

## WINDOW GLASS AND THE GOWER HOUSE (15Lv178): AN APPLICATION OF DONALD BALL'S DATING FORMULA

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The Gower House (15Lv178) is a historic tavern and hotel located in Smithland, Livingston County, Kentucky at the confluence of the Cumberland and Ohio Rivers. A town with a rich historical background, Smithland's economy was built upon steamboat travel and trade in the nineteenth century. The Gower House was occupied from the early nineteenth-century until the 1960s and it now stands empty and awaiting renovation. In an attempt to salvage the archaeological record before renovations destroy the deposits surrounding Gower House, Dr. Kenneth C. Carstens and his students at Murray State University have undertaken extensive research at the site. Thus far, the research team has conducted a surface survey of the inlot area, begun salvage excavation of a detached kitchen area, and located the foundation of a razed structure which had mirrored the standing portion of Gower House. The survey and excavation of the detached kitchen area revealed historical artifacts reflective of a tavern and hotel. Ceramics, bone, and glass make up the majority of the assemblage indicating food service and preparation. Window glass makes up a great deal of this assemblage.

Excavation of the Gower House detached kitchen area has characteristics which should be noted. First, the units thus far excavated have been excavated by a number of people. Unit I was excavated by natural stratigraphic levels. The remaining four units of the detached kitchen area were excavated at 10 cm intervals. These excavations were conducted by supervised volunteers from local high schools and Introduction to Archaeology classes at Murray State. A recent flood in Smithland collapsed the original test pit walls, making accurate profiles elusive. It also should be noted that excavation. Unit 4 has been excavated only to four levels because it is almost entirely filled by the stone foundation of the kitchen. It is believed, however, that window glass analysis at this point is valid because original window glass should be deposited at a time of demolition or repair, not at construction and thus the original glass already should have been excavated.

While these problems serve to complicate the matter of artifact analysis, they also increase the need for it. Studying window glass is well worth the effort if it can reveal anything about the stratigraphy of the detached kitchen

area. It also may allow for a better estimate of a date for the levels still being excavated.

### **Objectives**

For archaeologists, the value of window glass is related primarily to its potential to provide dates for a site. This makes window glass particularly valuable at Gower House because the earliest records of Gower House, including documentation of its construction were destroyed in a fire in 1831 (Berryman 1997). While many dates have been proposed for the construction of Gower House, none have proven definitive. Thus, the objective of this study is to determine construction date, and to explore other characteristics of window glass that may provide additional information about the Gower House.

### **Obstacles**

There are obstacles facing the window glass analyst that must be outlined at the start because they are what determine research methods and analysis. Flat glass has two very frustrating variations: thickness and color. What makes these elements frustrating is not that one cannot make scientific assessments about thickness and color, one certainly can. The problem is that the implications of variation in color and thickness, while they are certainly valuable are also difficult to sort out.

For example, the problem of color is that there are an infinite number of tints that glass can exhibit. How, in such a situation, can one create categories in which each artifact can fit? More often than not, the line between green tinted glass is as blurry as any distinction can be. Some pieces of glass are definitely tinted green and others are certainly blue. It is all of the hundreds of pieces that are some combination of the two that make classification so difficult.

The source of the dilemma lies in manufacturing. The one unifying characteristic of all types of window glass manufacture is that glass is made in batches. Each batch contains the needed raw materials and chemicals, but until the twentieth-century, there was no way to be certain that each batch contained the same amount of each ingredient. As a result, every batch resulted in glass with unique characteristics. Thus, an archaeological assemblage of window glass is not the type of thing that definitively can be divided into a few distinct color categories.

Thickness is much the same. During most of the nineteenth-century, window glass was made by hand. This created inevitable variation in thickness

not only between batches, but also within each pane of glass. Nevertheless, thickness and color do have chronological implications in window glass assemblages, and given that window glass is one of the most common artifacts on historic sites, it is well worth the effort it takes to make sense of it.

### **Window Glass Manufacture**

In order to create any kind of typological scheme for window glass, one must first understand how it was made. This summary will focus on the period of the Gower House, the nineteenth and twentieth centuries.

#### **Crown Glass**

In 1800, the predominant type of window glass in the United States was crown glass. Crown glass is made by the creation of a globe of glass at the end of a blow pipe which was then opened at one end and spun until it formed a great disk attached to the blow pipe at its center (Frank 1982:25; Rogers and Beard 1938; Wilson 1976). This method dominated glass manufacture until about 1840 when it was replaced by the more economical cylinder glass, which will be discussed later (Ison 1990). Crown glass is extremely thin, said to range in thickness from 0.92 mm (0.036 in) to 1.14 mm (.045 in) (Ison 1990). However, there is a great deal of variation in crown glass thickness. According to Wilson (1976) an ad for crown glass made in Boston in the late 1700s describes it as "good and brilliant glass that was quite thick and strong," indicating that thickness was a favorable trait. Frank (1982), however, says that thinner glass was more desirable because it let more light flow through the rather dark colored glass of the day. Thus, it is unclear whether the higher quality glass was thick or thin but it is certain that there was variation. In addition, each disk made contains its own variation between thickness at the center versus thickness at the perimeter. The only way to determine the degree of this variation would be to study a sizable assemblage of whole disks.

#### **Cylinder Glass**

Cylinder glass is made by again creating a bubble of glass at the end of a blowpipe. Then swinging it to lengthen it into a cylinder, which is then cut and heated to lay flat (Rogers and Beard 1938:141; Wilson 1976). Cylinder glass is thicker than crown glass by about 40 percent (Ison 1990). This is probably because the stress put on it by swinging would not allow it to be extremely thin without breaking. This glass type should have an average thick-

ness of 1.28 mm (0.050 in) to 1.42 mm (0.056 in) and the thickness did increase through time as thicker glass became more desirable (Ison 1990).

### **Plate Glass**

Plate glass did not become dominant until its production was mechanized in the 1930s when large factories could roll it out and polish it in mass quantities (Ison 1990; Rogers and Beard 1938). Variation of plate glass is not nearly as significant as in cylinder and crown glass because mechanization stabilized both thickness and color. Plate glass still dominates the window glass industry today.

### **Composition**

The chemical composition of glass has changed throughout the past two hundred years primarily in an effort to attain a perfectly clear color. Unfortunately for the archaeologist, color changes resulting from new chemistry innovations do not necessarily coincide with changes in manufacturing techniques and no universal rules exist connecting particular times to particular colors. Sufficed to say that as time passed, manufactures were able to come up with chemicals, which made glass clearer, and so a general trend from darker to clearer glass exists (Ison 1990). This certainly should not be applied in such a way as to place two pieces of glass side by side and declare the darker one older, but when whole assemblages of widow glass show a trend in color change from one archaeological level to another a pattern exists which does have chronological implications.

### **Discussion**

Because the nineteenth century is dominated by two very different types of window glass manufacture the application of a single linear formula to the whole century would be to disregard the 40% increase in thickness of cylinder glass over crown glass. Both types of glass did increase in thickness over their own periods of production, but they still need to be separated when dating formulas are calculated.

### **Donald Ball's Dating Formula**

In 1983, Donald Ball developed a linear formula for dating window glass based on the theory that thickness increased throughout the nineteenth-century. (Ball's formula states that:

$$D = \frac{M - 1.00\text{mm}}{0.0286} + 1800$$

Where D is the date and M is the mean thickness in millimeters of the glass assemblage. This formula was originally designed to apply to sites from 1800 to at least 1870 (Ball 1983). Ball (personal communication 1997) has revised that statement, however, and now says that the formula is close to the actual date until 1840 and becomes inapplicable after 1845. This makes sense given that 1840 is the date given for the beginning of cylinder glass domination (Ison 1990). Thus, the Ball formula applies to a specific type of glass within a specific date range. For those sites, which were built between 1800 and 1840, Ball's (1983) formula has proven to be very close. An example is a study done by Carskadden and Morton (1988) on the glass from a Muskingum Valley site of known occupation from about 1816 to 1820. This study produced a date about a year earlier than the documented date of construction (Carskadden and Morton 1988).

What implications does this have for Gower House? Ball's (1983) formula, because it is accurate for only the first half of the nineteenth-century, is only applicable to the first quarter of Gower House's occupation. But it is that early quarter of deposition that this study is attempting to date.

### Color Analysis

Some analysts have divided glass into three-color categories; clear, blue, and green (Ball 1983; Ball and Baer, 1997; Carskadden and Morton 1988). These categories however, encompass an extremely variable assemblage of artifacts when applied to Gower House. As previously mentioned, the distinction between blue and green glass can be very subjective. Thus rather than dividing the glass assemblages into color categories, each sample of glass from each unit level was examined as a whole for overall color characteristics. Generalizations were then made and added to the notes describing the whole sample in terms of dark, medium, or light tints. These assessments were made based upon the tint as it appeared relative to the whole glass assemblage.

While this method is very general, the application of a few color categories in an assemblage with so much variability could be misleading. Many different tints of glass were often produced simultaneously. The chronological overlap of color tints makes a particularist approach illogical. Thus because the trend from dark to clear glass is a very general one, occurring over a very long period. The Gower House glass was examined for general trends that might correlate the color of glass with stratigraphy through time.

The result of this analysis is what would be expected: the deeper the level, the darker, and thus color the glass (Table 1).

### **Thickness**

The thickness of each window glass fragment was measured to the nearest hundredth of a millimeter with an electronic micrometer. Some analysts have measured each piece of glass three times, and averaged those measurements to account for thickness variation within each piece (Roenke 1978). Each fragment in the Gower House sample, however, was measured only once at the center of the piece according to the advice of Grosscup (1979) who felt that "one measurement on each sherd would be sufficient as long as the sample is fairly large and we are dealing with modal distributions." These measurements were entered into a spreadsheet to facilitate the calculation of a mean thickness measurement. This measurement was then plugged into Ball's (1983) formula to determine a date for the sample from each unit level.

Although panes of glass are replaced as they break, and it is very possible that the original glass of Gower House's windows could be found in all levels, it is expected that as depth increases, the mean date of the glass should decrease. The resulting dates do not conform to the rule that as the level deepens, the date becomes older, however (Tables 2-6). Instead, the dates show a *general* trend towards older glass being below newer glass (Figure 1). This is especially true of Units 1-3, which are side by side and have been excavated to the same level (Figure 2).

### **Results**

The latest date given for a sample of glass at the site is 1833, which came from Unit 3 Level 8. For a site, which was inhabited up until the 1960s, clearly these dates are very low. This is probably because the adjustment has not yet been made to account for Ball's (1983) formula becoming inaccurate after 1845. A typology will need to be created to separate the pre- 1845 glass from the post-1845 years.

### **Typology**

Crown glass is more transparent than cylinder glass. It has a better finish because it is never laid out on any surface, and concentric circles can sometimes be seen on it (Ison 1990). The wear that a piece of glass obtains while in use and while deposited in the ground, however, can alter it enough to make it look like every other piece of scratched up flat glass. Additionally,

overlap between thin cylinder glass and thick crown glass prevents the use of a thickness measurement to accurately sort the two types. The best one can do is determine a minimum number of pieces of crown glass.

According to historical literature, cylinder glass was not made as thin as crown glass, which averaged from 0.91 mm (0.036 in) to 1.14 mm (0.045 in) (Ison 1990). Thus for purposes of separation, all pieces of glass below 1.14 mm were counted and classified a crown glass. It is not sound to apply Ball's (1983) formula to those pieces of glass determined to be crown glass by this study because 1.14 mm is an experimental cut off, not a determination of theology. It is a given that some of the glass from the sample in what will be labeled "other" should be included in the application of the formula and not to include them would be to create inaccurately low dates.

One can also count a minimum number of pieces of modern plate glass. Around 1860 a standard thickness for glass was developed through mechanization which began with a thickness of about 1.70 mm (0.070 in) (Ison 1990). In order to account for some overlap and to make sorting easier, a cut off of 2.00 mm was used to separate the newer standardized glass from other types. All pieces of glass falling between 1.14 mm and 2.00 mm were designated as "other" because this group should contain thick crown glass, cylinder glass and this plate glass. Counts were made and percentages were figures for each unit level (Tables 7-11). This study revealed that all of the units excavated to 80 cm or more exhibited a dominance of crown glass or a major rise in crown glass towards the bottom of the excavation units (Figures 3-7).

The lower levels at Gower House exhibit a dominance of glass used before 1845, which means that Ball's (1983) formula can be applied to these unit levels. This legitimizes the dates already calculated for the lower levels of each test unit.

Unfortunately for the Gower House, it is precisely these levels that have the smallest sample size of glass, so the results lose some power, but the combination of these dates provides a decent approximation of a date for construction of the Gower House detached kitchen which will be discussed in the conclusion.

### **Unit 1**

It is beneficial to take a closer look at Unit 1 because it was excavated by natural levels and did show some unique characteristics (Figure 8). Of particular interest is Stratum 4 with the largest sample size of any level by nearly 100 artifacts at n=263. These pieces of glass are also strikingly similar in tint and thickness indicating that the sample is a result of some type of demolition where many of the same window types were deposited at once. Stratum 4 is

described as ash fill with charcoals (Stottman 1996). Stottman (1996) notes that, "A higher frequency of window glass would be expected with demolition type activities or repair activities," and that Stratum 4, "may actually represent clean-up and repair activities to the structure." The date calculated for this unit level is 1809. It is believed that this sample is representative of the deposition of the original detached kitchen windows and that 1809 is a strong candidate of construction.

The other units were examined to look for a correlation of this hypothesis. A check of the levels which would have included this elevation in Units 2-5, however, illustrates that the window glass sample is not nearly as large, and Unit 1 appears to be a concentration.

### **Discussion and Conclusions**

It is very difficult to make scientific assessments of window glass on sites with a long period of occupation. The ideal time to analyze window glass is when one is studying a site of limited occupation which happens to fall somewhere in the time range and region of a dating formula such as Ball's (1983). Occupations over a long period of time which extend into the nineteenth and twentieth centuries require much more understanding in order for the window glass to be accurately assessed, and in this case the study becomes less scientific and more intuitive.

The application of Ball's (1983) window glass dating formula to the Gower House assemblage is only partially valid because the Gower House was inhabited long after the temporal usefulness of the formula. Any glass, which may have replaced windows in the Gower House after 1845, can not accurately be dated with Ball's (1983) formula. This was examined for patterns in stratigraphy. Because the lower levels of the test units illustrate a rise in crown glass and a decline of other types of glass, it is believed that the resultant dates of Ball's (1983) formula from these levels is significant. The dates of level seven and eight from each unit were averaged, resulting in an 1812 DATE (Table 12). The mode date of all unit levels is 1811, and as previously mentioned, the significant Unit 1 Stratum 4 resulted in a date of 1809. Thus the result of this analysis is a date for the construction of the Gower House detached kitchen of approximately 1809-1812, a very feasible date given all that has already been learned about this site.

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