum was assigned a unique identification number: the first three numbers indicate the drawer in which the piece is stored, and, after a period, a randomly assigned sequence number within that drawer. These should be distinguished from Lang's inventory numbers, which present a sequence number, followed by class designation (such as "H" for "Human"), and a room or area number (e.g., 1 H 64 for the first fragment with a representation of a human figure from Hall 64).

Figure 2. Detail of the archer's hand and wrist and the bow. Photo in raking light. J. Stephens

four stripes on the wrist, probably a bracelet (or bracelets), or, less likely, leather straps similar to the laces of the leather greaves of the warriors and hunters depicted in Hall 64 and room 48, respectively.[9] It is also possible that the stripes represent the collar of a glove. In front of the wrist, on the hand, two red brush strokes are clearly preserved on the larger piece, while on the small piece traces of curved lines seem to define parts of fingers or knuckles (Fig. 2). The figure wears a short-sleeved blue tunic or tight bodice, of a slightly lighter hue than the background and outlined in black. The sleeve is ornamented with three black stripes that follow the curve of the armpit at the lower edge of the garment.

The figure may have stood in a formal, hieratic position, may have been standing or walking, or may have moved still faster, with knees bent and body stretched forward (see below, Figs. 9–11). These reconstructions are discussed later in this article. The last possibility could explain the unusual direction of the outline of the bottom of the garment and the closeness to the body of what is likely to be the right arm. Two white strokes that jut out vertically above the bow arm appear to be fingers belonging to the right hand. The other fingers of that hand would have held back the arrow and bowstring. It is most likely that the index and middle fingers are depicted and that the others grasped the string.

The form of the object held in the hand in relation to the position of the outstretched arm suggests that it is meant to be a bow. On this basis,

9. Misidentification of the arm of the figure as a foot at the time of excavation is thus entirely understandable, even if the figures in Hall 64 and room 48 had not yet been found.

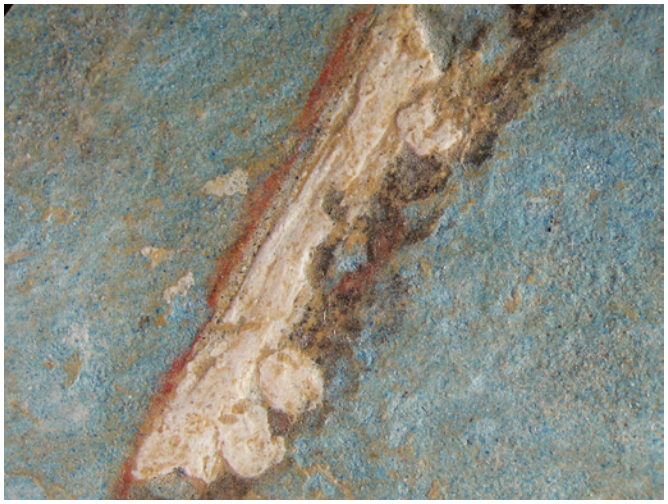

Figure 3. Detail of bow above the archer's hand, showing thick islets of white paint. Photomicrograph 6.3×. H. Brecoulaki

Figure 4. Detail showing red string or strap at upper end of bow. Photomicrograph 12.5×. H. Brecoulaki

we have identified the figure represented as an archer. The upper part of the bow seems to be straight. The bow was depicted in two superimposed paint layers: the first to be applied was a layer in black that followed a red sketch line visible at the outer left edge of the bow; a second layer of thick white paint followed, but it has extensively flaked away (Fig. 3). Rounded brush strokes of white paint in relief, visible along the inside of the bow, were presumably meant to suggest some decorative motif applied to it (Figs. 2, 3).

Traces of a thin red line are detectable along the outer edge of the bow preserved on the smaller piece. Either the artist had repositioned and repainted the bow, or these are the remains of a painted element that has otherwise disappeared. Islets of thick white paint are also preserved along the outer part of the bow; these may have been transferred from the upper thick white paint layer of the bow and refixed there by accident (Fig. 3). The upper end of the bow is bent toward the archer, and a red string or strap is wound around it (Fig. 4). A few traces of red and white paint,

Figure 5. Detail showing two parallel curved incised lines or scratches. Photomicrograph 6.3×. H. Brecoulaki

preserved on both pieces, along with the ghost left from paint that was originally applied on top of the blue ground, permit the bowstring to be reconstructed.

Between the upper extremity of the bow and the right edge of the fragment, where there is a red spot, two parallel curved incised lines are visible (Fig. 5). It is unclear if these incisions were intentional, part of a preliminary sketch of the bow, or accidental, caused by mechanical abrasion of the pictorial surface. Several scratches can, in fact, be observed on this part of the fragment.

A white element below the armpit is painted with the same thick white paint as the bow arm and is adorned with three unidentified red spherical motifs that were sketched in diluted black (Fig. 6). On the outer edge of two of the spherical motifs are very fine, threadlike brush strokes that wave to the left.[10]

The preceding description presumes that the outside of the left arm is depicted as grasping the bow. It is also possible, although in our opinion less plausible, that the inside of the right arm is shown (Fig. 9, below). In that case, what we prefer to interpret as the hand that drew the arrow would have to be identified as a quiver of some sort or a bag. The two white strokes that curve slightly to the left above the outstretched arm (Fig. 6) might then be interpreted as belonging to the fingers of the left hand or to the quiver. Evidence for an added layer of blue paint along the upper edge of the outstretched arm, between its wrist and the two white strokes, suggests the presence of a painted motif that has now vanished (unless the artist revised his original drawing, leaving traces of it remaining in white and red paint where the blue paint has flaked away). From the horizontal position and linear shape of this motif, one can imagine the presence of an arrow (Fig. 7).

The Archer Fragment is in fair condition overall (Fig. 8). Its plaster is notably compact, composed of a thick and homogeneous white layer. Mechanical damage can be observed on the upper edges of the fragment, in the area immediately above and to the right of the blue sleeve, and below the bow arm. Paint layers adhere well to the plaster and to each other.

10. These motifs bring to mind the clasp of the collar worn by one of the red dogs depicted on the lower part of the northeast wall of Hall 64: *Palace of Nestor* II, p. 120, pl. P.

Figure 6. Detail showing probable right hand drawing bowstring and three spherical motifs. Photo in raking light. J. Stephens

Figure 7. Detail showing added layer of blue paint, perhaps an arrow, above the extended arm of the archer. Photomicrograph 6.3×. H. Brecoulaki

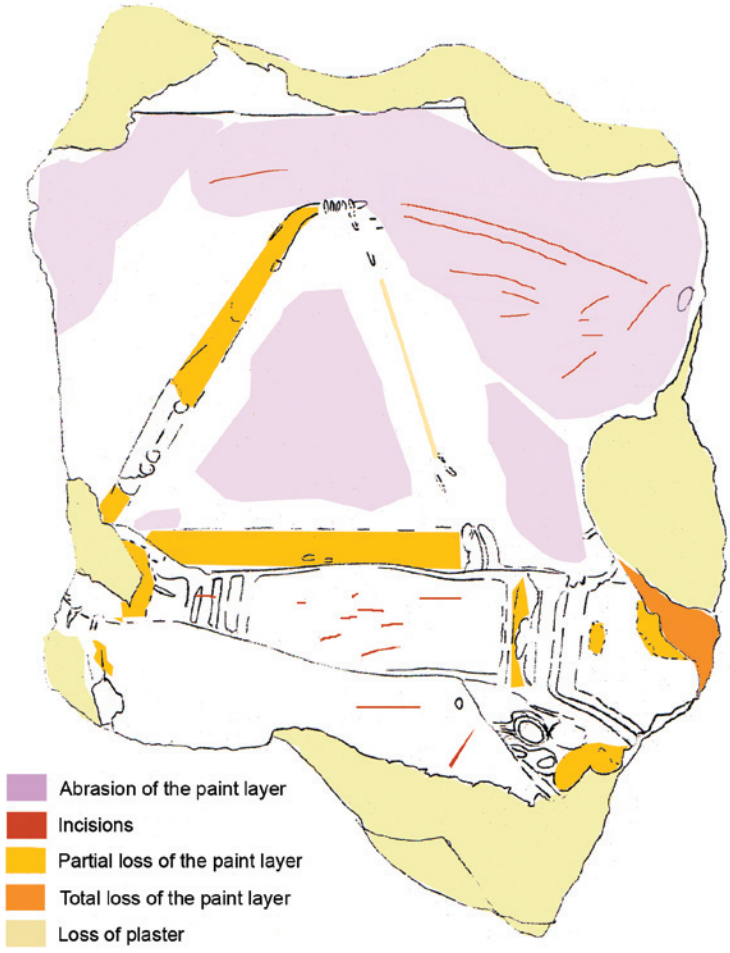

Figure 8. Sketch of the Archer Fragment showing the variable condition of the surface. H. Brecoulaki

Despite the irregular thickness of the paint layers, the surface of the painting has not been extensively abraded. In certain places, however, a total or partial loss of the paint layer through flaking inhibits the accurate identification of a number of details. Abrasion of the blue background is especially obvious near the upper edge of the fragment, where, as already mentioned, several scratches can be seen.

The original brightness of the colors was veiled by a thin film of fine earth, visible under a stereomicroscope. As this layer was not especially hardened by carbonation, nor was it firmly affixed to the surface, it was possible to remove it gently without having to resort to strong cleaning agents that could attack the original surface.[11] No other incrustations had formed on the surface of the fragment. There are no obvious traces of burning or of degradation patterns caused by moisture that would have resulted in color alteration. The good condition of the Archer Fragment, therefore, supports Lang's argument that such bright fragments with a blue ground were removed from the walls of the palace before its final destruction and may have been used as building material in the rubble fill of its walls or floors.[12] The condition of the joining edges of the two pieces that constitute the fragment testifies that it had been broken in antiquity.[13]

11. Penelope Vounissiou carried out superficial cleaning of the fragment with cotton swabs, distilled water, acetone, and ethyl alcohol. Cleaning was aimed only at the recovery of the original polychromy by elimination of dirt that had been deposited on the top surface of the fragment. The surface was subsequently consolidated with a layer of Paraloid B72 in a 3% concentration in pure acetone.

12. *Palace of Nestor* II, p. 7, n. 6; p. 77.

13. The two pieces have been glued together with HMG Paraloid B72 adhesive.

ICONOGRAPHY

Position, Gesture, and Dress

The Archer Fragment appears to us most likely to depict a figure holding a bow with the left arm, the outside of which is represented, and the nock of an arrow and the bowstring grasped with the right hand. In the discussion that follows, the representation of the archer is considered within the context of the art of the prehistoric Aegean.[14]

No archer with a bow is clearly identifiable in the corpus of wall paintings from the prehistoric Aegean.[15] Representations of archers in glyptic art, on vases, and in other media are few. Archers are occasionally depicted in chariots, but only in contexts where there is reason to suspect influence from the Near East.[16] Figures are typically shown in profile.[17] Knees are bent and the archer sometimes stretches one leg forward or backward, or leans forward as if to move quickly or to run.[18] The bow is held in the left arm and the bowstring is drawn with the tucked right arm.[19] The right arm forms a triangle under the outstretched left arm, with the right hand shown near the left elbow.[20] The bow is held in a closed fist, palm against its shaft.[21] The bow is not taut. Although archers are not often shown with other types of combatants in representational art, there is some archaeological and epigraphic evidence for their participation in warfare.[22]

14. This section of the paper represents research by Zaitoun.

15. Borgna (1992, pp. 132–133, nos. 22, 23), however, lists three fresco fragments that may show archers in scenes of war or the hunt. One fragment from the megaron of Mycenae depicts the legs of a man in a position that suggests they may have belonged to an archer; see Crouwel 1981, p. 122, pl. 85 (W8). Two other fragments from the palace at Tiryns may represent quivers; see *Tiryns* II, p. 122, no. 163, pl. XIV:2; p. 157, no. 226, pl. XVI:4.

16. A few scenes showing archers in chariots are represented on artifacts produced in the Aegean; see, e.g., a gold ring from Shaft Grave IV of Grave Circle A at Mycenae: *CMS* I, pp. 26–27, no. 15 (Athens, National Archaeological Museum 240). The style and iconography of Cypro-Aegean cylinder seals (Borgna 1992, pp. 128–129, nos. 11–14, pls. V, VI), and of a sealing on a pithos from Cyprus (Borgna 1992, p. 132, no. 21, pl. VIII:21) are clearly mixed; they resemble scenes from the Near East, if the seals were not actually made there. See the discussion of the same seals and sealings in Crouwel 1981, pp. 158–159, nos. G2, G16, pls. 10, 20; cf. the ivory box from Enkomi, Cyprus: Caubet 1999, pp. 15, 25, fig. 13. In Aegean iconography, the chariot is found mainly in hunting scenes.

17. A seal from the Thisbe treasure in Boiotia represents a woman shooting with a bow at a stag (Borgna 1992, pp. 45–46, n. 3, fig. 7:a). The three-quarter rear-view position of the figure and the quiver carried on her back are strikingly similar to what we imagine to be one plausible reconstruction of the Archer Fragment from Pylos (cf. Fig. 9, below). There is, however, an unusual clumsiness and incoherence in the drawing of the image on the seal that has suggested to most scholars that it is a modern work (e.g., Borgna 1992, p. 46, n. 5; Krzyszkowska 2005, pp. 320, 332–334). It is still not out of the question that authentic models inspired those who forged it.

18. Hiller (1999, pp. 321–323, pl. LXX:8a, b) describes the typical position of the archer when in combat.

19. Depictions of figures drawing an arrow with the left arm are much less common. See a stone seal with a female archer of LM II date, supposedly from Crete, now in Berlin, Staatliche Museen FG 2 (*CMS* XI, p. 39, no. 26, illustrated here as Fig. 12; see also Krzyszkowska 2005, p. 143, fig. 250) and the gold ring from Shaft Grave IV at Mycenae noted above (see n. 16).

20. E.g., a bronze dagger from Mycenae Shaft Grave IV (Karo 1930, p. 95, no. 394, pls. XCIII, XCIV); the silver Siege Rhyton and silver Battle Krater from Mycenae Shaft Grave IV (Karo 1930, p. 106, no. 281, pl. CXXII; pp. 119–120, nos. 605–607, pls. CXXVII–CXXXI; Sakellariou 1974); a gold ring in Berlin, Staatliche Museen 11886 (*CMS* XI, pp. 42–43, no. 29, illustrated here as Fig. 13; see also Borgna 1992, p. 127, no. 9, pl. IV:9; Krzyszkowska 2005, p. 333, fig. 623:a, b); and a stone vase fragment with an archer (Heraklion Museum 257; see *PM* I, p. 314; III, pp. 100, 106, fig. 59; Warren 1969, pp. 85, 177, fig. P473). In other representations, the figures are shown at rest, or the scenes are more schematic or more eastern.

21. This feature is clear on the stone seal illustrated below, Fig. 12.

22. There are exceptions in Grave Circle A at Mycenae; e.g., the silver Siege Rhyton and the silver Battle

Many factors may have played a role in determining how the image of an archer was rendered. In this case we think it is most plausible that the figure was shooting the bow, either standing (Fig. 10) or moving quickly with legs bent, nearly kneeling (Fig. 11). In either case, the right arm seems unusually close to the body, and its placement might best be explained if the left arm was outstretched and the torso bent forward and rendered in a three-quarter perspective from the back.

The stance of the archer could also have been rendered in the manner represented in Figure 9, in a pose similar to that on a prehistoric Aegean seal where a figure, probably a divinity, is depicted in a frontal position.[23] The archer shown on the seal brandishes a bow with one outstretched arm positioned horizontally, while holding an object in the other arm, which is outstretched vertically. The archer would presumably have carried a quiver.[24]

It is most likely, however, that the left hand clenched the shaft of the bow (as in Figs. 10 and 11), with the tips of the fingers not visible (the hand is slightly elongated, and the shaft is not held exactly in the palm). The right arm would have been drawn behind the figure, the bowstring grabbed by the right hand with two fingers raised. The head would have been drawn in profile. The brownish red dot at the right edge of the fragment, above or near the likely position of the head, might have belonged to a headdress, hair (the color would be unusual but not impossible),[25] a headband, or a hat comparable to that worn by a female archer on a seal in Berlin (see Fig. 12, below).

Our suggested reconstructions explain a number of iconographical elements represented in the Archer Fragment and are in general agreement with features of prehistoric Aegean iconography. Nevertheless, some details resist easy explanation.

The gesture of the right hand is puzzling. Borgna defines two main ways of drawing the bowstring.[26] Most commonly, the thumb and the index finger of the right hand are used in a method typical of the Mediterranean as a whole. In the other system, the index, middle, and third fingers pull the string, with the nock of the arrow held between the middle and third. In the Archer Fragment, however, if either of our reconstructions in Figures 10 or 11 is correct, the string's trajectory would have passed over the top of the fingers.

The red dots on what has been interpreted as the right arm in Figures 10 and 11 are also problematic. Although these may represent a bracelet of beads, in prehistoric Aegean wall painting beads are usually drawn more precisely and at a smaller scale. A bracelet should also have been set

Krater. Near Eastern influences are significant in the art of the Shaft Graves; in the structure of scenes of warfare on the silver Siege Rhyton, the iconography has been reinterpreted for an Aegean audience (Touchais 1999, p. 203, fig. 6). See also the wall painting from the megaron of Mycenae with its reconstructed siege scene that includes an archer alongside a chariot: Rodenwalt 1921, pp. 42–43, no. 16, suppl. pl. IV:16.

23. Oxford, Ashmolean Museum 1919-1956, supposedly from Vapheio; see Krzyszkowska 2005, p. 333, fig. 622.

24. See Borgna 1992, p. 26, fig. 4. The quiver would be placed under the arm, in front or in back, and carried by a strap over the shoulder.

25. A young woman carrying a basket is shown with red hair in a wall painting from Thera, Xeste 3, room 3, first floor; see Doumas 1992, p. 131, figs. 129, 130.

26. Borgna 1992, p. 24.

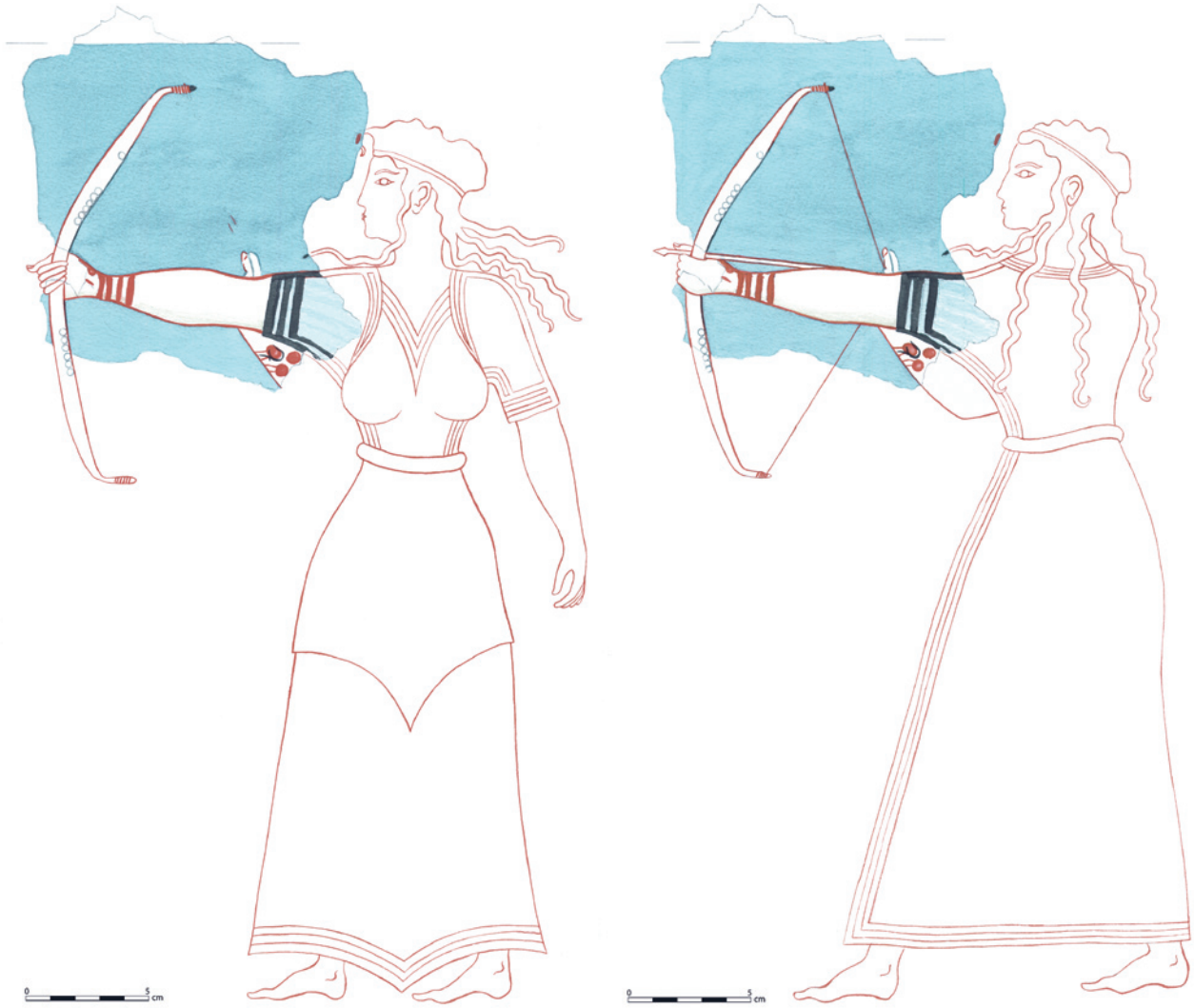

Figure 9 *(left)*. Color reconstruction showing the archer in a standing position. R. Robertson

Figure 10 *(right)*. Color reconstruction showing the archer in a standing or walking position. R. Robertson

perpendicular to the arm rather than at an angle to it.[27] It is possible, therefore, that the red dots represent an attachment for a glove or an arm-guard, with multiple fasteners arranged in at least two rows along the arm. One would, however, expect to find protection of this sort on the arm that holds the bow, with the attachment on the fleshy part of the forearm.

The red lines at the wrist of the left arm most likely represent a bracelet (or bracelets). No specific features permit them to be identified as an arm-guard.[28] Nor does the bow hand appear to have worn a glove. The red lines on the hand probably represent fingers or knuckles, as already noted.

The form of the quiver that might have been carried by the archer is not clear. Borgna observes that "non possiamo dire molto sull'aspetto della faretra nella Grecia protostorica."[29] The most common Aegean type is best

27. Among figures who wear jewelry in prehistoric Aegean art, see, e.g., *Mykenaia* from Mycenae (Immerwahr 1990, p. 191, My no. 3, fig. 32:h, pl. XX), the Boxing Boys from Thera, and the ladies from the House of the Ladies at Thera (Immerwahr 1990, pp. 54–58, Ak no. 5, fig. 17; Doumas 1992, p. 35, fig. 7, and p. 110, figs. 79–81).

28. An arm-guard is depicted in Egyptian painting; one instance may be found on the 18th-century wooden chest of Tutankhamun in the Cairo Museum: Smith 1958, p. 142. This example resembles a piece of leather and is worn on the arm that holds the bow; the other arm has a simple bracelet. For ways of protecting an archer's arm, see Borgna 1992, p. 28.

29. Borgna 1992, p. 92.

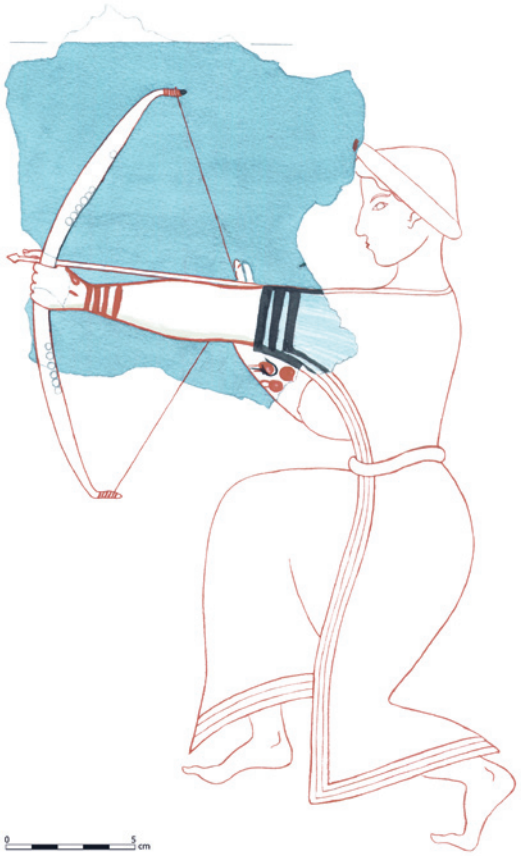

Figure 11. Color reconstruction showing the archer walking swiftly with legs bent. R. Robertson

represented by the double-axe from Voros on Crete.[30] This variety of quiver may have an oblong or conical cylindrical shape with a concave bottom or, alternatively, a prismatic rectangular shape. It sometimes is equipped with a lid. Such quivers would have been made of richly decorated perishable material.[31] In the Archer Fragment from Pylos, however, no shoulder strap for a quiver is visible, and it is possible that the archer carried a decorated textile bag that contained objects other than arrows.

An archer in Aegean art may wear a short tunic. Such a style of dress was employed in Mycenaean iconography for representations of men engaged in activities that required fast movement and freedom to gesture (e.g., in hunting and warfare scenes). It is frequently associated with individuals employed with chariots and horses.[32] Such dress was also worn

30. Heraklion Museum 2504 (LM III?): Càssola Guida 1973, pp. 163–164, no. 154, pl. XIV:1, 2; Borgna 1992, pp. 70, 134, no. 26, pl. X; Rehak 1999, p. 233, pl. XLVII:e.

31. Borgna 1992, pp. 25, 67–72. No actual quiver has been found. When represented in prehistoric Aegean art, the quiver is often shown by itself and in large scale (e.g., fragments of wall paintings from the palace of Tiryns: Borgna 1992, pp. 69, 133, nos. 23:a, 23:b, pl. IX; also the double-axe from Voros; see n. 30, above). Archers rarely carry a quiver when using the bow (but see the silver Battle Krater from Mycenae, and the Berlin gem illustrated below in Fig. 12). Other objects (e.g., a gold seal from Mycenae, *CMS* I, p. 22, no. 11) may show warriors with a sword and a large cylindrical container, similar to a quiver.

32. See Immerwahr 1990, pls. 64 (Groom fresco, Mycenae), 65 (Falling Warrior from Battle Scene, Mycenae), 67 (Chariot Scene from Hall 64, Pylos), 68 (Hunter from Boar Hunt fresco, Tiryns), 69 (Women in Chariot from Boar Hunt fresco, Tiryns), 73 (Hunter and Stag from Room 43, Pylos), 74 (Hunters with Dogs from Room 43, Pylos). In contrast, see the Warrior Vase from Mycenae (Immerwahr 1990, pls. 85–87), where the men are only marching to war, not yet fighting. Archers in prehistoric Aegean art may also wear a loincloth or a kilt, a flounced dress or skirt (or even priestly robes; see a pendant from Knossos now in Oxford, Ashmolean Museum 1938-1049; Borgna 1992, p. 126, no. 6, pl. III:6, and pp. 28–29, n. 26).

sometimes by women, as in the case of the Women in Chariot fresco from Tiryns.[33]

The border of the garment represented on the Archer Fragment is indicated by three thin black bands. Other clothing of this type is more characteristically bordered by two black lines or by a monochrome band edged by two black lines. Usually the upper border of the sleeve is represented, rather than the border beneath the arm, as in our example. In the prehistoric Aegean, one line of vertical stitching or a border is also typically indicated on the side of the garment, visible in a profile view.[34] In the case of the Archer Fragment from Pylos, the fact that the bottom border of the sleeve is emphasized must reflect the position and gesture of the figure.

Representation of the Bow

The shape of the bow is peculiar and cannot easily be situated in existing typologies of Aegean prehistoric weapons.[35] The bowstring appears to be only slightly drawn, which may explain the straightness of the bow, especially near the top. The straightness of its upper part is characteristic of Borgna's angular bow type, a variety commonly used both in Egypt and the Near East in either simple or composite form, but not attested in the prehistoric Aegean; the fact that it does not have curved ends, however, also invites comparison with Borgna's double convexity bow.[36] Furthermore, the white layer of paint on the Pylos example suggests that it may have been of composite construction. The white rounded brush strokes at the right edge of the bow lack close parallels.

The bow was not often represented in prehistoric Aegean art and was not necessarily depicted as a weapon used in combat or the hunt. In Minoan art, for example, it could form part of a ritual or even mythological vocabulary. The bow might have had sacral power, as a particular sealing from Kato Zakros suggests, or it might have been used in symbolic or emblematic ways in other instances.[37]

Gender of the Figure

Is the archer male or female? Men are usually depicted with reddish brown skin and women with white skin in prehistoric Aegean painting. Some scenes show white-skinned, apparently female, figures dressed like men and participating in male activities.[38] In the case of the Archer Fragment, there are no details to suggest that the artist intended to depict a man.

33. Immerwahr 1990, pl. 69. Compare the charioteers on the ends of the Ayia Triada sarcophagus (Immerwahr 1990, pp. 180–181, A.T. no. 2:c, d, pls. 52, 53); it is not possible to determine if their dress is long or short.

34. E.g., in the Boar Hunt fresco from Tiryns (Immerwahr 1990, pp. 129–130, 202–203, pl. 69, Ti no. 6).

35. Borgna 1992, pp. 17–21, fig. 1.

36. See Borgna 1992, pp. 19–21, for both types.

37. For the sealing from Kato Zakros, Heraklion Museum HMs 1135, see *CMS* II:7, p. 9, no. 5. Borgna (1992, p. 98) assigns an apotropaic value to the bow when employed as an emblem, one evoking the divinities Artemis and Apollo.

38. See Immerwahr 1983, p. 145; Damiani Indelicato 1988, pp. 39–42; Marinatos 1993, pp. 219–220; Blakolmer 1993; Hitchcock 2000.

Figure 12. Stone seal with a female archer. Berlin, Staatliche Museen FG 2. Drawing A. Berbner; *CMS* XI, p. 39, no. 26, reproduced with permission of *CMS,* courtesy I. Pini

Figure 13. Gold ring with cultic scene. Berlin, Staatliche Museen 11886. Drawing A. Berbner; *CMS* XI, pp. 42–43, no. 29, reproduced with permission of *CMS,* courtesy I. Pini

The seal and gold ring in Berlin mentioned earlier show conclusively that women can brandish a bow (Figs. 12, 13). Women may also wear the plain dress more commonly worn by men.[39]

Furthermore, very few men wear bracelets on their wrists in prehistoric Aegean art, although some of them have white skin.[40] The bracelet on the Archer Fragment from Pylos is similar to those worn by the white-skinned toreadors from Knossos. On the panel from the Court of the Stone Spout, one such toreador wears four rings on one wrist and five rings on the other.[41] Unlike the rings on the toreadors, however, the bands are not designed to protect the arm of our archer.[42]

The question then arises as to whether the figure depicted, if a woman, is a goddess. Although it is impossible to answer this question conclusively, representations of a warrior goddess are known in prehistoric Aegean art.[43]

39. E.g., the charioteers in the Boar Hunt from Tiryns; see n. 34, above.

40. Younger 1992, pp. 270–271; the helmeted figure from Mycenae (p. 280, no. 37) should be excluded from the list (for further discussion of this fragment, see below, n. 43).

41. Immerwahr 1990, p. 175, Kn no. 23, pls. 41, 42.

42. Bands were also used for protecting the fists of boxers, according to various systems discussed by Coulomb (1981, pp. 37–39). The arm in stucco from Knossos that is the object of his study wears a bracelet composed of five parallel bands (two brown and three thinner, cream-colored bands). See also Younger 1995, p. 516.

43. Immerwahr 1990, pp. 109, 115, 119–121, 140, 165, 167, My nos. 6, 7, 9, pls. 59–61 (the stucco plaque from the Cult Center at Mycenae, a wall painting from the Room of the Frescoes, and a fragment depicting a helmeted and probably female figure carrying a winged griffin in her arms); see also Kritseli-Providi 1982, pp. 28–33, no. A-6, pls. B and 2:a).

Other representations of women with weapons or women engaged in ostensibly male activities are more ambiguous. One fragment of a wall painting from the Kadmeia at Thebes shows a helmeted head with white skin in a windowlike opening.[44] Depictions of two women in a chariot are encountered, for example, in the Tiryns Boar Hunt.[45] Mycenaean vase paintings depict very feminine figures clad in long dresses and carrying swords.[46] But such representations do not necessarily depict divinities. It is not impossible that mortal women may have assumed the roles of warrior, hunter, or bull-leaper. Mortal women may have been associated with weapons, especially swords, in an emblematic way as a statement of power, and there seems to be no logical impediment to their having taken part in a hunt.

MATERIALS AND PAINTING TECHNIQUE

A principal focus of renewed study of the frescoes from the Palace of Nestor has been a scientific examination of the composition of materials employed in the plaster and paint layers, as well as the painting technique of the artists. A detailed presentation of the Archer Fragment offers an opportunity to demonstrate the value of such an approach to the study of prehistoric Aegean wall painting.[47]

Plaster

The constituent materials of the plaster of the Archer Fragment have been determined through X-ray diffraction (XRD) and proton-induced X-ray emission (PIXE-alpha) analysis (Fig. 14).[48] Calcium carbonate (calcite) proved to be the major component. The very low percentage of quartz observed represents inert material contained in the plaster (i.e., local sand).[49]

44. Michaud 1972, pp. 698–699, fig. 263; Immerwahr 1990, p. 128, Th no. 2. The entire picture may derive from a textile motif.

45. Immerwahr 1990, pp. 129–130, pls. 68–70, Ti no. 6. The fact that women represented in the Boar Hunt fresco do not carry weapons encourages Immerwahr to think that they do not take part in the hunt; the represented scene, however, may precede the start of the hunt. Rodenwaldt was of the opinion that a white female foot in this wall painting wore *Riemengeflecht* sandals, and he imagined a precedent for the later myth of Atalanta (*Tiryns* II, p. 122, no. 160, fig. 54; pp. 135–136, pl. XIV). Rehak (1999, p. 229) mentions white hands holding spears in the same painting. Women in the chariot on the Ayia Triada sarcophagus may also be evoked as parallels, but they are probably not human and the context there is funerary. See, too, a Mycenaean krater from Cyprus: Vermeule and Karageorghis 1982, p. 196, no. III.13.

46. Vermeule and Karageorghis 1982, pp. 196–197, nos. III.19 (a krater from Ugarit, Louvre, LH IIIA2) and III.29 (a krater from Aradippo, Cyprus, Louvre AM 676); the "warriors" are described as men, but appear from their dresses to be women.

47. This section of the paper represents observations by Brecoulaki, drawing on results of analyses by various colleagues in the natural and physical sciences that are noted where appropriate and documented below in Appendixes 1 and 2.

48. Nondestructive XRD and PIXE-alpha analysis were performed in situ with portable instrumentation by Lighea Pappalardo, Francesca Rizzo, and Francesco Paolo Romano under the supervision of Giuseppe Pappalardo, Department of Nuclear Physics at Catania University, and the Laboratory of Nondestructive Analysis of the Laboratori Nazionali del Sud of the Istituto Nazionale di Fisica Nucleare (INFN). A single microsample was taken from an edge of the Archer Fragment for further XRD and scanning electron microscopy-energy dispersive microscopy (SEM-EDS) analysis, performed by Vassilis Perdikatsis, Department of Mineral Resources Engineering at the Technical University of Chania.

49. Previously, a group of plaster fragments from the Palace of Nestor had been examined by William J. Young of the Research Laboratory of the Museum of Fine Arts, Boston (*Palace of Nestor* II, pp. 229–230). In

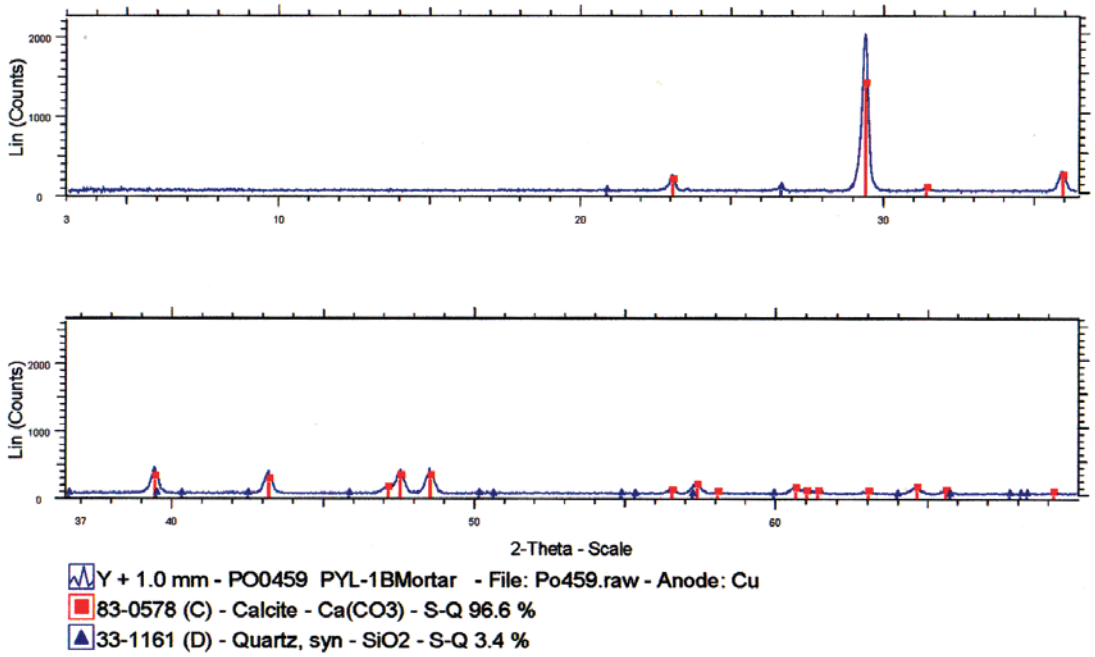

Figure 14. Constituent materials in plaster, as determined by XRD.
V. Perdikatsis

The plaster of the fragment consists of a single thick layer of very fine and homogeneous texture. It preserves its consistency and internal coherence, unlike most of the fragments collected from inside the palace, which appear to have been affected either by extensive water seepage or by fire. The outer surface of the fragment on which the painted composition was drawn was carefully smoothed before paints were applied, assuring both a uniformly even ground and the stability of the paint.

Pigment Analysis

Identification of pigments found in the paint layer of the Archer Fragment is based on the results of nondestructive X-ray fluorescence (XRF), PIXE-alpha, and XRD techniques performed in situ (Table 1, Fig. 15), along with semidestructive XRD and SEM-EDS analysis of the microsample taken from an edge of the blue background.[50] Half of the microsample was mounted in resin and polished to produce a cross-section in order to study its stratigraphy from the backing to the pictorial layers.

The blue pigment used for the background of the composition and for the garment of the archer is the well-known synthetic Egyptian blue pigment, a calcium copper tetrasilicate compound ($CaCuSi_4O_{10}$), similar in composition to that of the rare natural mineral cuprorivaite (see the

these samples plasters were found to have calcium carbonate ($CaCO_3$) as a major constituent, with a very low percentage of calcium sulfate ($CaSO_4$). All fragments, except one from room 43, came from surface levels and lacked clear contextual associations. For a review of scientific studies of plasters employed for Aegean Bronze Age wall paintings, see Jones 2005, pp. 202–209.

50. In situ XRF analyses were performed under the direction of Andreas Karydas of the Laboratory for Material Analysis of the Institute of Nuclear Physics, NCSR "Demokritos" (see Appendix 1). In the text and footnotes that follow, numbers preceded by XRF refer to positions on the surface of the Archer Fragment that were analyzed by XRF, those preceded by PY by PIXE-alpha. All positions are identified in Fig. 15.

TABLE 1. RESULTS OF XRF, PIXE-ALPHA, AND XRD ANALYSES

Color	*Portable Technique*	*Code*	*Detected Elements (XRF, PIXE-alpha) and Compounds (XRD)*			*Suggested Pigments and Compounds*
			Major	*Minor*	*Trace*	
Plaster	PIXE-alpha	PY2	Ca	Al, Si, Fe	—	calcite, quartz, Al_2O_3
Blue	XRF	229	Si, Ca,Cu	Fe	Sr	Egyptian blue, calcite
Blue	XRF	230	Si, Ca, Cu	Fe	Sr	Egyptian blue, calcite, minor amounts (few percent) of MgO and Al_2O_3 compounds
	PIXE-alpha	PY3	Si, Ca, Cu	Mg, Al, Fe	—	
White on blue	XRF	231	Ca	Fe, Cu	Zn, Sr	calcite on Egyptian blue
White on black, on red, on blue	XRF	232	Ca, Fe, Cu	—	Zn, Sr	calcite on organic black (possibly charcoal), on red ocher, on Egyptian blue
White on blue	XRF	233	Ca, Cu	Fe	Sr	calcite on Egyptian blue
White	XRF	234	Ca	Fe	Zn, Sr	calcite
Red on white, on blue	XRF	235	Ca, Fe	Cu, Zn	Sr	red ocher on calcite, on Egyptian blue
White on blue	XRF	236	Ca	Fe	Zn, Sr	calcite, quartz (~5%–10%), minor amounts (low percent) of MgO, Al_2O_3, S, and Fe compounds/elements
	PIXE-alpha	PY1	Ca	Al, Si, S, Fe	—	
	XRD	1	Calcite	Quartz	—	
Red on white	XRF	237	Ca, Fe	—	Cu, Zn, Sr	red ocher on calcite
Black on red, on blue	XRF	238	Ca, Fe, Cu	—	Zn, Sr	carbon black on red ocher, on Egyptian blue
Black on red, on blue	XRF	239	Ca, Fe, Cu	—	Zn, Sr	carbon black on red ocher, on Egyptian blue
White on blue	XRF	240	Ca	Fe, Cu	Sr	calcite
Blue on white	XRF	241	Si, Ca, Cu	Fe	Sr	Egyptian blue on calcite

All analyses were performed in situ on the upper surface of the fragment.

spectra of XRF, SEM-EDS, and XRD, Figs. 16–18).[51] This pigment was used extensively in Aegean painting, both on Thera and in Crete, where it was occasionally mixed with a natural dark blue mineral belonging to the family of amphiboles, characterized as magnesio-riebeckite; it is also the sole blue pigment yet securely identified in Mycenaean painting.[52] Egyptian blue was widely used in the wall paintings of the Palace of Nestor, as attested by

51. XRF 229, 230, 241; PIXE-alpha PY3. The presence of Egyptian blue is confirmed by XRF and PIXE-alpha analysis, which detected large amounts of silicon and copper, fingerprint elements of the cuprorivaite compound. Quantification of both XRF and PIXE-alpha analytical data shows, however, the presence of very large amounts of calcium, in quantities greater than expected in association with cuprorivaite or other compounds that have been detected in samples of Egyptian blue. It seems clear that calcite, rather than gypsum, was mixed together with the artificially produced Egyptian blue pigment, since sulphur is absent. For the pigment and its composition, see Tite, Bimson, and Meeks 1981; Tite, Bimson, and Cowell 1984; Üllrich 1987; Rieder 1997; Delamare 1998; Eastaugh et al. 2004.

52. For Thera, see Profi, Perdikatsis, and Philippakis 1977; Perdikatsis et al. 2000. For Crete, see Dandrau 1999, pp. 15–17. For natural blues, see Perdikatsis 1998. For identification in Mycenaean painting, see Philippakis, Perdikatsis, and Paradellis 1976. The occurrence of iron-manganese-rich material in three samples from the Menelaion suggests the possible use of riebeckite in Mycenaean contexts as well (Jones 2005, p. 215). The identification of indigo, an organic colorant, by means of Mobile Raman Spectrometry, in Mycenaean Thebes has been reported by Brysbaert and Vandenabeele 2004 (pp. 690–691). These results need to be treated with caution, however, until they are confirmed by subsequent analyses.

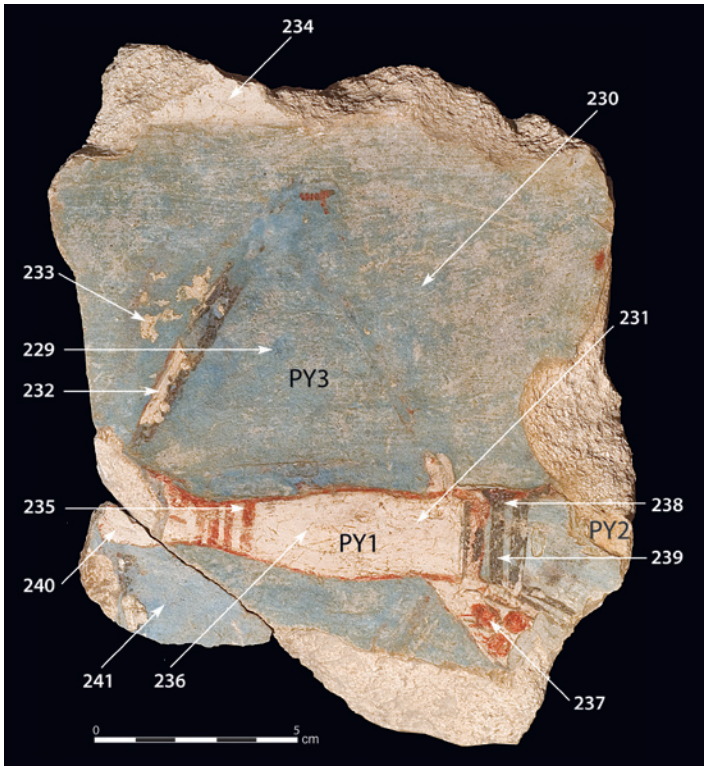

Figure 15. Positions analyzed by XRF and PIXE-alpha techniques.
H. Brecoulaki and A. G. Karydas

fragments collected from outside the northeastern wall of the palace and from the northwestern dump.[53] It is found in a variety of hues and was employed for multiple purposes.

In the cross-section of the blue sample taken from the background of the Archer Fragment, three distinct layers are visible (Fig. 19). From top to bottom, these layers consist of the following:

1. The blue layer identified as Egyptian blue (100–150 microns thick). The grain size of the blue particles ranges from 15 to 20 microns, and is indicative of a finely ground pigment.
2. A grayish layer (70–100 microns thick), composed of dispersed particles of carbon black in a white calcitic matrix that serves as an undercoat for the blue paint.
3. The layer of white calcium carbonate-based mortar that provides support for the paint layers applied to it.

The two red samples testify to the presence of iron and suggest the use of a red ocher rich in hematite (Fe_2O_3), the most frequently occurring iron ore.[54] Together with yellow ocher, red ocher is the most widespread pigment in Aegean prehistoric wall painting. The bright hue of the red on the Archer Fragment and the presence of iron as a major element in the XRF spectra suggest that a very pure ocher was used.[55] The detection of red ocher as the only natural red pigment employed in the wall paintings at Pylos is consistent with other available evidence for Aegean painters' palettes.[56]

At the two positions of black color examined with XRF (XRF 238, 239), the presence of iron and copper as major elements in the spectra

53. Brecoulaki 2005.
54. Gettens and Stout 1966, p. 183.
55. XRF 235, 237.
56. Dandrau 1999, p. 30; Jones 2005, pp. 215–216.

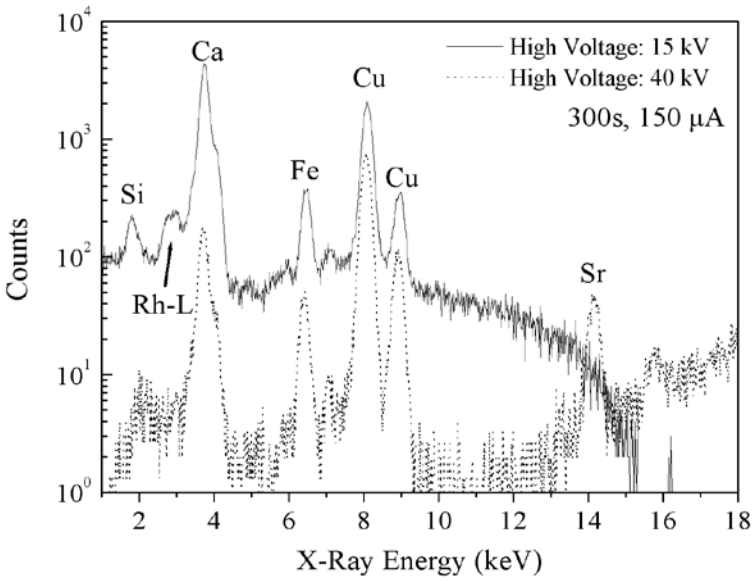

Figure 16 *(top)*. Composition of Egyptian blue pigment, as determined by XRF. XRF position 229.
A. G. Karydas

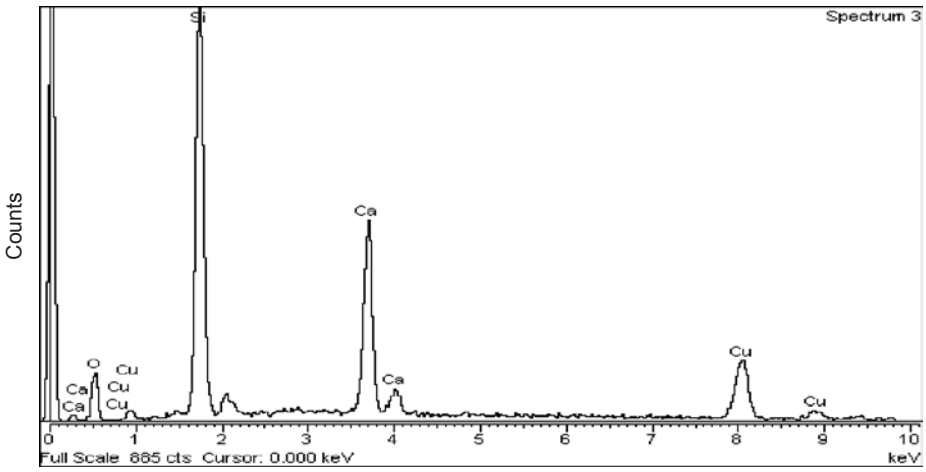

Figure 17 *(center)*. Analysis of Egyptian blue pigment by SEM-EDS.
V. Perdikatsis

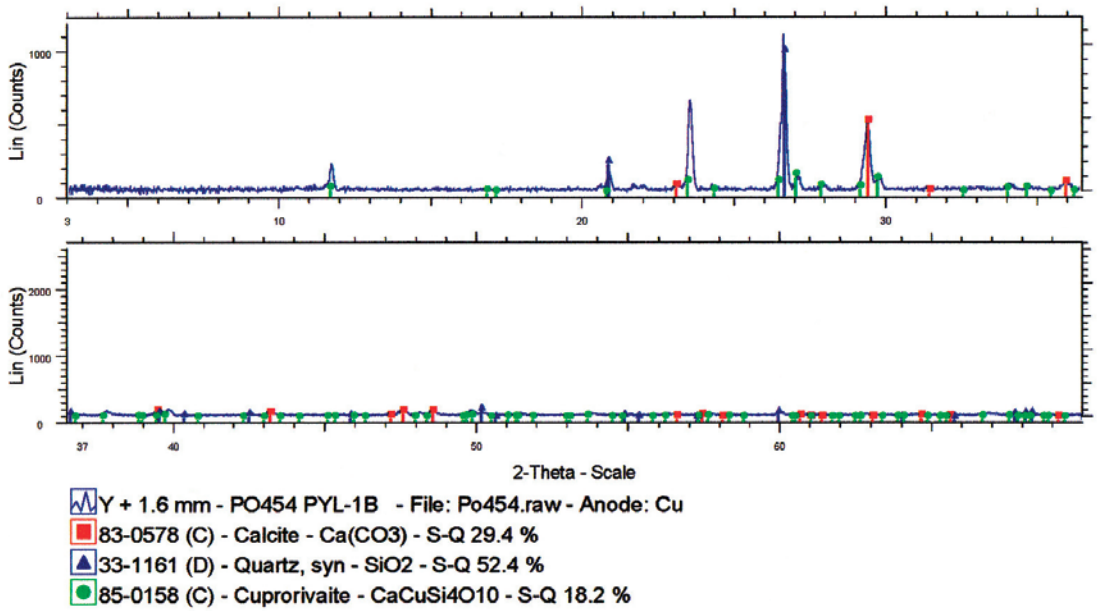

Figure 18 *(bottom)*. Analysis of Egyptian blue pigment by XRD.
V. Perdikatsis

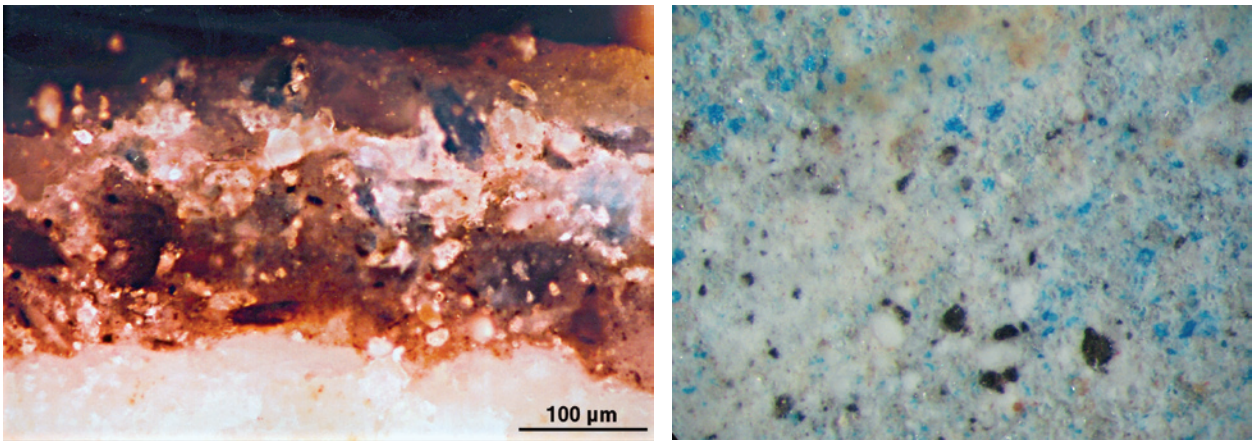

Figure 19. Cross-section of blue pigment, showing three distinct layers *(left)*; top surface of background layer, showing particles of carbon black and grains of Egyptian blue *(right)*. Photomicrographs (60× on right). H. Brecoulaki

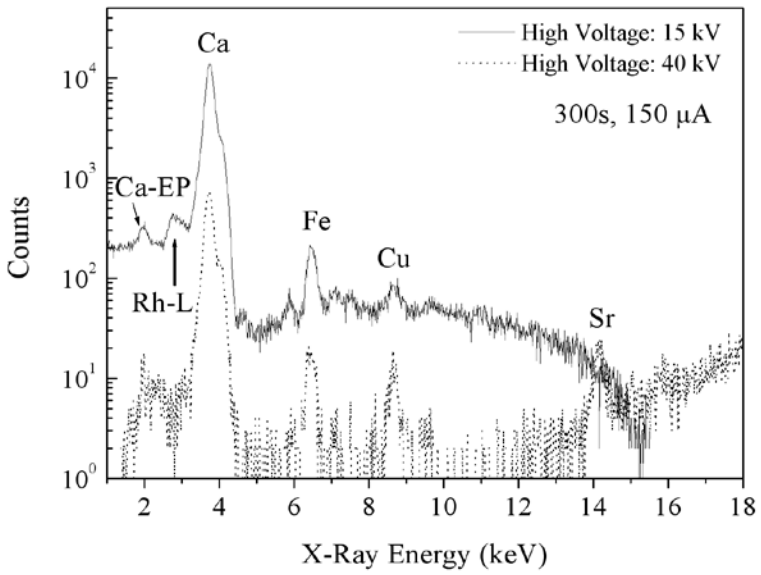

Figure 20. Spectrum for white pigment. XRF position 231. A. G. Karydas

reflects the presence of the red and blue layers that lie beneath the black paint. The fact that no other element that could be responsible for the black color was detected indicates the presence of a carbon-based black pigment, possibly charcoal.[57]

The main compound identified in samples of white pigment from five positions is calcite (calcium carbonate), which was thickly applied over the blue ground in order to render the white human flesh in low relief (Fig. 20; XRF 231, 236, 240) and to add a three-dimensionality to the form of the bow (XRF 232).[58] It was also used as a thinner layer applied directly on the mortar for the creation of the white band border (XRF 234) at the top of the fragment.

57. See Winter 1983; Dandrau 1999, pp. 11–12; Eastaugh et al. 2004, p. 82. Concerning black pigment-minerals in prehistoric Aegean painting, see also Perdikatsis 1998, p. 105.

58. XRD analysis performed on a white area on the Archer Fragment has shown clearly a strong presence of calcite ($CaCO_3$) and a weaker presence of quartz (SiO_2). The Si and Al detected by PIXE-alpha (PY2) largely reflect the composition of the plaster substrate.

Organic Media

The analysis of one microsample by means of gas chromatography-mass spectrometry (GC-MS) and pyrolytic gas chromatography-mass spectrometry (PY/GC-MS) has revealed the use of egg[59] that would have acted as the binder of the pigments.[60] Such an analytical investigation of the painting technique has never previously been carried out for prehistoric Aegean wall paintings, although it has been hypothesized by various scholars that a secco technique or a mixed secco/fresco technique was practiced by prehistoric Aegean artists.[61] The multiple superpositions of the paint layers observed on the Archer Fragment would have required the use of tempera rather than a true fresco technique.[62]

Convention of the Blue Background

Reliance on a blue background is a distinctive practice of painters with both stylistic implications (e.g., enhanced bidimensionality) and technical requirements (the use of added colors). In the case of the Archer Fragment, blue is clearly the dominant hue. While parts of the human body are emphasized with the addition of a luminous white pigment, the garment of the figure does not stand out clearly against the background.

The use of a uniform blue background was considered by Lang to be characteristic of wall paintings from an earlier phase of the decoration of the Palace of Nestor. This generalization needs to be reconsidered, as it is now clear to us that not all blue backgrounds are the same, nor were they produced with the same technique. While Lang was entirely correct in observing that blue was the most frequently employed background color in earlier wall paintings, she does not distinguish between the technically more sophisticated purple background of the battle scene from Hall 64 and the plain blue background of fragments found outside the palace

59. Egg has been detected in the analysis of samples from the tomb of Nefertari (Stulik, Porta, and Palet 1993; Newman and Serpico 2000) and in a 4th-century A.D. mummy portrait in the collection of the Petrie Museum (Ramer 1979). The use of egg as a binder has been attested in Early Hellenistic paintings from Macedonia and Italy, and egg was also employed for coloring votive knucklebones from Mount Helikon (Colombini, Modugno, and Francesconi 2001; Romiopoulou and Brecoulaki 2002; Tsimbidou and Brecoulaki 2002; see also Colombini et al. 2004). Amino-acid analysis cannot distinguish clearly between egg-yolk and egg-white, nor can eggs of different species of birds be distinguished.

60. A study of organic binders was conducted under the supervision of Maria Perla Colombini (see Appendix 2). Analysis of a representative number of other samples from the wall paintings of the Palace of Nestor has confirmed the use of egg, animal glue, and tragacanth gum, indicating the use of sophisticated tempera techniques (Brecoulaki 2005). It is now clear that the presence of organic binders can be detected in Aegean paintings and that these have not necessarily decayed through time (contra Noll, Born, and Holm 1975; Perdikatsis et al. 2000, p. 116).

61. Cameron, Jones, and Fillipakis 1977; Assimenos 1978; Chryssikopoulou et al. 2000.

62. Technological investigation of other fragments from room 27 that display stylistic affinities with the Archer Fragment has confirmed the use of a common palette and similar painting technique. A thick layer of a finely ground Egyptian blue served as background. Successive layers of white paint, mainly composed of calcite, were applied on it. The low relief produced by the application of this thick white paint is a distinctive stylistic trait of the painter and proves that a tempera technique was used. In all fragments examined, subsequent layers of iron-oxide-based red and yellow pigments were then applied on top of the white undercoat in order to indicate pictorial details. The use of a carbon-based black pigment (and not the black mineral pyrolusite that was most commonly employed for paintings found inside the Palace of Nestor) further supports the association of these fragments with the Archer Fragment on technical grounds.

proper.[63] The Archer Fragment displays the earlier type of blue background, and it was not on the walls of the palace in its final days.

Pigments represented in the palette employed by the prehistoric wall painters of Pylos (red-yellow-blue, black, and white) were usually applied pure on the blue background, so that they retained all their saturation and vividness. Such a bold use of color reflects the particular taste of a workshop or the preferences of a group of painters at a specific point in time, rather than any technical deficiency in, or limitation of, the abilities of the painter or painters.

STAGES OF THE PAINTING PROCESS

In the case of the Archer Fragment, the first step in pictorial execution was the creation of the color of the background.[64] The Egyptian blue pigment was finely ground and mixed with calcite in order to produce a vivid and light-colored hue.[65] It was then applied on top of a gray undercoat to the entire area that the composition would occupy.[66] The body of the figure was not reserved within the background, as was done in the case of life-size figures, where "economy of both time and blue pigment makes good sense," according to Lang.[67] The application of an undercoat beneath the blue background, not a regular practice at Pylos, seems to have had both aesthetic and practical motivations; a uniformly even surface enhanced the adherence of the sandy blue pigment and would have served as a backup in cases where the Egyptian blue layer wore off or was chipped away.[68]

Traces of a sketch in red paint applied directly on the blue ground are visible around the edges of the arm of the archer and at the outside edge of the bow. The painter presumably used this technique simply to define the main outlines of figures and objects, which were then drawn more deliberately with fine lines. The use of a red outline has also been observed on other small-scale fragments from area ne, outside the palace, and also on images of life-size women from area nws, also outside the palace.[69]

63. According to Lang (*Palace of Nestor* II, p. 43), "blue is the most frequent color for this purpose from early times. It does not seem to be the predominant background color in the material found inside the palace, as it is in the fragments found in the northwest slope dump, which should indicate that the latest trend before the destruction was away from blue backgrounds."

64. The discussion in this section reflects the thoughts of Brecoulaki.

65. The light hue of Egyptian blue may in part reflect its particle size after grinding, but it must also depend on the initial components of the pigment and the microstructure of the sintered product. The high percentage of alkali products contained in light-colored Egyptian blue is thought to have been achieved in at least a two-stage process; the pigment would have been reground before resintering to produce the intimate mixture of components revealed in examination of their microstructures (Lee and Quirke 2000).

66. This method, with figures painted over a colored background as if on plain plaster, is described by Lang (*Palace of Nestor* II, pp. 13–15, method 1) as most common for the depiction of small-scale figures.

67. *Palace of Nestor* II, p. 14.

68. A similar technique has been attested in a wall painting from Ayia Irini; there a layer of Egyptian blue was applied on top of an undercoat composed of carbon-based black (Majewski and Reich 1973). In Thera, moreover, a layer of ocher was superimposed on a layer of Egyptian blue in order to produce a brown hue (Profi, Perdikatsis, and Philippakis 1977).

69. Lang, in describing the White Goddess (*Palace of Nestor* II, p. 83), observed that her face was first sketched with a red line. We confirmed this observation through microscopic examination when the fragment was being restored. The use of red outlines for preliminary sketches is a practice attested also in Egyptian painting (Davis 2000).

Within the sketch of the figure, the painter applied a thick white coating of calcite on top of the blue ground, in order to cover the red outlines almost entirely. Several superimposed coats of white paint were used to create a pronounced thickness for the arm holding the bow and to convey an illusion of volume.[70] Since no traces of brushstrokes are visible, it is possible that the painter used a kind of spatula for this purpose. The hypothesized hand that drew the arrow, in contrast, was rendered in a slightly lower relief than the bow arm, as if it was meant to recede into a more distant plane. A red line was also used to outline the contours of the archer, covering the border between the thick white layer of flesh and the blue background, and to represent interior details, some of which, such as the stripes on the sleeve of the archer's garment, were rendered with multiple superimposed layers of paint. The realistic effect achieved by using low relief to suggest the volume of the arm of the archer is contradicted by the solid red outline, which promotes a sense of two-dimensionality.

The garment of the archer was drawn after the arm was completed. Its blue areas were reserved on the blue background, as painters did in the case of some other figures.[71] At least two superimposed paint layers were applied on top of the blue background: first, a layer of calcite; second, a layer of Egyptian blue.[72] The painter applied these additional layers in order to increase the thickness of the layer of paint that formed the garment, so that it equaled that of the arm and was also modeled in low relief. It was certainly not the painter's aim to color the garment differently from the background, and the difference in the hue concentration of the two blues is insignificant.[73]

Finally, some details relevant to the order of painting and the nature of the composition should also be noted. The layer of white paint applied between the two layers of blue was used to cover the blue ground, to facilitate bonding with the layer of Egyptian blue applied on top of it. The painter then added the black stripes of the garment. The use of egg tempera enabled the superimposition of multiple layers of paint and permitted the painter to create opaque and thick impasto effects.[74] Despite the restricted numbers of colors in the palette, the technique adopted for painting the Archer Fragment reflects both the individual skill and personal style of its painter.

70. Davis (1990, p. 220) long ago observed that "Minoan painters made frequent use of added white, a thick impasto identical with the lime plaster they painted on. In Thera, added white is very rare. It was used occasionally: e.g., for the fingernails of the male figures from the ante-room of the lower story of Xeste 3. For the most part, white is the result of areas left 'reserved' or unpainted against the plaster ground."

71. E.g., the figure on fragment 35 H 2 (014.16-2).

72. Two coats of blue paint for the background are noted by Lang (*Palace of Nestor* II, p. 77, pls. 25, 121) in her discussion of fragment 36 H 105 from Pylos (a representation of a bull-leaper).

73. We first thought that the unusual use of multiple coats of paint in this instance reflected a change of plan on the part of the artists—a revision or renovation of the original composition, as in the case of successive repaintings of the hearth in the Throne Room.

74. A similar technique was used to render the garments (animal skins) of the Tarzans (31b H nws) and the figure's white flesh on fragment 40 H ne.

THE ARCHER FRAGMENT IN RETROSPECT AND PROSPECT

The detailed analyses presented here notwithstanding, there is still much to be learned about the Archer Fragment and paintings from the Palace of Nestor. Neither the stance nor the gender of the archer can be definitively determined, although it seems most likely that a female was intended. Our own approach to reconstruction has been deliberately ambiguous in order not to impose our own views too forcefully on others. At the same time, we have attempted to provide art historians with information sufficient for them to attempt their own reconstructions. As current research at Pylos progresses, it is possible that the discovery of additional joining fragments of this composition will shed further light on its iconography.

Continuing study of the masses of unpublished fragments from the Palace of Nestor should clarify the nature of the decorative programs that adorned the walls of the Main Building, both before and at the time of its final destruction. Our work demonstrates the enormous promise that both chemical and stylistic analyses hold for defining the characteristics of those individual painters or workshops that operated at different times and in different rooms of the palace. Certain aspects of their methods, once obscure, are now understood. It is clear, for example, that one might better speak of wall paintings than frescoes, since organic binders were used to enhance the adherence of pigments to plaster and to painted undercoats. At the same time, certain traits that are highly typical of individual painting styles (e.g., the use of multiple layers of paint to achieve a low relief effect) are so diagnostic that in the near future it may be possible to assign groups of wall paintings to particular painters. Thus, for the first time in the study of prehistoric Aegean painting, a microchronology for the entire painterly oeuvre of a Mycenaean palatial complex may lie within our grasp.

APPENDIX 1
IN SITU EXAMINATION BY X-RAY SPECTROMETRIC TECHNIQUES

The instrumentation used in X-ray spectrometric methods has improved significantly in the last decade, allowing the development of integrated portable X-ray spectrometers with complementary analytical capabilities. These new technologies have been employed to characterize wall-painting pigments from the Palace of Nestor at Pylos. From 2002 to 2005, a portable XRF spectrometer developed at the Institute of Nuclear Physics at NCSR "Demokritos" was used to analyze plaster and pigment compositions at more than 350 different points (here referred to as positions) on fragments of wall paintings.[75]

The XRF spectrometer consisted of a Rh-anode side-window low power X-ray tube (50 watt, 50 kV, 125 μm Be window), a PIN X-ray detector with a 300-μm nominal crystal thickness and a FWHM of 220 eV at the Mn-K_α peak, and a battery-operated MCA card. The analytical range of this portable XRF spectrometer extends from the atomic number Z = 13 (Al) for major concentrations (but, more practically from Z = 14 [Si]) to Z = 92 (U), under two operational modes: an unfiltered mode with the tube high voltage set at 15 kV and a filtered mode with the tube high voltage set at 40 kV. In the filtered mode, using a set of different materials as filters in the path of the beam that excites the spectra, the tube emission spectrum is modified so that the low energy continuum up to 13–14 keV is practically eliminated. Two laser pointers are mounted in the spectrometer head in such a way that the intersection point of their beams coincides with the cross-point of the incident X-ray beam axis and the detector axis. The beam spot at the sample position has a diameter of less than 3 mm.

In 2004, additional analyses were conducted by the LANDIS group of the LNS/INFN by means of novel PIXE-alpha and XRD spectrometers. The PIXE-alpha spectrometer consisted of a ^{210}Po alpha source, coupled with a Si drift detector.[76] In the PIXE-alpha spectrometer, the use of a helium flux in the space between the source sample and detector increases considerably the efficiency in detecting Na, Al, Mg, and Si, while at the same time eliminating interfering Ar-K lines from the measured spectra. The analytical capabilities of the spectrometer extend from Na to Zn via the detection of their K lines, as well as to heavier elements such as Sn, Ag, Au, and Pb via the detection of their L or M emission lines.

75. Karydas et al. 2005.
76. Pappalardo et al. 2003.

Thanks to its very small dimensions and low weight, the system can be easily transported to a museum or archaeological site. A typical measuring time of about 30 minutes is required in order to obtain satisfactory statistics for most of the elements. The portable XRD system is equipped with a low-power Fe anode X-ray tube and a Si-PIN detector; the system works in a goniometric geometry and uses the characteristic Fe-K_α line as incident radiation.

The aforementioned X-ray spectrometers were used for the examination of the larger piece of the Archer Fragment (063.70) in order to provide combined and complementary analytical information. Both the XRF and PIXE-alpha techniques can determine the elemental content of the analyzed sample, but they exhibit complementary analytical characteristics. The PIXE-alpha technique is more sensitive to the detection of light elements down to sodium (Z=11), whereas XRF is more sensitive in the analysis of medium Z elements (Z > 26), even if they are contained in trace quantities. The information depth for each element, although strongly dependent on the atomic number of the element analyzed and the matrix composition, is very different for the two methods.

The PIXE-alpha technique, because of the small range of the alpha particles, generally penetrates to a depth of not more than 5–10 μm and thus should be characterized as a surface-sensitive technique. In contrast, the XRF method can yield information up to a depth of a few tens or even hundreds of micrometers. Through the application of both methods, a pigment can be identified deductively when a specific single element or, more commonly, a certain group of elements that characterize the chemical identity of a particular pigment compound is detected.

The XRD spectrometer provides more concrete analytical information by identifying directly the exact type of mineral or synthetic pigment compound. A significant problem emerged, however, during the pilot application of the portable XRD spectrometer at Pylos; the long time required for counting did not allow the measurement of many positions and different colors.

The analytical results obtained by the three X-ray spectrometric methods applied to the examination of the Archer Fragment are presented above in Table 1. The corresponding positions analyzed by XRF and PIXE-alpha are shown in Figure 15, and characteristic XRF spectra of blue and white pigments are shown in Figures 16 and 20.

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APPENDIX 2
ANALYSIS OF ORGANIC MATERIALS

The characterization of organic materials in wall paintings generally represents a challenge for the chemist owing to the small size of the sample available for analysis. Procedures based on chromatographic techniques interfaced with mass spectrometry are most frequently employed in such instances.

The simultaneous use of both PY/GC-MS and GC-MS analytical procedures makes it possible to characterize proteins, plant resins, and lipid materials such as waxes and vegetable oils.[77] A sample from the Archer Fragment was observed under the microscope in order to identify its painted layers and to choose a few micrograms of these for the pyrolytic (PY/GC-MS) technique, leaving the remainder of the sample for the GC-MS technique.

PY with In Situ Sylilation/GC-MS

A few milligrams of the paint samples, together with 5 ml of hexamethyldisilazane, were inserted into quartz tubes (4 cm × 0.53 mm) and placed into a continuous mode microfurnace pyrolyzing injection system Pirojector (SGE, USA) operating at 600°C. The pressure in the furnace was maintained at 14 psi and the purge flow was 0.5 ml/minute. The pyrolysis chamber was connected by a PTV injector to a 6890N GC System Gas Chromatograph (Agilent Technologies, USA) coupled with a 5973 Mass Selective Detector (Agilent Technologies, USA) single quadrupole mass spectrometer. The MS transfer line temperature was 280°C, the MS ion source temperature was held at 230°C, and the MS quadrupole temperature at 150°C. The mass spectrometer was operating in the EI positive mode (70 eV), and the mass range was from 50 to 750 m/z.

For the gas chromatographic separation a HP-5MS fused silica capillary column (5% diphenyl-95% dimethyl-polysiloxane, 30 m × 0.25 mm i.d., J&W Scientific Agilent Technologies, USA) with a deactivated silica precolumn (2 m × 0.32 mm i.d., J&W Scientific Agilent Technologies, USA) was employed. The PTV injector was operated in split mode at 300°C, the split ratio being dependent on the sample size. The chromatographic

77. For the application of these techniques, see Rampazzi et al. 2002; Bonaduce and Colombini 2003.

conditions were 31°C isothermal for 8 minutes, 10°C/min up to 240°C and isothermal for 3 minutes, 20°C/min up to 300°C and isothermal for 30 minutes. The carrier gas was used in constant flow mode (He, purity 99.995%) at 1.0 ml/min.

GC-MS Analysis

The sample (1.2 mg) was subjected to ammonia extraction (300–400 ml of NH_3 2.5N were twice added to the sample in an ultrasonic bath at 60°C for 2 hours). This procedure allows the solubilization of proteins and the separation of the proteinaceous matter from insoluble inorganic salts, such as calcium carbonate, that can interfere in amino acid analysis. The extracted ammonia solution was evaporated to dryness under a stream of nitrogen and then subjected to acidic hydrolysis assisted by microwave (Power = 250 W for 10 minutes; Power = 500 W for 30 minutes) in vapor phase with 30 ml of HCl 6N at 160°C for 40 minutes. After the hydrolysis, bi-distilled water (200–400 ml) was added to the acidic hydrolysate, which was then extracted with diethyl ether (200 ml; three times). The ethereal extracts were then mixed with the residue of the ammonia extraction. An aliquot of the amino acidic solution was evaporated to dryness under a stream of nitrogen and was subjected to derivatization with 10 ml of N-methyl-N-(t-butyldimethylsilyltrifluoroacetamide) (MTBSTFA), 40 ml of pyridine (solvent), 2 ml of triethylamine (catalyst), and 5 ml of norleucine solution, at 60°C for 30 minutes. After the addition of 5 ml of hexadecane, 2 ml were analysed by GC-MS. The analysis allows the amino acid pattern useful for protein identification to be determined.

The residue of the ammonia extraction was subjected to alkaline hydrolysis under sonication adding 1 ml of hydroalcoholic KOH solution (KOH_{CH_3OH} [10% weight]/ KOH_{H_2O} [10% weight], 2:3) at 60°C for 3 hours. After hydrolysis, neutral organic components were extracted with *n*-hexane (500 ml, three times; the combined extracts made up the neutral fraction). After acidification with hydrochloridic acid (10 M) up to pH = 2 of the residual solution, the acidic organic components were extracted with diethyl ether (500 ml three times; the combined extracts made up the acidic fraction).

Aliquots of both fractions were evaporated to dryness under a gentle nitrogen stream and subjected to the derivatization reaction. The dried extracts were admixed with a solution of internal standard (5 ml of tridecanoic acid solution, 140 mg/g) and derivatized with 20 ml of N,O-bis(trimethyl)silyltrifluoroacetamide (BSTFA) containing 1% trimethylchlorosilane (at a temperature of 60°C for 30 minutes) using 150 ml isooctane as the solvent. After the addition of 10 ml of hexadecane solution (80 mg/g) as an injection internal standard, 2 ml of the solution were analyzed by GC-MS.

The analysis of the neutral fraction allows the determination of neutral terpenoid compounds, sterols, alcohols and alkanes. The analysis of the acidic fraction allows the determination of monocarboxylic, dicarboxylic, and hydroxycarboxylic fatty acids and terpenoid acids.

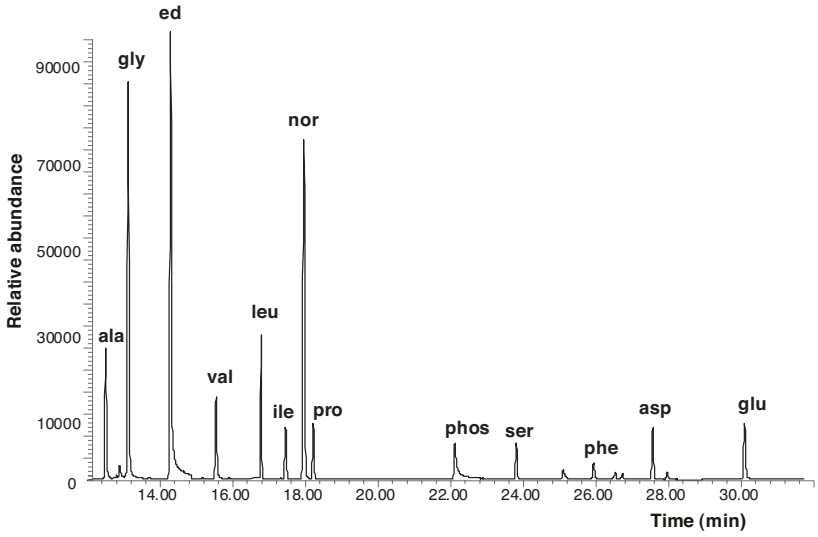

Figure 21. Chromatogram acquired in the single ion monitoring (SIM) for the analysis of proteins. Peak assignment: alanine (ala), glycine (gly), valine (val), leucine (leu), isoleucine (ile), proline (pro), phosphate acid (phos), serine (ser), phenylalanine (phe), aspartic acid (asp), glutammic acid (glu). Internal standards: esadecane (ed), norleucine (nor). These amino acids are present as their t-butyl-dimethylsilyl derivates. M. P. Colombini and U. Bartolucci

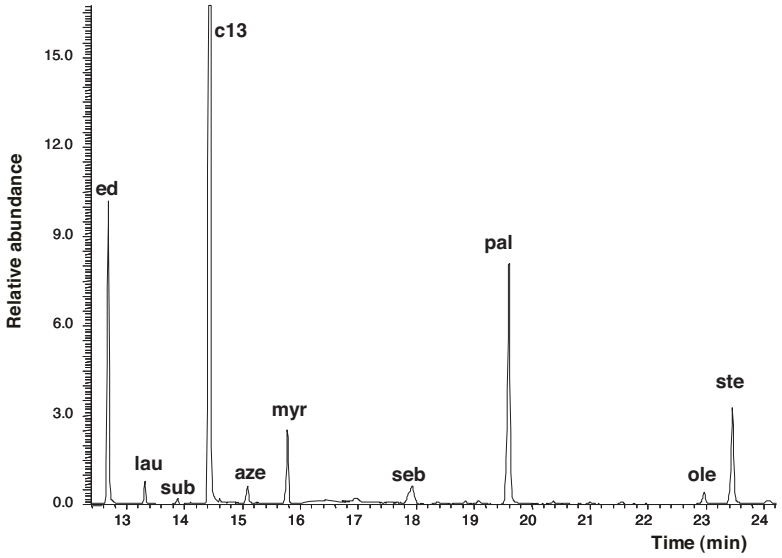

Figure 22. Chromatogram acquired in the single ion monitoring (SIM) for the analysis of lipids. Peak assignment: lauric acid (lau), suberic acid (sub), azelaic acid (aze), myristic acid (myr), sebacic acid (seb), palmitic acid (pal), oleic acid (ole), stearic acid (ste). Internal standards: esadecane (ed), tridecanoid acid (c13). The acidic compounds are derivatives of N,O-bis(trimethyl)silyltrifluoroacetamide (BSTFA). M. P. Colombini and U. Bartolucci

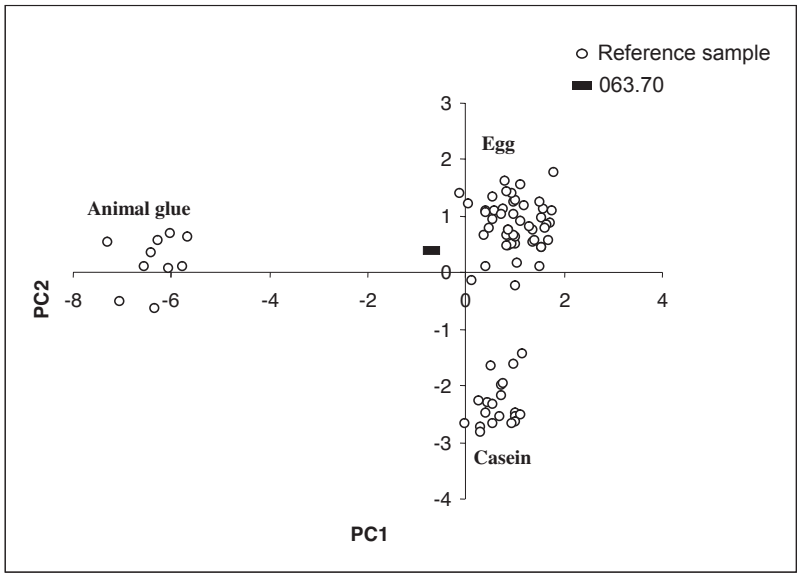

Figure 23. Score plot of the principal component analysis of the amino acid percentage contents of reference samples and a sample from the Archer Fragment (063.70). M. P. Colombini and U. Bartolucci

TABLE 2. AMINO ACID PERCENTAGE CONTENT

Ala	*Gly*	*Val*	*Leu*	*Ile*	*Pro*	*Ser*	*Phe*	*Asp*	*Hyp*	*Glu*
10.9	11.4	6.0	7.3	4.3	3.8	7.3	4.1	15.1	0.0	29.9

Hyp = hydroxyproline. For other abbreviations, see caption for Figure 21.

TABLE 3. FATTY ACID PERCENTAGE CONTENTS AND CHARACTERISTIC RATIO VALUES

Lau	*Sub*	*Aze*	*Myr*	*Seb*	*Pal*	*Ole*	*Ste*	*Aze/Pal*	*Pal/Ste*	*ΣD%*
3.1	0.9	0.1	12.7	8.1	52.4	2.5	20.1	0.1	2.6	9.1

For abbreviations, see caption for Figure 22.

Results and Discussion

The analysis performed by the PY/GC-MS technique highlighted the presence of hexadecanonitrile and a trace of levoglucosane, markers that are related to egg and polysaccharide material, respectively. The low amount of the polysaccharide material suggested the possibility of biological contamination rather than the presence of a vegetable gum such as gum arabic.

To evaluate further the possibility that an egg binder was employed in the painting, a GC-MS analysis was performed (Figs. 21, 22). Quantitative analysis of amino acids (Table 2) demonstrated that the extractable protein from the sample is 0.25% (w/w%), a considerable proportion of a proteinaceous binder with respect to the blank (0.02%). In the chromatogram, the presence of phosphates suggests the use of a casein or egg binder, while the absence of hydroxyproline suggests the absence of animal glue. Moreover, oxalates are in evidence; these are the final products of the oxidation of organic materials or of the metabolism of microorganisms.

In a principal component analysis of the amino acid percentage contents (Fig. 23), the sample from the Archer Fragment is located close to the egg cluster. The presence of egg binder is thus affirmed. This observation is confirmed by a pattern of fatty acids, a low amount of dicarboxylic acids, and the ratio values shown in Table 3, all of which point to the absence of a drying oil and the presence of a lipid such as whole egg or egg yolk. It may thus be concluded that egg was employed in the sample as a binder for pigments. The trace of polysaccharides may be related to microbiological activity that has slightly altered the amino acid pattern and has produced oxalates.

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APPENDIX 3
SUPPLEMENTARY IMAGES OF THE ARCHER FRAGMENT

Additional color images of the Archer Fragment can be viewed online at http://dx.doi.org/10.2972/hesp.77.3.394. A list of captions for these illustrations is provided below.

Figure S1. View showing the thickness of the fragment. Photo in raking light. J. Stephens

Figure S2. Small joining piece 063.71. Photo in raking light. J. Stephens

Figure S3. Detail of red spherical motifs on probable right arm. Photomicrograph 6.3×. H. Brecoulaki

Figure S4. Detail of probable left hand with fingers depicted in red paint, and worn area where layer of gray paint (grains of carbon black) is visible under the layer of Egyptian blue. Photomicrograph 6.3×. H. Brecoulaki

Figure S5. Detail of sleeve showing worn area where the superimposition of the layer of Egyptian blue is visible. Photomicrograph 6.3×. H. Brecoulaki

Figure S6. Detail of probable left arm showing the impasto effect of white paint composed of calcium carbonate and the thickness of brush strokes. Photomicrograph 6.3×. H. Brecoulaki

Figure S7. Detail showing the upper extremity of the bow, two incised lines, and a red spot at the right edge of the fragment. Photo in raking light. J. Stephens

Figure S8. Detail of fingers of probable right hand. Photomicrograph 12.5×. H. Brecoulaki

Figure S9. Detail of red stripes on wrist of probable left arm. Photomicrograph 6.3×. H. Brecoulaki

Figure S10. Detail of probable left hand and wrist. Photomicrograph 6.3×. H. Brecoulaki

Figure S11. Detail of upper part of bow and islets of white paint. Photo in raking light. J. Stephens

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