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The Architectural Surfaces of Petra: Techniques of Paint Application

The meticulously rock carved façades which give Petra its peculiarity and uniqueness are seldom noted to have been once coated with plaster that was often painted. Thorough observations, coupled with scientific studies, help to provide further insight into the once prosperous city, its decorated monuments and technological know-how (Shaer 2000; forthcoming). In presenting the findings regarding the application of paint layers on a tomb façade and an interior wall painting, a better understanding is provided regarding the variety of materials and methods used in painting architectural surfaces. In addition some decorative aspects that provide further knowledge of the Nabataean culture will be regarded.

The façade in question is that of Tomb 826 (Fig. 1) which is a Pylon Tomb according to the tomb façade classification of Brünnow and Domaszewski (1904: 408). The façade consists of two rows of crowsteps, with a torus, which is a rounded moulding, below the upper row of crowsteps as well as above and below the lower row. A stone carved fascia, which is the horizontal band that can usually be found below the torus on other façades in Petra, is in this case absent and was replaced by a relatively thick plaster layer constituting a band. At about 1.2 m below the lower torus the façade was carved in and a ceramic water pipe was inserted, the remains of which are very few. This water pipe, dated to after AD 50 (McKenzie 1990: 54, 110), is clearly a later addition and is part of the water system running down the entrance of Petra and passing through several other monuments as well.

Plaster and paint remains can be noted on the façade, which have led to a hypothetical reconstruction of the façade's original appearance (Plate IV, 10). The plain surface and the protruding crowsteps were originally coated with a single layer of a fat lime wash covering most parts of the façade and afterwards lime plaster with aggregate, and the paint layers were added to additionally coat the architectural elements. Two layers of lime plaster with many aggregates covered the recessed areas between the crowsteps, the torus elements, and the moulded fasciae. Each layer had a thickness of 3–5 mm, so that often the total thickness of the plaster is 7–10 mm. Sometimes a single plaster layer rather than two layers is found above the lime wash. Above the plaster, a paint layer was applied and polished over. Red was applied between the crowsteps (Plate IV, 3), yellow on the torus and blue on the fascia (Plate IV, 4). The fascia below the lowermost torus has red painted on the surface as do the few plaster remains of a single layer found below it. The application of layers shows that first the lime wash was applied directly on the sandstone as a ground layer, followed by lime plaster and finally the red paint layer.

Haematite was applied as the red pigment that was probably applied *al fresco*. For the yellow paint layer yellow ochre was used, while in the turquoise blue painted layer Egyptian blue was used as pigment. Below the Egyptian blue layer are black particles of soot, which probably served to provide a deeper colour tone (Plate IV, 5). There is no lime present in the paint layer as expected, since Egyptian blue is known not to work well with lime and so cannot be used in a fresco technique.

The plain surfaces of the façade have only remains of the white wash layer, except in the middle of the façade, where at c. 3.3 m below the bottom torus there is a patch representing thicker plaster remains (Plate IV, 6).

Many of the painted surfaces show horizontal marks of polishing, thus implying that a metal tool was used. Also, from the edge marks of the plastered areas it appears that rulers and templates, sometimes with concave edges, were used.

Binder/aggregate mass ratio measurements of the plaster have shown the ratio to be in the range of 1:0.5 and 1:1. The aggregates consist of quartz and fragments of limestone, chert and sandstone. Calcite aggregates present could also have been dissolved in the acid mix along with the binder during this test, which might account for the low amount of aggregate in some cases. Taking into consideration that about 20% of the aggregate might have been calcitic and thus dissolved with the binder – as found in the analysis of sand from the area – the binder content would still seem high with respect to the aggregate. Although all of the samples are generally of a similar nature, it seems that there are at least two mixes of plaster prepared for the upper decorative architectural elements and the middle ones, which vary in aggregate size and B/A ratio. Since both mixes appear to have been contemporary with the original façade's finished surface, the difference in mixes could be merely circumstantial where the plasterers did not seem to adhere to a strict recipe for the plaster mixture or for the aggregate size used.

The white fat lime layer on the façade, in addition to being a white coating of the façade's plain surfaces, was also a ground layer that might have been intended to help in closing the pores of the sandstone, and thus providing a uniform substrate surface for applying the plaster layer. The plaster patch in the middle of the façade may have been a plaque (made of plaster) comprising an inscription with information regarding the date, name of owner, or name of architect. Such rectangular plaques are found carved on the façades of Mada'in Saleh, a Nabataean site situated in Saudi Arabia, with monuments dated to the period spanning AD 1 to AD 76 (Jaussen and Savignac 1909; 1914).

On this façade, plaster was not merely used as a coating for the surface, but also had the function of imitating architectural elements, such as the fascia that is usually carved as a protruding horizontal band under the torus. Moulding such elements in plaster is much easier than carving them in stone, and helps to avoid failures that might occur in carving. The use of deep colours like red, blue and yellow on architectural elements helps to distinguish them from the plain façade surfaces, hence giving the impression that the façade is a set of constructed elements rather than a single piece of rock carving and thus adding to the sense of separation of the monument from the natural rock.

Red, blue and yellow, in addition to white, are the only colours to have been noted until now decorating the exterior façades of tombs. On the other hand, interior mural paintings additionally

include hues of green, pink, orange, brown and black. Red and yellow ochre, haematite and Egyptian blue, the pigments used on the exterior façades, have also been noted by Pliny (XXXV, XIII–XXIX) to be of less expense than others. These pigments could also be found locally and hence their use would appear logical since the large painted surfaces were exposed to the weathering elements. Red, blue and yellow were also three main colours that were used to decorate the Prince's Tomb at Vergina and the Great Tomb at Lefkadia (Ling and Prag 2000: 201), and, although here is no conclusive evidence or explanation regarding the use of primary colours on tomb façades in Petra, they are nevertheless a reminder of the restricted palette mentioned by Pliny (XXXV, XXXII). Pliny mentions that renowned Greek artists such as Apelles, Aeton, Melanthius and Nichomachus used only white, yellow, red and black, and describes how art was much more highly regarded than in earlier Greek times. Bruno (1977: 54–55) speculates that the colours mentioned by Pliny could represent primary colours, where blue was described by the ancients as black, or there existed a black that was "capable of appearing blue" (Bruno 1977: 77).

Concerning interior wall painting in Petra, perhaps the most intricate decoration that has survived is that of the biclinium at Siq el-Barid. This monument is basically a room of 5 x 6.2 m, with a vaulted recess accessible through its back wall. The back wall itself has remains of stucco in imitation of ashlars, while the ceiling of the alcove has an elaborate painting consisting of grape vines, flowers, various types of birds and cherubic figures (Plate IV, 1–2).

Two types of green pigment were detected in the ceiling painting. One of these is atacamite mixed with gypsum (Plate IV, 7). Here, the green layer appears as a fine homogeneous pale green colour, and not as round masses with dark centre as would be typical of the formation of synthetic salts (Scott 2002: 136). Additionally, atacamite has been detected in Petra, in association with malachite, as fine green veins in white sandstone (Plate IV, 8). Hence, atacamite here is not a deterioration product of other copper pigments, but was used as a natural pigment.

The other green pigment detected is green earth that was found mixed with particles of yellow ochre and Egyptian blue. Such a mixture gives a brighter green hue than would have been in using green earth alone. This is further enhanced by having the gypsum preparation layer below, which contains particles of soot.

The analysis of samples representing the white/greyish surface of the bignonia grandiflora flower (Plate IV, 9) showed a fine layer of possible aluminium hydroxide, with evidence of alum ($AlK(SO_4)$) in one of the samples. Aluminium hydroxide may have been used in this case as a white pigment to depict a white hue for the flower. However, this transparent white material is often used as a substrate for dyes, and alum is reported as its source in classical times (Gettens and Stout 1966: 91–91). The fact that this material was detected in relation to the bignonia flower motif, usually of yellowish/orange hue, raises the question of whether an organic pigment such as madder was also used. Additionally, the gypsum intonaco layer is quite compacted and implies a burnishing action, either of the paint layer or of the gypsum intonaco as a preparation for the paint layer.

It is evident that the execution of this painting was not done in the fresco technique. The pigments are mixed with gypsum for applying the paint layer, whereby gypsum was most probably used as a binder and/or extender. Beeswax was detected in one of the samples and hence it is certain that an organic binder was used with at least some of the pigments. This paint layer is applied over a preparation layer (intonaco) made of gypsum and with a thickness within the range of 300-500 μm, over a support layer of lime mortar with aggregates (arriccio). These were applied above two other layers of lime plaster containing aggregates. The painting layers often overlap, rendering the natural motifs in shades, providing a three dimensional impression and hence a realistic depiction. The adjacent and overlapping paint layers seem to have been applied successively, starting with the light tones, followed by the dark ones and finally the opaque outline of the motifs was drawn tracing the boundary. This is especially evident for the yellow/brown stalks and vine leaves. An exception to this successive painting is in the depiction of the light green vine leaves which are rather "flat" motifs, without a drawing outline, and appear to have been painted after the brown ones had been painted and dried.

The biclinium complex, with its stucco and decorative painted plaster, has been known to archaeologists since at least 1906. It was described by G. and A. Horsfield (1938: 21–24), Tarrier (1988: 55–56) and Glueck (1956; 1965: Pl. 203–204) who says that the ceiling painting emphasises the "joie de vivre" celebrated in Nabataean art, with its depiction of the grapevines and the gods Pan and Eros and the sophisticated forms which have become an artistic translation of the Nabataean civilisation (Glueck 1956: 19).

Zayadine (1987: 141–142) sees the painting as being of Alexandrine influence, dating it to the first half of the first century BC. Horsfield (1938: 21–24) dates it to the fourth or beginning of the third decade BC, while McKenzie (1990: 43, 52) dates it to the first half of the first century AD by grouping it with the Theatre, dated to that period, on the basis of the stone dressing of its rock cut walls. Moreover, Glueck (1956: 21–23) compares this painting to a mosaic at Oudna, 25 km south of Tunis, dated to the last part of the first and beginning of the second century AD, and also to a painting at the entrance of the vault of the Catacomb of Domitilla in Rome, also dated to the transition period between the first and second centuries AD. Based on this argument, Glueck dates the ceiling painting at al-Bayda to the end of the first or beginning of the second century AD.

Such ceiling decorations appear to have been popular in the Pompeian Third Style of painting, to which belong the painting of the vaulted ceiling of the Tomb of Pomponius Hylas on Via Latina in Rome, dated to AD 19–37, and the paintings of the House of Orchard at Pompeii dated to AD 40–50 (Ling 1991: 65–66). However, such comparative examples can only prove that the mural painting of this biclinium is "part of a fairly long and widespread cultural and more specifically artistic tradition" (Glueck 1956: 22–23). There is no reason to believe that the execution of such a painting was not done by a Nabataean artist, whereby Hellenistic elements, especially those present in Alexandrian forms influenced many Nabataean artistic expressions.

To conclude, it can be stated there are at least two main techniques of painting in Petra: one is fresco, where pigments were mixed with lime and applied on damp lime plaster, while the other is secco, where often gypsum was used in the painting layer which is itself sometimes applied over a gypsum preparatory layer, as in the case of the ceiling painting. This very fine gypsum layer could be denoted as a "gesso" layer, a term used by Italian painters to signify a priming material constituting a mixture of glue and gypsum (Gettens and Stout 1966: 115). The gypsum in the paint layer could have had the function of a binder or an extender. In the latter case, it would have been associated with an organic binding media such as beeswax.

The pigments used in executing the wall painting of Petra were those common in ancient Egypt and the classical world. All of the natural pigments identified can be found in the vicinity of Petra, while the artificially produced Egyptian blue was most probably manufactured locally, since copper as a raw material is found in the area and copper mining and smelting sites have been identified (Glueck 1940: 68–77; Hauptmann 1989: 119; Muhly 1943: 215). Specifically in the area of Wadi Sabrah, c. 7 km to the south/southwest of Petra, a Nabataean copper smelting site has been found (Glueck 1940: 74), where additionally green earth, atacamite, ochres and haematite could be identified.

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Fig. 1. The façade of Tomb 826 (photo by Th. Urban)