Depression Glass and Nested Symmetry Groups

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Abstract

Depression glass was enormously popular in 1930's-40's U.S. It contains many beautiful examples of centrally symmetric design patterns, reflecting the recent introduction of machine made glassware. Depression glass also demonstrates a phenomenon that occurs in many kinds of design patterns: Nested symmetry groups that emphasize various elements, or relations between elements, within the designs. We show several examples of such glassware, with descriptions of the various types of symmetry groups that apply to these examples.

Introduction

Machines for mass production of glassware did not become common until the late 1920's. Just as such glassware became common, the Great Depression sunk much of the United States into borderline poverty, or worse. The cheap, easy availability of what had been available only to the wealthier members of society made such glassware very popular, and manufacturers used pieces as gift premiums for other purchases. Glass-making machines made it possible to press elaborate patterns into the glass. The artisans and craftsmen making such glassware were clearly experimenting with different types of patterns, and much of that experimentation is revealed in symmetry variations and combinations they put into their designs. We use this glassware as examples to analyze some of these forms of symmetry variation. This gives an impressive variety of the types of features ethno-mathematicians should be looking for in the arts and crafts of different cultures and different times.

A Short History of Depression Glass

The first machine to make glass was produced in 1924, and the second in 1926. Until then, glassware was something only the wealthy could afford, at least as "dinner sets". As of about 1928, machine-manufactured glassware began being produced in large numbers. As the Great Depression hits in 1929, these cheaply manufactured dish sets, using low-grade glass (with bubbles, ripples, and other imperfections) become available very inexpensively. The result is described by Caruso [1]:

> "The real lure of Depression glass—what captivated Americans then and enchants them now—is the stunning array of patterns and kaleidoscopic colors. Glass manufacturers created dozens of patterns, ranging from plain to playful to elegant, and many of those patterns came in a Crayola crayon assortment of colors that continued to fill cupboards right up until the Second World War. … A table set in sparkling colored dishes "brightened up that whole drab period." Even in hard times, the price of Depression glass was right—in fact, it was often free. Buy a 25-pound bag of flour and you'd find a cake plate packed inside. A box of cereal would get you a cobalt blue Shirley Temple milk pitcher. A new dish set came with a new bedroom set."

It is hard at this remove to appreciate the quantity of the premiums being produced, but consider that Quaker Oats once placed an order for 8 railroad cars of glassware to give away as premiums!

Weatherman describes an effect this "luxury" could have on morale at that time:

> "… they glimpsed an old, sweet dream shining in the darkness just ahead of them. For many, many families it became something they could focus on, group around, work towards, in its own small way. For some, simply owning a piece of it was enough; it afforded a bit of brightness they would never forget."

Depression glass became a symbol of this era, even to later generations who may have received them as a wedding present, or who remember eating off these fancy plates when visiting grandma's house.

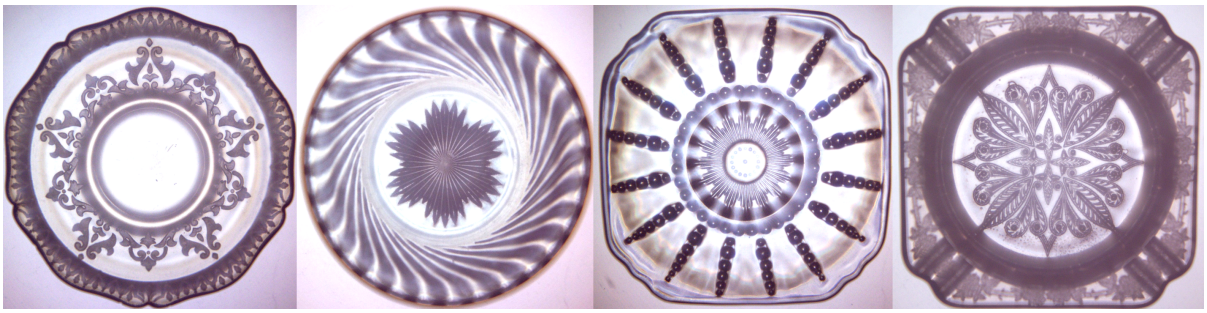

Figure 1: *Examples of Depression Glass patterns: Patrician, US Swirl, Columbia, and Adam.*

Symmetry Groups of Depression Glass

There are 92 different patterns in the group traditionally labeled "Depression Glass". Of these, 73 substantial forms of design symmetry. Ten of the designs have cyclic symmetry, i.e. rotational symmetry without reflections; several of these are spiral designs. The other 63 patterns have dihedral symmetry. The symmetry groups that appear in these patterns include (at least):

C_n, with n = 2, 3, 6, 20, 28, 32, 100

D_n, with n = 2, 3, 4, 5, 6, 8, 10, 12, 14, 16, 18, 20, 24, 28, 30, 32, 36, 44, 48, 56

Such a listing, however, fails to capture the variety of pattern combinations that arise. For example, the US Swirl bowl of Figure 1b has a central element with D_6 symmetry (rotations of 1/6-th + reflections), while the outside annulus has a C_{30} cyclic symmetry group. Thus the symmetry group of the full pattern is C_6, but to appreciate the symmetries among various design elements, we need to "see" all three symmetry groups, i.e. $C_6 = C_{30} \cap D_6$. To ignore the symmetries represented by the two larger groups means deliberately ignoring some of the interesting design choices of the creator.

These designs were often made with a center disk and an outer annulus. In early designs, this center disk was unpatterned, as with the *Patrician* saucer of Figure 1a. But "patterns which had plain centers were found to scratch easily, thus many patterns had more intricate designs, added to the molds later in the production of the pattern." [2]. Although we have not found an adequately detailed description of the mechanics of these machines, it is clear from many examples that the molds used to press the glass consists of, or was made from, several components, as shown in the *Madrid* dinner plate of Figure 2. This has a central circular patch, with 8 sectors alternating between 2 different patterns. We have included this particular example, because of the many pieces of depression glass we have, this is one of only three in which the symmetries of the center patch *do not* align with the symmetries of the sectors in the annulus. This is one of 3 Madrid pieces we have, and the only one of those three where the alignment is incorrect. This rarity emphasizes the fact that the craftsmen making these molds were (generally) aware of these symmetries, and found them important.

Depression glass sets include many individual items of different sizes, including saucers, lunch plates, dinner plates, cake plates, serving platters, etc. With some patterns, all of these items will have a pattern with the same symmetry group. For example, all of the "Adam" pieces (e.g., Figure 1d) have essentially the same elements, with the same D4 symmetry group; although the oval platters stretch this design so that the result formally has D2 symmetry while maintaining the "impression" of the D4 symmetry. On the other hand, the *Cherry Blossom* pattern includes designs with D4, D6, D8, D10, D12, and D14 symmetry, all using the same design elements (see Figure 3b), but with different numbers of these motif elements depending on the size of the glassware item.

Sub-Groups of Symmetry Variants

As with many cultural artifacts, the general impression we get of a design often includes symmetries that do not stand up to a more careful analysis of that design. The first impression of the *Madrid* pattern in Figure 2 is (for most viewers) a design with 8-fold symmetry. Adjacent sectors are clearly very similar, and almost surely designed to communicate that sense, yet a second look shows them to be substantially different. Some artistic constructions contain "errors" that disrupt symmetries, and are usually ignored for analysis. But this type of variation is clearly intentional. If we ignore the center circle, the annulus has a D4 symmetry group, but a D8 "approximate symmetry" group, or "approximation group" for conciseness. The symmetry group is then a sub-group of the D8 approximation group. To appreciate the complexity that the artist has put into this design, we need to notice both kinds of "symmetry" groups. Other depression glass patterns have similar constructions, although deciding which elements were intended to be "approximate" to others is fundamentally subjective. Another "approximation group" occurs when a motif within a pattern has an *apparent* symmetry (usually bilateral) that is not a true symmetry. The motif in the annulus of the *Sharon* design (Figure 3) is an example of this. So the *apparent* symmetry group of this pattern is D6, while the *actual* symmetry group is D3 (the motifs alternate in right- and left-handed versions). A similar thing happens with the *Cherry Blossom* pattern, but that pattern gives such a strong impression of mirror symmetry that we have included it with our counts of the dihedrally symmetric patterns.

Much of the complexity of the patterns in Depression glass comes from the interactions of the symmetries of elements in concentric rings around the center. In the *Cameo* plate of Figure 4a, most of the design has a D6 symmetry pattern. But the center design element has 12 spokes, which line up precisely with both of the two types of motifs in the outer annulus. The *Old Florentine* plate of Figure 4b has a central design with a D3 symmetry group, for both the inside 3 clover flowers and the next set of 6 flowers. Meanwhile, the outer annulus of *Old Florentine*, the plate shape itself, and a motif inside the center of those clover flowers all have D6 symmetry. In all cases, the symmetries of one set of motifs and those of the other all line up, and one group will be a sub-group of the other one.

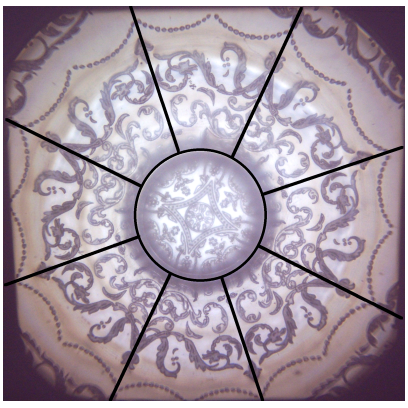

Figure 2: A *Madrid* dinner plate.

Figure 3: Sharon plate; Sharon & Cherry Blossom motifs.

Figure 4: Symmetry groups and sub-groups: *Cameo, Old Florentine, and Princess*

The *Princess* plate of Figure 4c has a center design with 24 elements, D12 symmetry, and D24 approximation (tulips alternate with leaves). The middle annulus here has D4 symmetry and a D8 approximation group. One might object that the annulus motifs are different enough that they are not "approximations" of each other. But isolating the center as in Figure 5 shows that the resulting motifs are *identical*, but have been alternately flipped from the inside out as you move around the circle! (Similar to a glide reflection.) This is an example of a "hidden symmetry," not obvious, but surely intentional. The resulting 4 "symmetry" groups are *not* all sub-groups of each other: the D8 annulus approximation group is *not* a sub-group of the D12 symmetry group of the center, and the full structure of these 4 interacting groups is complex.

Figure 5: Detail of *Princess* center

Conclusions

Depression glass gives us many beautiful examples of symmetric patterns, and a class of examples with an interesting story behind it. Even better, they give us examples of many ways that artists and craftsmen do interesting things in constructing symmetric designs—patterns which deserve a "close reading" to see interactions between symmetries and approximate symmetries of the overall design and symmetries and approximations of the individual components. For more examples, and more detailed photographs, see our web page at: cs.beloit.edu/chavey/Depression.

References

[1] Iyna Bort Caruso, "Collecting Depression Glass", *Country Living*.

[2] Christine Nagy, "A Depression Glass Primer", *National Depression Glass Association*, <http://www.ndga.net/articles/nagydgprimer.php>.

[3] Rosemary Trietsch, "Introduction to Depression Glass", *Just Old Glass*, <http://www.justoldglass.org/articles/>

[4] Hazel Marie Weatherman, *Colored Glassware of the Depression Era, Book 2*, 1974.