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RESEARCH-IN-PROGRESS REPORT

ORIENTATION AND SYMMETRY: THE STRUCTURING OF PATTERN REPEATS IN THE PARACAS NECROPOLIS EMBROIDERIES

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The most extensive Peruvian fabric remains come from the archeological site of Paracas Necropolis on the South Coast of Peru. Preserved by the dry desert conditions, this cache of 429 mummy bundles, excavated in 1926-27, provides an unparalleled opportunity for comparing the range and nature of variations in similar fabrics which are securely related in time and space. The bundles are thought to span the time period from 500-200 B.C.

The most numerous and notable fabrics are embroideries: garments that have been classified as mantles, tunics, wrap-around skirts, loincloths, turbans and ponchos. In general, a single figure is repeated in the borders and sometimes in the gridded field of any one garment. Approximately ninety mantles with figures repeated in gridded fields have been included in the study up to this point. The figures repeat in different orientations: up-down and left-right facing. By reducing the figure to an arrow, a chart of the orientation variations emerges. A second chart, derived from the orientation arrows, makes the symmetrical relationships between the figures more visible to untutored eyes. The variations are categorized by a) the symmetry or assymetry of the figure itself and B) the number of different orientations of the figure in a mantle. There are seven types or categories with from two to eight sub-types each. Only two in the sample of over ninety do not scan in a regular fashion. These two may be attributable to purposeful scrambling, ancient error or some aspect of the system that is not yet understood.

From the charting of the ninety mantles, two important points emerge. Firstly, there is a system behind the orientation variations: they can be regularly classified and they comprise an almost complete set of ways in which planar patterns can fit together through repetition. The mantles contain the evidence for a consistent and highly developed system that is concerned with describing space, similar in scope and content to the branch of mathematics that was developed for describing the variations in crystalline structures. Secondly, the charting itself reveals the method they used to encode this information. Differences in figural orientation and the resulting symmetry between contiguous figures define the distinctions between the types.

The encodement of information in the Paracas Necropolis embroideries can be further unfolded. Dr. Anne Paul, who is working with me on this project, is focussing on the colour repetitions of the figures. A separate but systematic set of variants is present in the colour alternations. This system appears to describe ordering possibilities. It is expected that further levels of encodement will be uncovered as we expand the sample to double its present size and work more intensively with other aspects of the repeating patterns.

Given the early date of these fabrics, this system may seem esoteric and abstract. However, there is evidence in the same cache of mummy bundles that the system has an empirical basis in a widespread ancient activity. Not surprisingly, fabric structure appears to be the key. A series of interlaced headbands have precisely depicted images of fabric structures such as twisted strands and oblique interlacing. The headband images have the same order of distinctions found in the repeated figures on the embroidered mantles: symmetry, colour, number and order. A separate study of the headbands shows a convincing parallel classification of types that overlaps with the symmetry and colour classifications of the embroidered mantles.

In the light of recent interest in symmetry studies (cf. Dorothy Washburn and Donald Crowe, *The Symmetries of Culture: Theory and Practice of Plane Pattern Analysis*, University of Washington Press, Seattle and London, 1988), it is interesting to note that the symmetry classification based on crystallography does not fit the patterns in the mantles very closely. There are seventeen and only seventeen two-dimensional patterns in the crystallographic classification. Ten of the seventeen patterns are present in the sample so far. Five of the absent patterns have three- or six-fold rotation, pattern classes that simply do not occur in the mantles or in the repeating patterns in ancient Peruvian art. They also are largely absent in the structures of ancient Peruvian textiles (one example of tri-axial interlacing, a Late Horizon bag, has been located). The lack of fit between the mantles and the crystallographic classification lies mainly in the fact that the mantles have many more variants. The mantle variants that fall outside the crystallographic classification do so through attributes that are homologous with textile structures. Furthermore, colour variation is not conjoined with figural orientation in the mantles but operates as a separate system with different rules and different patterns. Several lines of evidence, in addition to the headbands with images of textile structures, indicate that the emic (from within the culture) classification of symmetry types derives from the structures of fabrics. Comparing the symmetry types in the mantles to the symmetry types in the crystallographic classification does show that a similar mathematical content can be derived from a different empirical basis.

The expertise of the ancient Peruvians in making fabrics in diverse structures seems to have provided them with a format for the abstract exploration of spatial and ordering possibilities. The depiction of fabric structure images, like those on the headbands, is one level of abstraction removed from the actual structures. The symmetry between discrete figures in repeating patterns is removed to a further level of abstraction where the invariant aspects of fabric structure (symmetry, number, order and colour) determine the pattern repeat.

From the large sample of Paracas Necropolis embroideries, it is possible to get a larger picture, one that gives a glimpse of how variations fit together into a system, what the nature and basis of the system was and the method of encodement used to preserve their considerable knowledge of space and order.