SYMMETRY ANALYSIS OF CERAMIC DESIGNS AND IROQUOIAN-ALGONQUIAN INTERACTIONS

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Abstract

Preliminary data from three cases of Iroquoian influence upon adjacent groups are examined. In all three cases, the preferred symmetries in forming decorative bands on pots change in the direction of Iroquoian norms. In the first case, among Western Basin peoples, designs having typical Iroquoian symmetries become admixed with local designs showing other symmetry processes. In the second case, Shenks Ferry people are seen to shift after AD 1300 from symmetry preferences typical of Algonquian groups to Iroquoian symmetries. In the third case, Algonquians in the Connecticut valley show varied efforts to adopt Iroquoian symmetries. Questions of ethnicity are discussed for all three cases, within a culture history framework.

Résumé

Nous examinons les données préliminaires relatives à trois manifestations de l'influence iroquoienne sur des groupes voisins. Dans les trois cas, les symétries privilégiées pour former des bandes décoratives sur les pots évoluent dans le sens des normes iroquoiennes. Dans le premier cas, parmi les peuples de la tradition de Western Basin, des motifs marqués par des symétries typiquement iroquoiennes s'adjoignent aux motifs décoratifs locaux bâtis sur d'autres conceptions de la symétrie. Dans le second cas, le peuple de Shenks Ferry semble passer, après 1300 de notre ère, des symétries caractéristiques des groupes algonquiens à celles des Iroquoiens. Enfin, dans le troisième cas, on voit les Algonquiens de la vallée du Connecticut s'efforcer d'adopter de différentes façons les symétries iroquoiennes. Nous abordons la question de l'appartenance ethnique dans les trois cas, dans le cadre de l'histoire culturelle.

This paper examines the distinctive symmetry preferences of Iroquoian and Algonquian peoples which appear on their decorated ceramics. Such research is a part of cognitive archaeology (Renfrew and Zubrow 1994). My own work in cognitive archaeology is done within the framework of cognitive science and is linked to my other research in culture history (Denny 1991), and in cognitive linguistics and cognitive psychology (Denny 1986). With respect to culture history, symmetry preferences are a part of the associations of archaeological data with native cultures (Washburn 1999). With respect to psychology, symmetry preferences are already viewed as an aspect of cross-cultural differences in cognition (Ascher 1991). For Northeastern North America, the region in which I work, symmetry analyses of ceramic decoration began with Jay Custer's (1987) paper in which he showed different preferences for symmetry types between Algonquians and Iroquoians in the lower Susquehanna region. In the present investigation, I examine Iroquoian influences upon symmetry use by Algonquian potters, in three regions: Lower Susquehanna, Southern New England and north of Lake Erie.

The techniques for symmetry analysis as applied to decorations on ceramic vessels, were first set out in handbooks by Anna Shepard (1948; 1949), to which one must still refer for certain crucial notions. More recently, very detailed instruction is provided by Dorothy Washburn and Donald Crowe's (1988) guidebook. For some designs, one has to use recent theoretical analyses by Grunbaum & Shephard (1987).

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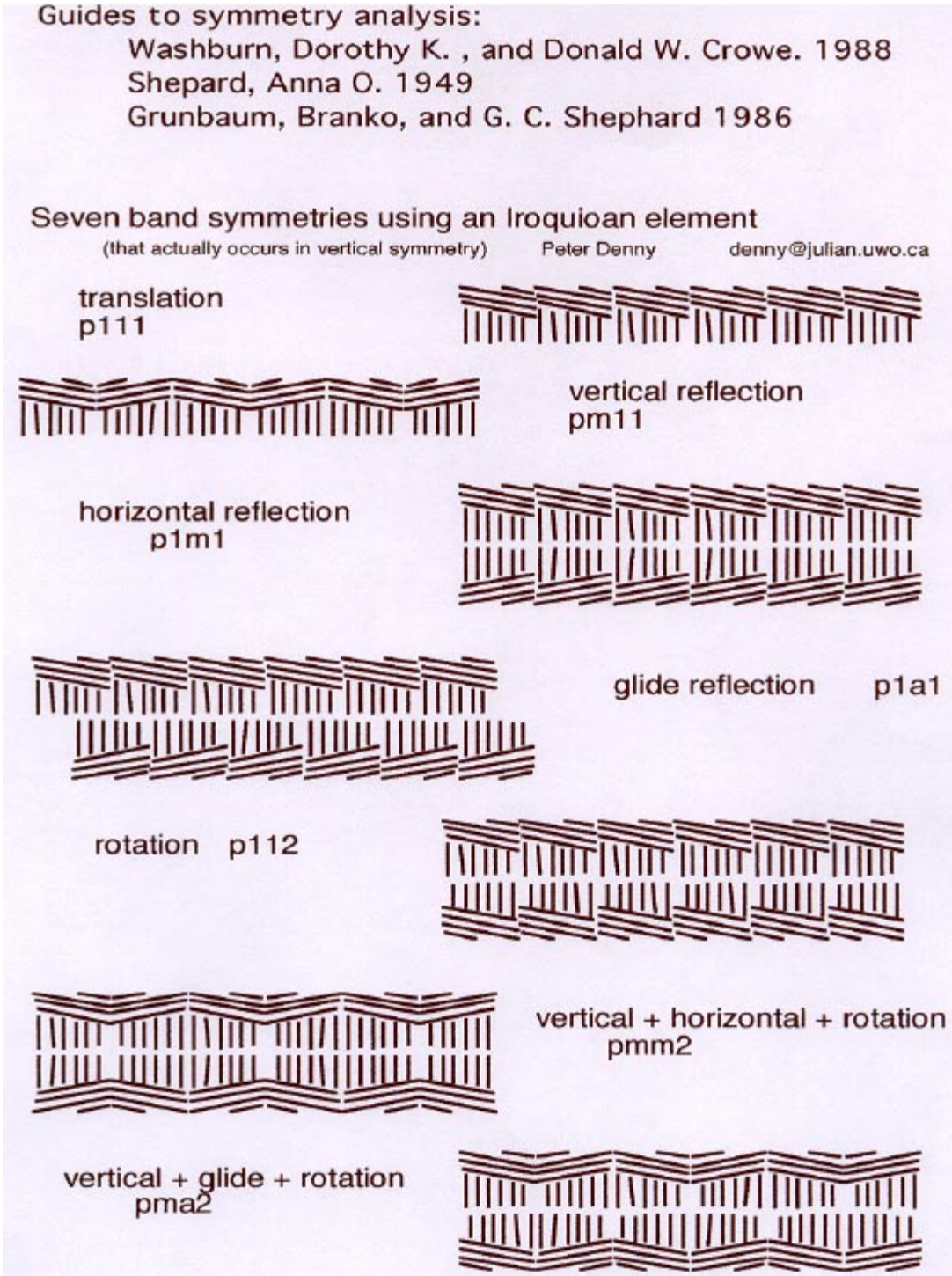


Figure 1. Fundamentals of Symmetry Analysis

We will mostly be concerned with preferences among the seven possible symmetries that can be used to repeat a design element along one axis.

Fig. 1 shows the seven band symmetries applied to a particular Iroquoian design element — the second example is the actual Iroquoian design, using vertical reflection symmetry (pm11)[in round brackets I give the standard abbreviations for the symmetry types]. You can see the element is reproduced by mirror reflection across a mirror axis which is perpendicular to the axis of the band. The other examples are hypothetical ones showing what would have been produced by the other symmetries. For instance, the

copies of the element may be moved along by translation alone (p111); or by horizontal reflection (p1m1), in which a copy is reflected across the axis of the band and another copy moved along it by translation. The other symmetries will be explained as we come to them.

This is a preliminary study in which there is no formal sampling; I assumed that designs illustrated in published papers were in fact characteristic of the cultures they came from. Before looking at transitions between Iroquoian and Algonquian designs, we have to see what Iroquoian and Algonquian symmetry preferences were. For this preliminary study only the most characteristic Iroquoian motifs were looked at, those having plats of parallel straight lines set at differing angles. Fig. 2 shows the most frequent designs of that sort recorded by Pendergast (1973) from the Roebuck site of the St. Lawrence Iroquois; from these we can infer the most popular symmetries. We can see that the high frequency Iroquoian symmetries were: **vertical reflection** (pm11), **glide reflection** (p1a1), **rotation** (p112) and the combination of those three, **vertical reflection + glide reflection + rotation** (pma2**)**. Briefly explaining what we have not seen before, glide reflection makes a copy reflected across the axis of the band which is simultaneously translated along it; and rotation makes a copy that is rotated 180E as it is translated along the band. Hopefully you can discern the three-way combination, vertical reflection + glide reflection + rotation, from these definitions.

Fig. 3 shows Algonquian designs from the Nanticoke people on the northern Delmarva peninsula. These are a selection from Fig. 5 of Griffith (1980), however, the analysis is based on all the designs in that figure. There are 32 bands illustrated there, and in 16 of them the symmetry type is the combination of **vertical reflection + horizontal reflection + rotation** (pmm2). The first design shown in the present Fig. 3 is a straightforward example; you can see that the left half of each rectangle can be reflected vertically to yield the right half, that the upper half of each can be reflected horizontally to yield the bottom half, and that any rectangle can be rotated 180E around a point further along the axis of the band to yield the next rectangle. Grunbaum and Shephard (1987) have shown that some designs built from line segments or from continuous lines are closely related to this symmetry type: the lower band of the second example in our Fig. 3 shows bands of vertical line segments which have **vertical reflection + horizontal reflection + rotation** (pmm2) symmetry; despite the minimal nature of the lines, the left half of one would reflect vertically into the right half, the upper half horizontally into the lower half, and any line would rotate 180E into the next line. Analogous reasoning applies to the smm2 symmetry inferred by Grunbaum and Shephard for continuous lines, such as those shown in the upper band of this design. For any arbitrarily small portion of a straight line, a copy can be made by reflecting it vertically across an axis perpendicular to the band, a copy can be made of its top half by reflecting it horizontally, and it can be rotated to yield the next portion of the line; consequently it also counts as **vertical reflection + horizontal reflection + rotation**.

The other popular symmetries for these Algonquian potters were **rotation** (p112), seen in 9/32 bands in Griffith's F ig. 5, e.g., the lower band in the third example in the present Fig. 3, and **translation** (p111) seen in 4/32 bands, e.g., the upper band in the fifth example (reduced from another favourite symmetry). Although **horizontal reflection** (p1m1) is not seen for these Nanticoke designs, I have informally observed it to be popular in other Algonquian groups.

Overall, we see distinct preferences: Iroquoians prefer: 1) **vertical reflection + glide reflection + rotation** (pma2), 2) **glide reflection** (p1a1), and 3) **vertical reflection** (pm11). Algonquians prefer: 1) **vertical reflection + horizontal reflection + rotation** (pmm2), 2) **translation** (p111), and also, as we will see, 3) **horizontal reflection** (p1m1). In addition, both groups like **rotation** (p112). Let's look now at the transition zones where Algonquians were adopting Iroquoian designs.

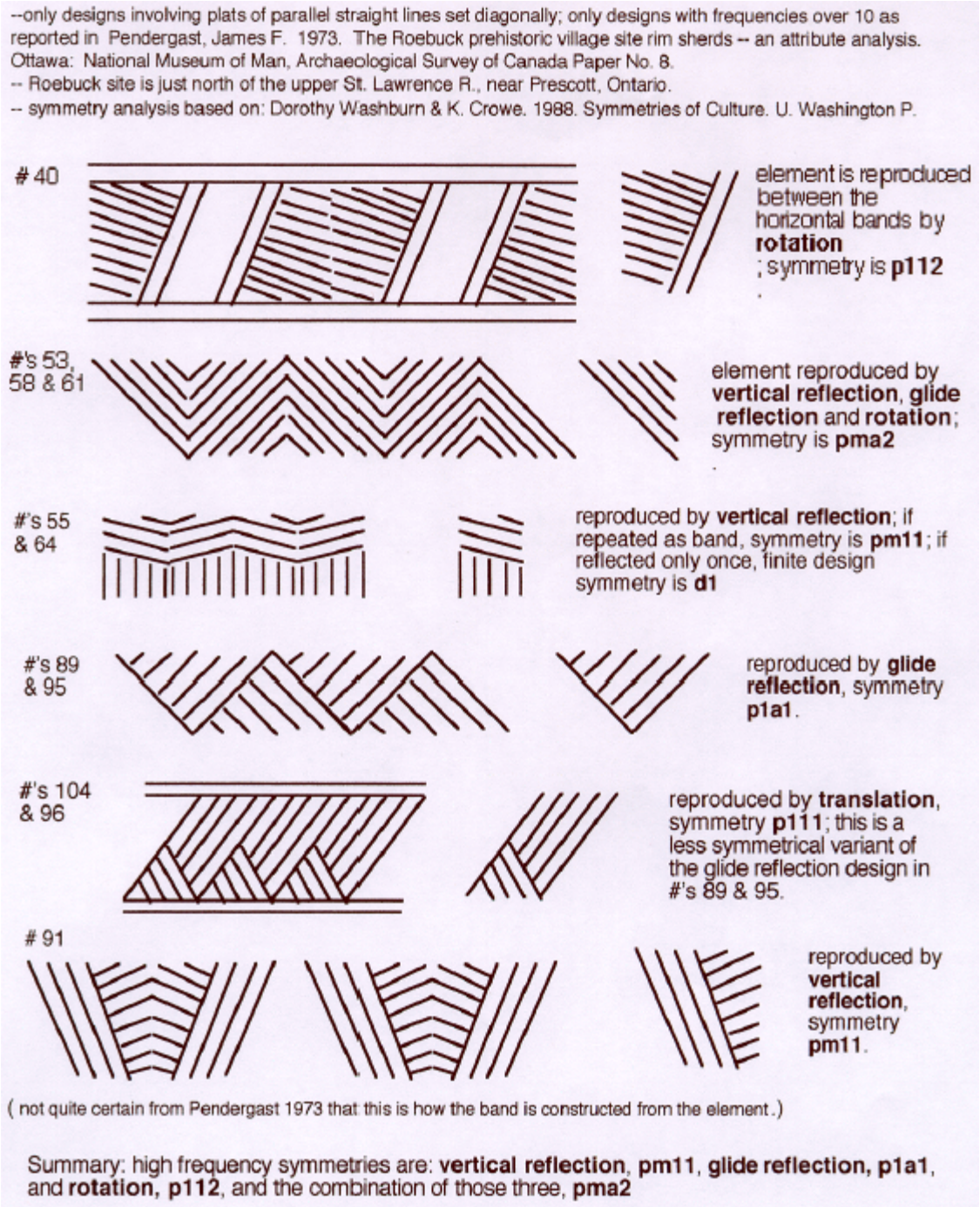


Figure 2. Symmetry analysis of frequent designs on St. Lawrence Iroquois rim sherds

Case 1: Shenks Ferry, AD 1250-1550, lower Susquehanna drainage

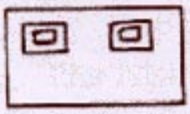
In the first half of Fig. 4, we see the earliest Shenks Ferry types, S. F. Cordmarked and Simple Incised, which emphasize **vertical reflection + horizontal reflection + rotation** (pmm2), **horizontal reflection** (p1m1), and **translation** (p111), choices that are close to the Algonquian pattern. Somewhat later, after they had expanded into the northern part of the Susquehanna drainage (Heisey 1971), possible Iroquoian influences appear in the S.F. Complex Incised type: in example F. we see **glide reflection** symmetry (p1a1), one of the Iroquoian preferences. Otherwise, the earlier emphasis on **rotation** (p112) and on

-- drawings from Daniel Griffith. 1980.
-- from sites on Delmarva Peninsula mostly near southwest entrance to Delaware Bay
-- in Griffith's Fig. 5, 32 bands are illustrated; the frequencies of the band symmetry types were:

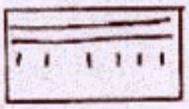
-- **vertical reflection, horizontal refl. & rotation (pmm2, pmm, smm2, smm)**	**16/32 bands**
-- **rotation (p112, p2)**	**9/32**
-- **translation (p111)**	**4/32**
-- **vertical reflection (pm11)**	**2/32**
-- **vertical refl., glide reflection, & rotation (pma2)**	**1/32**
-- **no use of horizontal reflection (p1m1) or glide reflection (p1a1)**	

-- the following are examples from Fig. 5 of the frequent types (bold indicates the symmetry counted):

Rappahannock Incised, c. AD 1050-1300

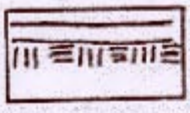


vertical reflection + horizontal reflection + rotation, pmm2

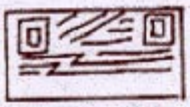


upper band: **vertical reflection + horizontal reflection + rotation**, smm2; continuous symmetry -- Grunbaum & Shephard 1987 p. 257
lower band: **vertical reflection + horizontal reflection + rotation**, pmm2

upper band (2 horizontals): **vertical reflection + horizontal reflection + rotation**, smm2; continuous symmetry -- Grunbaum & Shephard 1987 p. 257
lower band: **rotation**, p112



upper band (2 horizontals): **vertical reflection + horizontal reflection + rotation**, smm2; continuous symmetry -- Grunbaum & Shephard 1987 p. 257
lower band: **vertical reflection + horizontal reflection + rotation**, pmm2



upper band: vertical reflection + horizontal reflection + rotation, pmm2, reduced by plats of parallel lines to **translation**, p111
lower band: **rotation**, p112

upper band: **vertical reflection + horizontal reflection + rotation**, pmm2
lower band: **rotation**, p112

Townsend Corded, c. AD 1250-1600

rotation, p2 (band from 2-dimensional array), if viewer detects diagonal cord markings; if not, vertical and horizontal reflection + rotation, smm (Grunbaum & Shephard, 257)

upper band: **vertical reflection + horizontal reflection + rotation**, pmm2; marks aligned vertically making one band of two lines.
lower band: **rotation**, p112
if two bands seen as one, symmetry is translation, p111.

Figure 3. Townsend ceramics AD 1000-1600 probably Nanticoke (Eastern Algonquian)

horizontal reflection (p1m1) continues, in accordance with Algonquian preferences. Even later, perhaps after AD 1500, and presumably in response to Susquehannock movement south down the Susquehanna, the Shenks Ferry people contracted to the lower Susquehanna (Heisey 1971). As shown by the Lancaster and Funk Incised types in the second half of Fig. 4, their symmetry preferences shifted to those associated with the Iroquoians, **vertical reflection + glide reflection + rotation** (pma2), **vertical reflection** (pm11), and **glide reflection** (p1a1); there seems to have been a rather thoroughgoing assimilation to Iroquoian style, and eventually these people were absorbed by the Susquehannock. Based on his pioneering

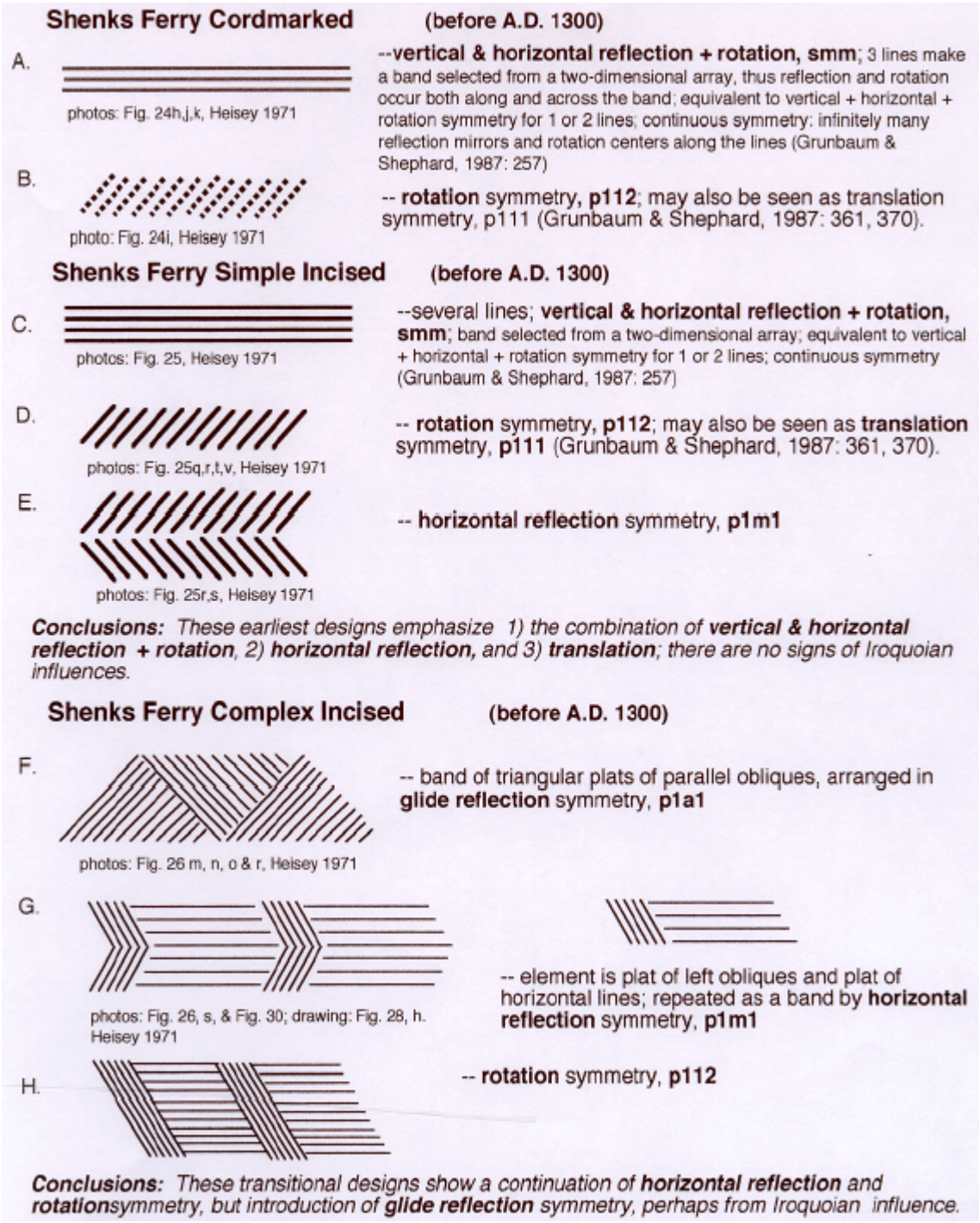


Figure 4. Shenks Ferry designs.

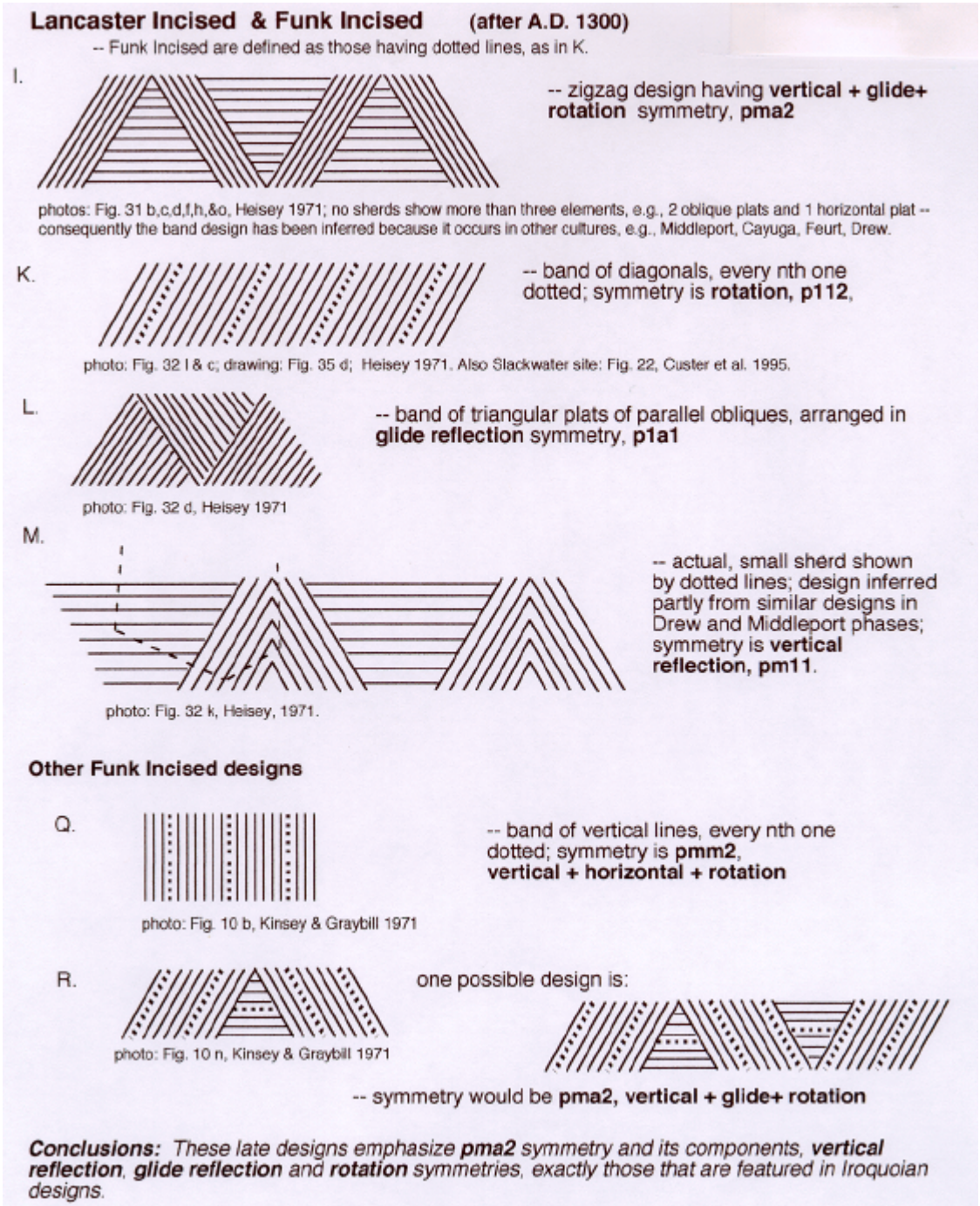


Figure 4 continued. Lancaster Incised and Funk Incised (after A.D. 1300)

study (Custer 1987) of symmetry preferences, Custer (1996:269) thought that the Shenks Ferry people might have been Iroquoian; however, this more detailed analysis suggests they were Algonquians who became strongly affiliated with Iroquoians.

Case 2: Iroquoian influences in the Connecticut valley

Chilton (1998, 1999) has shown technological differences between the ceramics of Southern New England Algonquians and their Mohawk (Iroquoian) neighbours which are associated with the different requirements of their socio-economic lifeways. In order to extend these contrasts to decorative designs, in collaboration with Elizabeth Chilton, I have analyzed the symmetry preferences of one of her Algonquian groups, the occupants of the Guida Farm site in the middle Connecticut valley, who are thought to have been Woronocos. Using the eight sherds illustrated in Chilton (1996) as a preliminary sample, we find four which show typical Algonquian symmetry preferences and four showing typical Iroquoian symmetries. In the first half of Fig. 5 of this paper, we see four examples showing Algonquian-preferred symmetries: 1) **vertical reflection + horizontal reflection + rotation** (pmm2), 2) **rotation** (p112), and 3) **translation** (p111). Note that where added details reduced a design to translation symmetry, as in some bands in the latter three examples, the original design always had one of the other favoured Algonquian symmetries.

In the second half of Fig. 5, we see four examples showing Iroquoian preferences: 1) **vertical reflection + glide reflection + rotation** (pma2), 2) **vertical reflection** (pm11), and 3) **glide reflection** (p1a1).In the third and fourth examples, we see the alteration of these symmetries to produce **asymmetrical** designs, a practice which also characterizes Iroquoian ceramics; although not among the most frequent design types that we used for our baseline of Iroquoian symmetries, an example from the same Roebuck site of the St. Lawrence Iroquoians can be seen in Pl. IV, Figure 21 in Wintemberg's site report(1936). We have seen that the Guida Farm Algonquians mastered Iroquoian decorative design to a considerable degree, yet they seem to have maintained a variety of Algonquian designs as well. This suggests quite intense social contacts, but not absorption into Iroquoian society.

Case 3: Younge phase of Western Basin

Now we turn to earlier times when the classic Northern Iroquoian society was forming. For Younge phase, AD 900-1200, of the Western Basin tradition, located northwest of Lake Erie, Iroquoian influences have been noted, which were thought possibly to come from Glen Meyer phase just to the east. Looking at Younge phase designs in the first half of Fig. 6, which are restricted in this preliminary study to ones made from plats of parallel straight lines, we see designs that use the symmetries popular among Iroquoians: 1) **vertical reflection + glide reflection + rotation** (pma2), 2) **glide reflection** (p1a1), 3) **vertical reflection** (pm11). The last example is an **asymmetrical** design, also like those seen for Iroquoians. However, the second half of Fig. 6 shows that these plats were also handled by Algonquian-preferred symmetries: all four examples show **vertical reflection + horizontal reflection + rotation** (pmm2), which in the third example is reduced by added details in the design to **rotation** (p112), and in the fourth to **horizontal reflection** (p1m1). Apparently the Iroquoian-type designs do not go back to the previous Riviere Au Vase phase (Murphy & Ferris 1990 — designs in their Figs. 7.5 & 7.6 have Algonquian-preferred pmm2, p112 & p111 symmetries). Consequently, it appears that the new element in Younge ceramics is Iroquoian style.

Could Glen Meyer phase just to the east have been a source? A quick look at the Calvert site (Timmins 1997) isn't encouraging because they too seem to show a mix of Iroquoian and Algonquian design prefer-

-- analysis by Peter Denny (denny@julian.uwo.ca), April, 2000
in collaboration with Elizabeth Chilton (Harvard University)
-- sherd drawings by Maureen Manning-Bernatsky and Valerie McQuillian; from Chilton 1996

These four designs show the same symmetry preferences seen in other Algonquian groups:

Vessel Lot 31

-- upper band: **pmm2** symmetry, **vertical reflection + horizontal reflection + rotation**
-- lower band: **smm2** symmetry: **vertical reflection + horizontal reflection + rotation**, continuous analog of pmm2

Vessel Lot 19

-- collar band: right diagonals themselves have **rotation**, **p112**, symmetry, but the scallop shape of the line segments and the horizontal line touching above reduce the symmetry to **translation**, **p111**.
-- upper neck band: band of rectangles has **pmm2** symmetry, **vertical + horizontal + rotation**.
-- middle neck band: four straight lines form a band taken from a two-dimensional array with **smm** symmetry, **vertical and horizontal reflection with rotation**; however, the scalloped segments reduce the symmetry to **pm**, **vertical reflection** along one axis and **translation** along the other.
-- lower neck band: same as collar band -- **rotation** reduced to **translation**, **p111**.

Vessel Lot 76

-- upper band of rectangular punctates has **pmm2** symmetry, **vertical + horizontal + rotation**, and lower band of left diagonals has **p112**, **rotation** symmetry; however since they are touching they form one band and the symmetry is reduced to **translation**, **p111**.

Vessel Lot 86

-- upper band containing two lines of dots and vertical lines of dots hanging beneath; each of these components has **pmm2** symmetry, **vertical + horizontal + rotation**, but joined together the symmetry is reduced to **translation**, **p111**.
-- lower band: four (or more) dotted lines have **smm** symmetry, **vertical and horizontal symmetry with rotation**, while left oblique dotted lines have **rotation** symmetry, **p112**; however, joined together the symmetry is reduced to **translation**, **p111**.

Figure 5. Guida Farm site ca. AD 1200-1600. Middle Connecticut Valley, Eastern Algonquian (probably Woronocos)

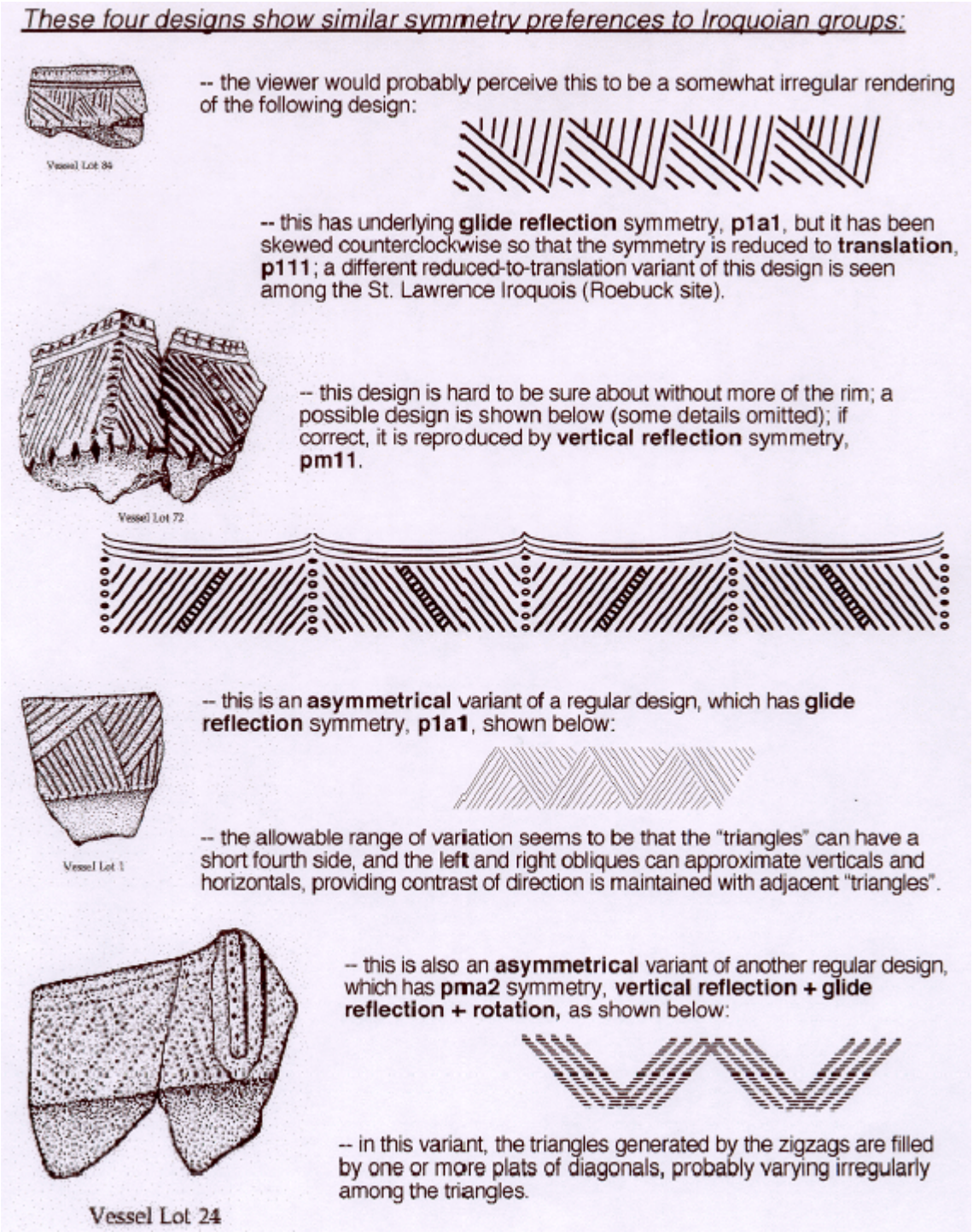


Figure 5 continued.

-- only designs made of plats of parallel straight lines are considered in this preliminary study.

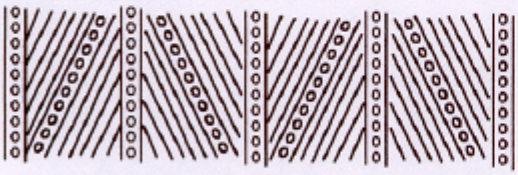
--- the symmetry is **pma2**, a combination of **vertical reflection**, **glide reflection** and **rotation**.

--- incised, neck zone; Krieger site, lower Thames R., n. of L. Erie; date uncertain, maybe AD 800; drawing: Fig. 5, p. 10 in Jarvis (1996)

--- element (at left) combined by **glide reflection** symmetry, **p1a1**, to form band (at right)

-- incised, neck zone; Krieger site, lower Thames R., n. of L. Erie, date uncertain; Fig. 7.11 b, Murphy & Ferris 1990

not shown: horizontal bands above this design



-- **pma2** symmetry: **vertical reflection**, **glide reflection**, and **rotation**

-- incised with circular punctates; Krieger site, lower Thames R., n. of L. Erie; date uncertain (Murphy & Ferris 1990:226), maybe AD 800.; drawing: Fig. 7c, Kidd, 1954.

-- this is an **asymmetrical** design in which the potter only presents to the viewer plats of parallel straight lines at differing oblique angles; good evidence that there is no overall symmetrical layout comes from the two blank areas left at the top edge.

-- incised; Krieger site, lower Thames R., n. of L. Erie; date uncertain (Murphy & Ferris 1990:226), maybe AD 800.; drawing: Fig. 10 m, Kidd, 1954.

Figure 6. Western Basin - Younge phase (AD 900-1200) Symmetry Analysis.

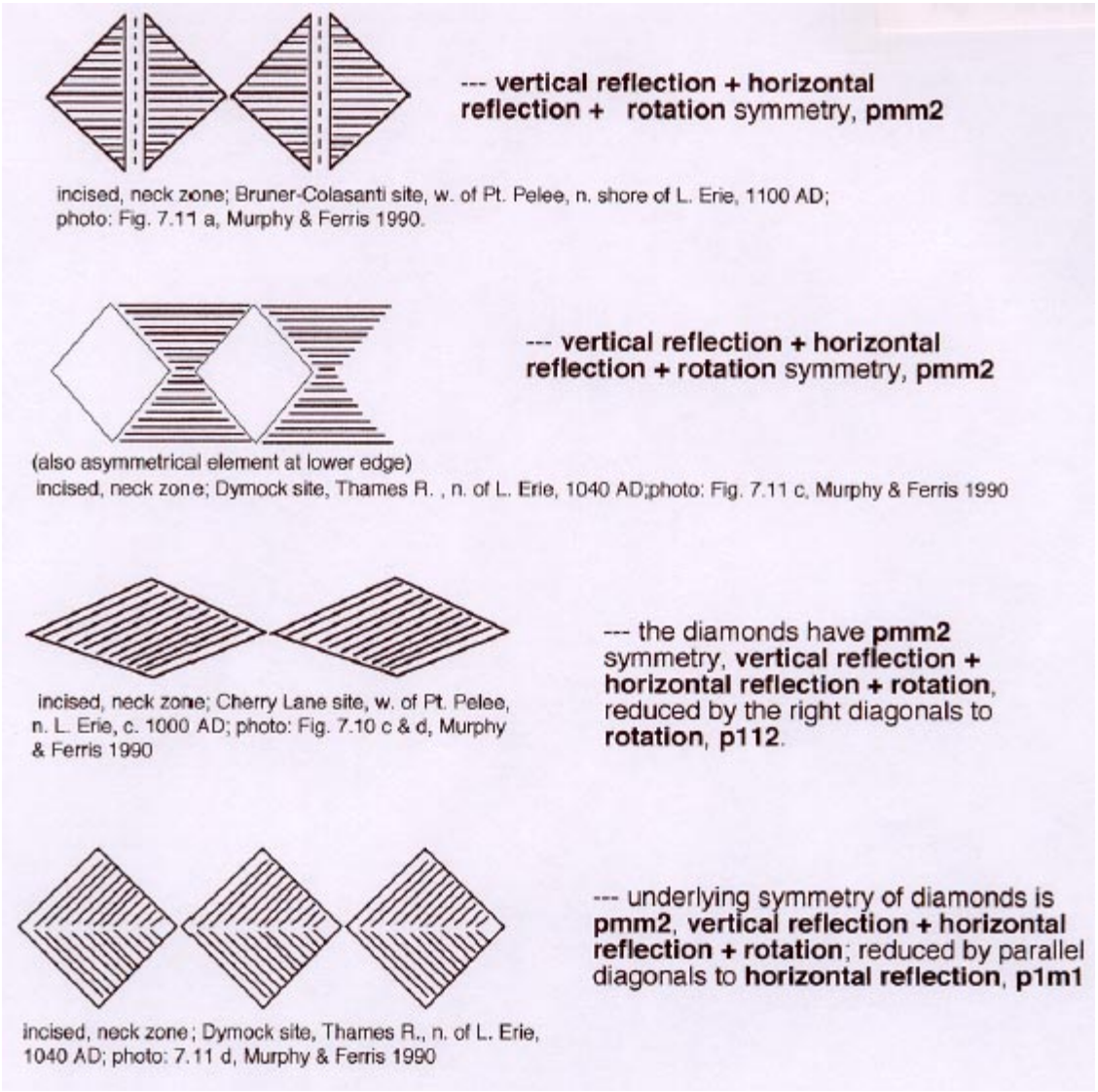


Figure 6 continued.

ences. In the first example of the present Fig. 7, we see repeated **horizontal reflection** (technically, a band cut from the two-dimensional symmetry, pm), and also **rotation** (p112); in the second, **horizontal reflection** (p1m1) and **vertical reflection + horizontal reflection + rotation** (pmm2); and in the third, this latter symmetry (pmm2) and also **rotation** (p112); these are all typically Algonquian. However, in the second and third we also see Iroquoian style plats at oblique angles, but these sherds are too small to determine symmetries. The last example shows the same strategy we saw in Younge phase of using diamond layouts to render Iroquoian-style triangular plats into a preferred Algonquian symmetry, **vertical reflection + horizontal reflection + rotation** (pmm2). All in all it looks like the beginnings of Iroquoian influences on an Algonquian group.

Where might these influences on both Younge and Glen Meyer be coming from?

To the south, in the Middle and Upper Ohio drainage, we find contemporaneous phases that have a more consistent use of Iroquoian-type symmetries. For Feurt phase on the Middle Ohio, in its early period AD 1050-1250, we see in the first half of Fig. 8 the Iroquoian-like preferences for **glide reflection** (p1a1) in the first item, and for the combination of **vertical reflection** + **glide reflection** + **rotation** (pma2) in the latter three. The last is especially interesting because we see that diamonds, which we previously saw

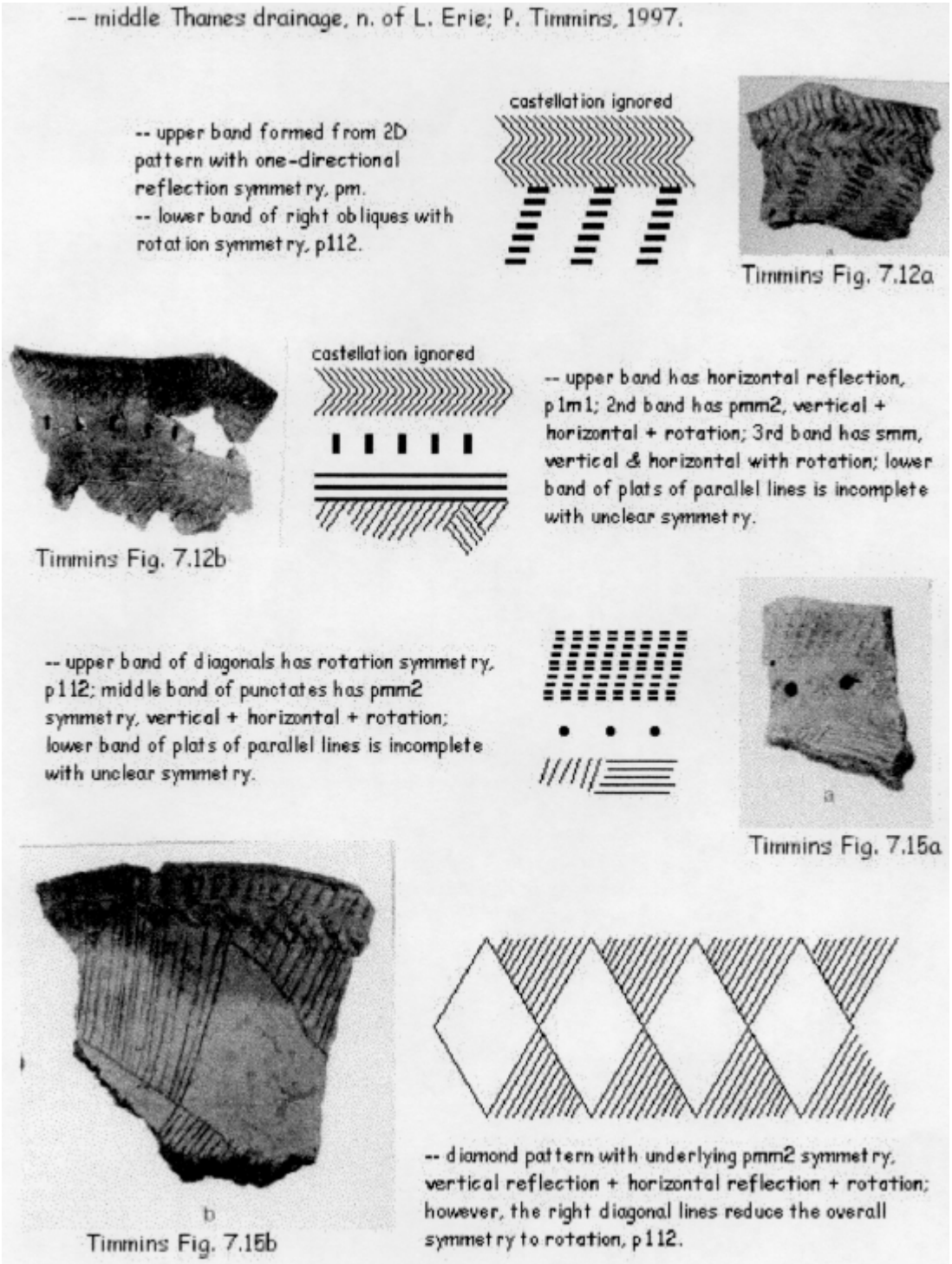


Figure 7. Glen Meyer (AD 900-1250), Calvert site (AD 1200-1300)

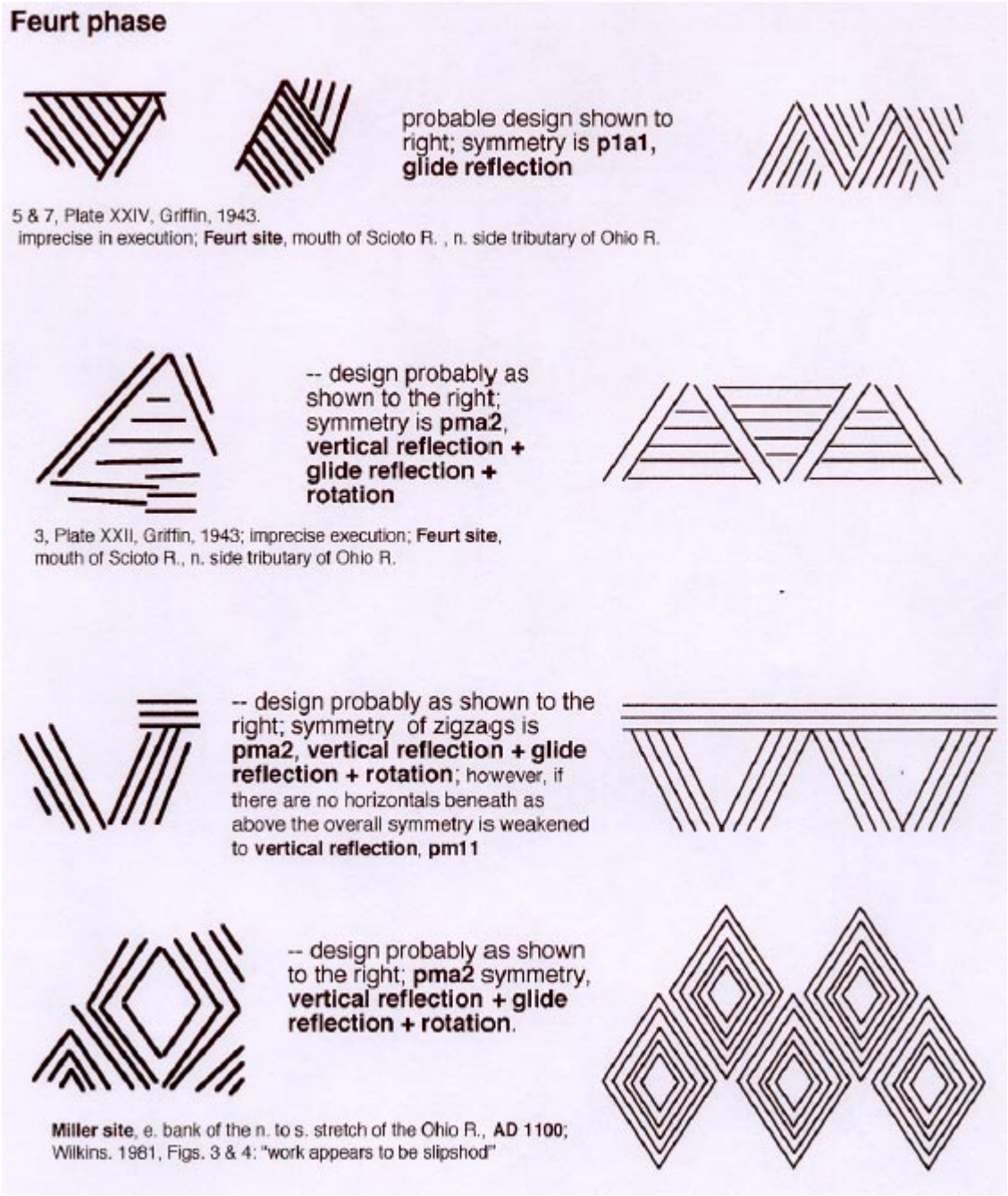


Figure 8. Feurt and Drew phases, Early period, AD 1050-1250. Symmetry analysis.

Drew phase

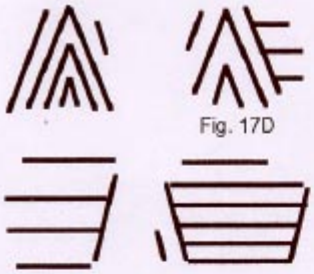


Fig. 17D

Fig. 12

-- these four are interpreted as parts of the same design:

-- symmetry is **pm11**, **vertical reflection**

Wylie site, R. Eisert, 1981

-- symmetry is **vertical reflection, pm11.**

design element

dashed lines show approx. limits of actual sherd

-- unidentified site, Monongahela R.; photo: Pl. 62B, drawing: Fig. 27Q, W. Mayer-Oakes 1955

Assymetrical designs are frequent

-- dashed lines show limits of sherd
-- drawing: Fig. 17 A

-- dashed lines show limits of sherd
-- drawing: Fig. 17 B
-- rows of punctates above and below

"This design (Fig. 17 A), while non-repeating, consists of series of parallel lines differently oriented, with no attempt at ornate geometric figures." -- p. 45, Buker, 1970; **Drew** site.

-- symmetry is **pmm2, vertical reflection + horizontal reflection + rotation**; design element shown to the right

element

Drew site; actual sherd shown in heavier lines; execution is imprecise; drawing: Fig. 27 A, Buker, 1970

Figure 8 continued. Drew phase.

associated with Algonquian symmetries, can be handled in an Iroquoian-preferred symmetry, **vertical + glide + rotation** (pma2). This is despite the fact that the individual diamonds themselves have the other combined symmetry which we have seen fits Algonquian preferences, vertical reflection + horizontal reflection + rotation (technically a diamond has the finite symmetry, d4, which is the analog of the band symmetry, pmm2) — these Feurt people seem single-mindedly Iroquoian.

Drew phase just to the east, AD 1050-1250, shows the same Iroquoian preferences for glide reflection (Fig. 16C, Buker 1970) and for the pma2 combination (Fig. 27P, Mayer-Oakes 1955), but I have chosen to illustrate, in the second half of Fig. 8, the presence of another Iroquoian-preferred symmetry, **vertical reflection** (p1m1), seen in the first two items. **Asymmetrical** designs are also frequent on Drew ceramics, as shown in the two examples in the third item, which we have seen are also an Iroquoian characteristic. In contrast, in the last example, we see diamonds handled in the Algonquian-preferred pmm2 symmetry, **vertical reflection + horizontal reflection + rotation**, which better fits their shape. I think these observations accord with other evidence (reviewed in Denny 1997) that Feurt phase were the founding group of Northern Iroquoians and that Drew phase was a blend of Feurt peoples and previous Watson phase inhabitants. On the first point, Graybill (1984) suggests that Feurt was founded by southern migrants, and on the second, Mayer-Oakes (1955) says that Drew ceramics were originally distinct from Watson wares, but gradually became a mixed tradition, of which I believe this fourth design is an example.

In conclusion, I think we have seen that symmetry analysis contributes a valuable level of precision to the association of artifacts with the Amerindian cultures from which they sprang, thus helping to ensure that the archaeological record becomes a recognized part of the history of native groups.

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