Aspects of Symmetry in Arpachiyah Pottery

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Abstract

Arpachiyah is one of the most well-known and extensive sources of Halafian pottery (ca. 5500 – 5000 BC). In this paper, we apply symmetry analysis in the style of Washburn and Crowe to analyze symmetries underlying central motifs in bowls and dishes from Arpachiyah. We note that while there is a great variety in the degree of symmetry, there is an overwhelming preponderance of dihedral patterns.

1. Introduction

Arpachiyah is a small site in northern Mesopotamia a few kilometers east of Nineveh. It was excavated briefly by Mallowan in 1933 [7] and again by Hijara in 1976 [4,5]. Despite the brevity of the excavations, a large number of important finds were excavated at the site. The main part of the site itself formed a small tell or debris hill, built up over perhaps as many as fifteen occupation layers. Additionally, there were some less well-preserved outlying locations in the surrounding area. Among the finds were many pottery objects from the Ubaid and preceding Halaf periods (ca. 5500 – 5000BC). The Ubaid-era occupation seems to have been quite poor – Mallowan commented on the low quality of the house construction and many of the pottery and stone-ware finds were unpainted and in many cases poor manufacture. However, the earlier levels produced finer ware, including a series of painted bowls and dishes incorporating complex designs from the last Halaf occupation layer. Although most of these bowls were badly broken, and in fact appeared to have been deliberately smashed, it was possible to reassemble the sherds sufficiently to study the overall design. This was an immense labor – one bowl (A748) was reassembled from 76 pieces [7].

Due to their abundance and clear stratification, the finds from Arpachiyah are important in linking archaeological levels of different sites in the Near East and demonstrating their connections. For this reason, they have been subject to various types of stylistic and physical analysis. For example, Davidson and McKerrell used neutron activation analysis to show that there was a considerable transfer of ceramics produced in Arpachiyah to Tepe Gawra [3]. However, despite a propensity for geometric decoration, the material has not been subjected to a thorough symmetry analysis. This paper represents the first step in such a study.

2. Symmetry Analysis

Ceramics break, but they don't decay. Once abandoned and buried in the ground, pottery will survive without much additional damage for hundreds, even thousands, of years. Over the same period many other goods, especially organic artifacts such as those made from cloth, leather or wood will largely vanish without trace. Their survivability ensures that the study of ceramics plays an important role in the archaeologist's approach to the past.

Another aspect of ceramics that makes them important is their extreme variability. Pottery comes in a vast array of different shapes and sizes, with plates, dishes, bowls, cups, beakers, vases, urns, all ranging from small to large, sometimes extremely large. They may be finely or crudely made, from a wide variety of clays with different characteristics and fired with varying degrees of skill. They may be decorated or undecorated. If decorated, there are an unlimited number of ways for the painter to design the decoration.

Archaeologists use all these factors to glean information from pottery. While form and location of find can indicate function and thus say something about the lives of those who lived there, changes in type and style can provide a chronological framework for understanding not just the site under investigation, but via linkages with similar ceramics elsewhere, show correlations between levels at different sites. Assemblages of the same types of pottery show that peoples in different places were contemporaneous, and also that there was some form of contact between them. As pottery plays such an important role on scales from the micro investigation of the inhabitants of a single building to the macro level tying together cultures encompassing huge areas, it is vital that precise delineation of the characteristics of pottery assemblages be obtained. In this regard, it is important that analysis of pottery be objective and reproducible. That is, different researchers viewing the same collection of objects should reach the same conclusions. Although desirable, this is manifestly not the case with many aesthetic criteria and interpretations of style. It is, however, a feature of symmetry analysis.

Symmetry analysis restricts itself to a study of the formal symmetries of the designs on pottery (or other wares). It is thus limited to decorated pottery, and requires enough of the piece to survive that the overall design can be viewed; it is of little use on the vast numbers of individual sherds typically uncovered in an excavation. Symmetry analysis does not concern itself with interpretation of motifs or designs, only with their abstract symmetry. Where sufficient decorated pieces survive, it presents an objective analysis. For a more detailed evaluation of the strengths and limitations of symmetry analysis, see Irving [6]. Modern symmetry analysis is largely due to the efforts of Washburn, and the clearest accessible description of the technique is in the classic Washburn and Crowe [9]. It has been successfully applied in several cases where there was suitable material, for example by Crowe studying Ghanaian clay pipes [2], Washburn in the Aegean [8] and Washburn and Matson in the American Southwest [11]. The recent book [10] includes a number of more recent case-studies, including one by Washburn on patterns in Ica Valley ceramics.

Whenever an element of a design is repeated, there is the possibility of some sort of regular, orderly repetition, that is, some symmetry. There are several systems of classifications for symmetries. If the design allows translations in one dimension, the resulting patterns are called 1-dimensional, or frieze patterns; if there are translations in two dimensions, the designs are referred to as 2-dimensional, or wallpaper patterns; if there are no translations the designs are termed finite. The standard notation for 1- and 2-dimensional patterns derives from crystallography, where the concern was for describing the regular placements of atoms. The regions between the atoms did not require special handling. However, in a decorated design, one has to account for the use of multiple colors in the regions, and there are extensions to the notation to handle these cases, (see Washburn and Crowe [9] for details). In this paper, we confine ourselves to finite designs, and it will turn out that in the pottery we consider, there is no symmetry-breaking through use of color.

For finite designs, there are two types of symmetries with which we have to be concerned, rotations and reflections. A design has rotational symmetry of order n if a rotation of $\frac{1}{n}$th of a

turn, or $360/n^{?}$, leaves the pattern unchanged. Additionally, a pattern may have reflection, or mirror, symmetry. The symmetry group, or type, of a finite design is determined by the largest *n* such that it has rotational symmetry of order *n*. Following the notation of Washburn and Crowe, we say a design has symmetry type *cn*, if it has *n*-fold rotations but no reflections, and type *dn* if it does have reflections. Types *cn* and *dn* are the only possibilities for finite patterns.

3. Bowls from Arpachiyah

The finds from Mallowan's excavation were divided between Iraq and Britain; those from Hijara's remain in Iraq. In this paper, we concentrate on the central designs of the Halaf-ware bowls from Mallowan's level TT6, principally from the single location, the Burnt House. Hijara was mostly interested in the earlier Halaf occupation phases and none of his finds from this level are complete enough to be included in this analysis. Consequently, we use Mallowan's record numbers to identify each object. Recently, Campbell made an extensive study of all the artifacts discovered in the Burnt House with a view to interpreting its function and subsequent destruction [1]. As part of his study, Campbell published a catalog of artifacts relevant to his discussion. Mallowan did not publish a complete record of finds and since excavation many pieces have been scattered among museums and collections, although the bulk of the important bowls are in either the British Museum or the Iraq Museum. Those in the British Museum I was able to view in July 2004 and March 2005; those in Iraq were unavailable to me and conclusions have to be drawn from published illustrations.

Figure 1: A 745

There are about 20 bowls of assorted shapes and sizes of which enough survives to be able to interpret the symmetry of the central design. Others, such as A 746 are too badly damaged to attempt a reconstruction with confidence, even though some of the design survives. For

convenience, we divide the bowls into three groups based upon central design: those with a cruciform design; those with a central rosette, and a miscellaneous group.

Among the most well-known pieces from Arpachiyah is A 745, a delicate small bowl currently on display in the British Museum and featured on the Museum's Compass website (see Figure 1). The design features a central Maltese cross in black paint with the corners drawn together in a sweeping curve. The curve is emphasized by two exterior parallel lines and the interior spaces so created are filled with red paint with a small reserve area setting off the red and black. Unsurprisingly, for a design based on a Maltese cross, the bowl has symmetry type *d*4. A similar design, but with only the cross and exterior lines painted, occurs on A 754 and A 514 (the latter not illustrated by Mallowan and Rose, and unfortunately not included in Campbell's catalog). Both bowls thus have *d*4 symmetry. The piece labeled A 1003 by Campbell may also have had a similar design, but the bowl is too damaged to be certain. Table 1 summarizes this information.

Number	Museum Number	Central motif	Symmetry
A 514	BM 127503	Maltese Cross	*d*4
A 745	BM 127585	Maltese Cross	*d*4
A 754	IM 14720	Maltese Cross	*d*4
A 1003	I of A 53/337	Maltese Cross?	*d*4

Table 1

The first group was defined by having a central Maltese cross. However, it is clear from A 514 and A 745 that the space between the arms of the cross was also considered important. These petal-shaped pieces, taken as a motif in their own right, form rosettes that make up the largest class of bowls. Figure 2 shows an illustrative example.

Figure 2: A 752 central rosette

In this group, the number of petals varies widely, from eight upwards, and although there is some clustering around powers of two, there are examples that fall outside that tendency, as A 750, with 13 petals. The petals vary in design, whether rounded or pointed, filled or hatched, but in all cases they maintain mirror symmetry so that each is of dihedral type, but with no obvious emphasis on the number of petals. Some of the bowls, such as A 529, have too much fire-damage to be absolutely sure how many petals there were originally in the rosette. These bowls include the very fine large bowls that make up some of the most spectacular early pottery from any Halaf site.

Number	Museum Number	Central Motif	Symmetry
A 511	Louvre 1973	Rosette	*d*8
A 529	BM 127504	Rosette	*d*15?
A 746	IM 17836	Rosette	damaged
A 747	IM 14741	Rosette	*d*8
A 748	IM 17837	Rosette	*d*32
A 750	BM 127507	Rosette	*d*13
A 752	BM 127508	Rosette	*d*16
A 753	IM 14753	Rosette	*d*8
A 755	IM 14724	Rosette	*d*8

Table 2

The last group comprises a miscellaneous collection of designs. There are two bowls with sets of triangles pointing together, A 742 and A 743. Mallowan and Rose illustrated A 742 and stated that A 743 was a smaller duplicate, but no illustration is available and the dish is in the Iraq Museum. This is the only example of duplication in the entire Arpachiyah corpus, and even then the bowls are not of the same size. A 742 has dihedral symmetry of order 6, and if A 743 is identical in design, then we can assume it has *d*6 symmetry, too. A 751 is an example of a Maltese square design and so is constrained to have *d*4 symmetry. A 763 has a curious design of crossed lines and dots. Mallowan said the design was on the underside of the bowl; Campbell suggested it might be a lid. Whatever the purpose, or the significance of the design, it is again of type *d*4. A very unusual design is that on A 524 (see [7, Plate XIX]). The design has two chequered bands crossing in the center, and the alternating motifs in the small squares appear to allow a dihedral symmetry, so that the design is of type *d*2.

The final example from the miscellaneous group is A 515, a coarse bowl with a bukranium (bull's head) design formed by four bukrania with heads at the center of the bowl. Hence, the design has a dihedral four-fold symmetry, and we label it as *d*4, although the symmetry has been deliberately broken by the placing of a red dot, perhaps symbolizing the sun, in the horns of one of the bulls. The symmetries of this group are summarized in .

Number	Museum Number	Central Motif	Symmetry
A 515	BM 127511	Bukrania	*d*4
A 524	IM 15702	Checkered arms	*d*2
A 742	BM 127583	Triangles	*d*6
A 743	IM 14726	Triangles	*d*6
A 751	IM 14733	Maltese Square	*d*4
A 763	IM 14762	Crossed lines	*d4*

Table 3

4. Conclusions

The most notable result of this study is that every single piece, regardless of motif, has dihedral symmetry. There is a clear preference for even numbers, although there are some exceptions, but only among the rosettes. Apart from the rosettes, most pieces have low-order symmetry, with *d*4 and *d*6 the most common. These are in contrast to earlier and later phases and the types of decorations found at other sites. A detailed comparison is beyond the scope of this paper, but the conclusions determined here will form part of a larger study. Another important feature that is not always sufficiently stressed is that all these pieces are different. There is no standardization, rather there appears to be a requirement that every piece be individual.

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