Korbi: Thanks for all of your help and letting me use some of your ideas.
Rod

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Glass Trade Beads: A Progress Report

ABSTRACT

The use of glass trade beads as a good chronological marker has been hampered by a lack of precise terminology and uniform description. There has also been a profound lack of appreciation of what is in reality a large series of complex manufacturing techniques that vary with time and geography. The several manufacturing techniques can be grouped into drawn, wound, mold-pressed, fired, blown, and a few minor techniques. Suggestions are made for describing the physical appearance of beads. Suggested levels of analysis include laboratory analysis, historical analysis, and cultural analysis.

Introduction

It has become customary in historical archaeological reports for the section on glass trade beads to contain a perfunctory statement on bead manufacturing techniques. These statements are invariably condensations from one of several available secondary sources. Since each secondary source is usually based on one primary source, the secondary sources as well as the tertiary statements are usually descriptions of one specific time period in one specific country, and more often than not, they have little or no relationship to the beads being described. Too often, the bead descriptions do not follow any established format and include new and confusing terminology. The data presented in one report will not be comparable to another, thus making any comparative analysis virtually impossible. It is in response to these and other problems that this work is addressed.

What follows is not another typology or classification but rather a statement of the current status of bead description and analysis. For classification studies see the works of Beck (1928); Stone (1970:288–294, 1974:88–89); Kidd and Kidd (1970); Bass et al. (1971); Lugay (1974); Smith and Good (1982); and Meighan (n.d.). Any use of Kidd and Kidd (1970) must also include Karklins (1982); however, Smith (1983:4) has expressed additional concerns.

Bead Manufacturing

Before glass trade beads can be truly appreciated, it is necessary to understand the various techniques of manufacture. Virtually all analytical classifications found in the trade bead literature utilize manufacturing techniques as the first level of analysis. Meighan (n.d.: 37) using size, shape, and color; and DiPeso et al. (1974: 228) using shape are the major modern exceptions. The terms applied to the basic technology unfortunately have not been standardized, and very different terms are used by equally knowledgeable researchers. The major advantage of the several basic terms suggested here over many of the others is that they refer to the process of manufacturing not to a geometric description of the bead after it is manufactured (Karklins, pers. comm.). For example, what is called a drawn bead here is often called a tubular or cane bead. Tubular and cane imply the shape, but not all tubular beads are necessarily made by the drawn process. This work is based on a three page summary formulated over 15 years ago (Sprague 1966) and has been distributed among students and bead researchers ever since.

As the bead making industry has progressed, it has advanced through several broad evolutionary stages. Specific techniques such as ''baked'' beads and some geographical areas such as the Middle East have been more conservative than others. While not using these specific terms, Francis (1983b:193–194) suggested a three stage bead making development of cottage industry, large-scale industry, and mechanization.

Drawn Beads

The most commonly occurring bead in most archaeological sites is the drawn bead (Figure

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1a–1e) also known as tubular drawn, cane, hollow-cane (Harris and Harris 1967:135), tube (Kidd and Kidd 1970:50), and cut (Storm 1976:106). The major process involved in making drawn beads has been described many times; however, three publications in English have priority as the best compilation *from* the primary sources: Murray (1964), van der Sleen (1967), and Kidd and Kidd (1970). One of the best primary sources in the English language is a work edited by Dionysius Lardner, the earliest edition of which is 1832. It bears a striking similarity to an even earlier work (Anonymous 1825). Lardner's (1832) description of drawn bead manufacturing on the island of Murano in the Bay of Venice reads:

> When upon inspection the coloured glass is found to be in a fit state for working, the necessary quantity is gathered in the usual manner upon the rod, and is blown into a hollow form. A second workman then provides himself with an appropriate instrument, with which he takes hold of the glass at the end which is farthest from the extremity of the rod, and the two men running thereupon expeditiously in exactly opposite directions, the glass is drawn out into a pipe or tube, in the manner of those used for constructing thermometers, the thickness of which depends upon the distance by which the men separate themselves. Whatever this thickness may be, the perforation of the tube is preserved, and bears the same proportion relatively to the substance of the glass as was originally given to it by the blower.
>
> Tubes striped with different colors are made by gathering from two or more pots lumps of different coloured glass, which are united by twisting them together before they are drawn out to the requisite length.
>
> As soon as they are sufficiently cool for the purpose, the tubes are divided into equal lengths, sorted according to their colours and sizes, packed in chests, and then dispatched to the city of Venice, within which the actual manufacture of the beads is conducted.
>
> When they arrive at the bead manufactory, the tubes are again very carefully inspected, and sorted according to their different diameters, preparatory to their being cut into pieces sufficiently small for making beads.
>
> For performing this latter operation, a sharp iron instrument is provided, shaped like a chissel, and securely fixed in a block of wood. Placing the glass tube upon the edge of this tool at the part to be separated; the workman then, with another sharp instrument in his hand, cuts, or chips, the pipe into pieces of the requisite size; the skill of the man being shown by the uniformity of size preserved between the different fragments.
>
> The minute pieces thus obtained are in the next process thrown into a bowl containing a mixture of sand and wood ashes, in which they are continually stirred about until the perforation in the pieces are all filled by the sand and ashes. This provision is indispensable, in order to prevent the sides from falling together when softened by heat in the next operation.
>
> A metallic vessel with a long handle is then provided, wherein the pieces of glass are placed, together with a further quantity of wood-ashes and sand; and the whole being subjected to heat over a charcoal fire, are continually stirred with a hatchet-shaped spatula. By this simple means the beads acquire their globular form.
>
> When this has been imparted, and the beads are again cool, they are agitated in sieves, in order to separate the sand and ashes; this done, they are transferred to other sieves of different degrees of fineness, in order to divide the beads according to their various sizes. Those of each size are then, after being strung by children upon separate threads, made up into bundles, and packed in casks for exportation.

A work published slightly later (Anonymous 1835:78–80) describes the hollow sphere as two cones made by two workers and put together. The softening of the broken edges (heat finishing) is done by tumbling in "a sheet iron cylinder about eighteen inches in length and a foot in width, with an iron handle to it . . . thrust into the furnace and subject to a rotatory motion." This source also states that the beads were polished by rubbing them with cloth. Knight (1874:254) has an excellent drawing of a rotary heat finishing furnace. Gasparetto (1958:198) lists 1817 as the date for the introduction of the tumbling type of finishing. Tayenthal (1900:21) gives "the end of the 80's" (1880s) as the date for the introduction of the Italian drawn bead techniques into Jablonec (Gablonz).

A later work (Pellatt 1849) not only gives a description for drawn bead manufacture similar to Lardner (1832) but also presents excellent illustrations, which have been reproduced frequently in secondary sources, to show the drawing process as well as the process for making striped beads. This procedure, known as casing or flashing (Kidd 1979:57), is lucidly described in a still later work (Lock 1879:1073–1074) but using the same illustration:

> A mass of molten glass attached to the blow–pipe is pressed into a circular open mold, around and inside of which, short lengths of coloured cane have been arranged. The mass is withdrawn with the canes adhering to its surface, and after being rolled upon the marver to effect

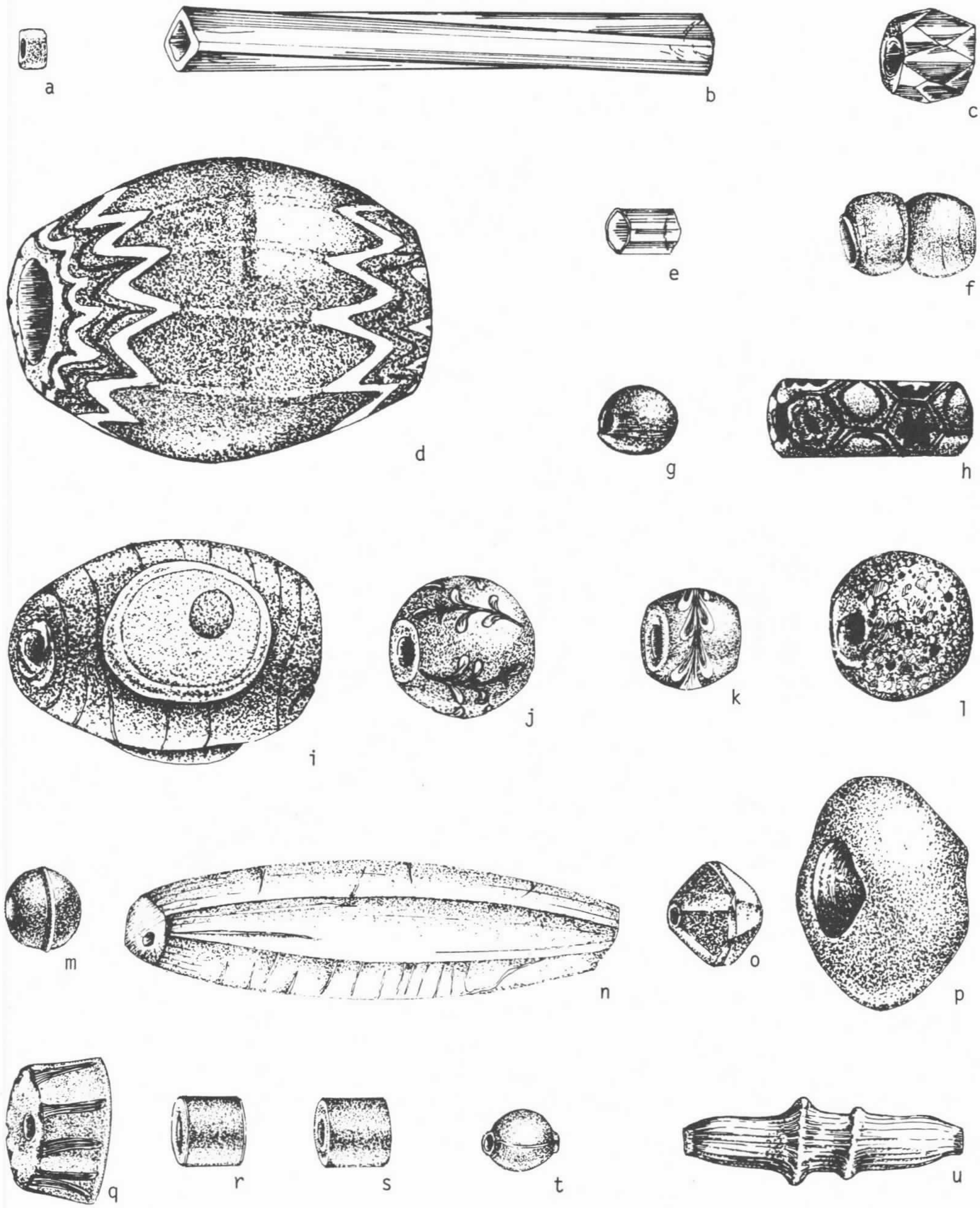

FIGURE 1. Examples of major bread types discussed in the text. a, drawn pony bead; b, drawn square, striped, and twisted bead; c, drawn, facetted "Russian" bead; d, drawn chevron bead; e, drawn short bugle bead; f, double wound bead; g, wound bead showing projection; h, wound *millefiorri* bead; i, wound eye bead; j, wound floral spray or arabesque bead; k, wound squiggle bead; 1, wound crumb bead; m, pressed round bead; n, pressed elongated faceted bead; o, mandrel pressed bead; p, donkey bead; q, African baked bead; r, tile bead, smooth end; s, tile bead, rough end; t, blown collared bead; u, blown fancy bead.

amalgamation, is drawn out in the usual manner. If short lengths of variegated cane be used in the above process, in the place of plain coloured cane, the section of the cane produced will bear some resemblance to a flower.

An excellent 20th century work (Anonymous 1919) presents a picture of improvements through mechanization. One major difference in this later description is that the gather is not blown hollow; rather, a cup-shaped area is scooped out and pressed into the glass and then blown (Anonymous 1919:606). The final polishing in this report is called "lucidation" and was accomplished "with emery paste or other grinding material, or even sawdust" (Anonymous 1919:608). Two recent publications (Francis 1979b; Kidd 1979) list several other alternatives to these procedures and suggest that each master craftsman had his own variations on the basic technique.

Allen (1983b:27) makes the disarmingly simple but vitally important observation that there are four major ways in which drawn beads can be finished from the basic cane. These are: "1) beads finished in a cold state, individually; 2) beads finished in a cold state, *en masse;* 3) beads finished in a warm state, individually; and 4) beads finished in a warm state, *en masse*." While Allen's concern was with rosetta beads, the four classes still hold true for all drawn beads. Type 1 involves alteration by grinding on wheels. Type 2, according to Allen (1983b:28), is a late process involving cold tumbling in an abrasive. Tayenthal (1900:21) mentions the use of sandstone. Type 3 is a poorly known process of working canes on a spit within a flame, a process discussed in more detail below. Type 4 is the typical drawn bead process discussed in detail above.

Francis (1982, 1983b) has reported two quite different drawing techniques from India. In one process the gather is drawn out by one person rather than two. This is accomplished after "the free end of the glass is quenched in a bucket, an iron rod is stuck into this end, and the rod is put in a sand pile or on hooks driven into the ground" (Francis 1982:14). The other process (Francis 1982:17) is an ingenious one involving the creation of a vacuum "not unlike that used by modern automatic drawing machines such as the Danner method" discussed below.

Certain characteristics are found in different beads depending on their manufacturing technique and help to identify the bead. The small bubbles found as inclusions in the glass tend to be elongated in the same direction as the perforation in drawn beads since the originally round bubbles have been distorted by the drawing process.

Any number of additional variations can be made on the basic technique. The gather of molten glass, before being drawn out, can be shaped on a marver or marvering surface (i.e., a flat, or in some cases corrugated piece of marble, bronze, or cast iron), or the gather can be formed in a mold into square or other geometric shapes and can even be twisted as it is drawn out to give a combination of traits such as a square, striped, and twisted bead (Figure 1b).

To define the structure of drawn beads, in the past, strong support has been given to the terms "simple" for one layer of glass, "compound" for two or more layers, and "complex" as having decorative designs made of glass elements pressed into the bead as suggested by Duffield and Jelks (1961:40–41). Stone (1974:88–89) solved the basic weakness of this system by setting up four levels of structure: 1) simple—composed of one layer; 2) compound—composed of two or more layers; 3) complex—utilizing applique or inset designs; and 4) composite—involving both compound and complex attributes.

The abbreviations recommended by Duffield and Jelks (1961:41) are still valid despite their lack of acceptance over the past 20 or so years:

In the following descriptions of the beads an abbreviated set of terms is employed for designating the structure of the compound and complex [and composite] specimens. The term used for a tubular bead made up of two or more concentric layers of glass lists the layers by color, beginning with the exterior layer and ending with the central core. For example, a bead with a blue glass core and an exterior layer of white glass would be termed White/Blue (this may be read as white over blue). A bead with three layers might be designated Clear/Red/Green, or a more complex form might be labeled Red-and-White (swirled)/Green/Red. Some of the beads have stripes, dots, or other designs formed by tiny

> glass rods or dots that are embedded in one of the constituent layers. This feature is indicated by the use of the symbol <. For example, many of the Cornaline d'Aleppo beads are listed as Clear/Red<White Stripe/Green, which may be translated as: a clear glass exterior layer, a second layer of red glass into the surface of which are inlaid white rods that form stripe patterns, and a central core of green glass. White<Blue Dots/Blue would indicate a bead with a blue glass core and a white exterior layer into which are embedded blue dots.

It is true this technique combines elements of structure, color, and ornamentation, but it is still useful for reducing bead descriptions. The order of layer description is illogical. It makes more sense to describe them in the order they were manufactured; however, the convention appears to be established.

Most drawn beads are used in beaded work and are often given the designation embroidery beads. It is hoped that the term garter bead as used by Harris et al. (1965) will not gain widespread acceptance beyond its two or three other uses in the literature. The smaller embroidery beads are usually called seed beads. Francis (1979a; 1981a:9) also lists micro bead, sand bead, and bead–work bead and indicates that what are called seed beads would be better not called by that name, because they are not made from seeds. The larger varieties of drawn beads for bead work are often called pony beads or pound beads (Figure 1a). Conn (1972:7–8) defines seed beads as 0–2 mm, pony beads as 3–5 mm, and an undesignated group, 2–3 mm as intermediate.

Nesbitt (1878) and Francis (1979b) divide 16th century Italian drawn bead makers into two classes: 1) *Margariteri*, makers of small beads such as seed beads; and 2) *Perlai* or *Paternosteri*, makers of larger beads that are further finished by hand techniques. Gasparetto (1958:186) gives greater detail on the history of these and other terms such as *conterie*. Originally *conterie* refered to *perle a lume* or lamp beads made by winding as described below and from large tubes. From the 1800s *conterie* replaces *margarite* as the term for small drawn beads (Gasparetto 1958:235–236). There is a complex and contorted history of the specializations within the Italian bead industry to which the recent works in English on the subject (Kidd 1979; Francis 1979b) do not do justice. Francis has presented unpublished summaries of the Italian bead industry chronology (Allen 1980:3) that would be welcome in print.

A little noticed statement by Gasparetto concerning the second class of large drawn beads *(Paternoster)* has been referred to in English only, very briefly by Francis (1979b:8). Gasparetto (1958:186) describes this process for heat finishing drawn beads as contrasted to the iron pan or rotary furnace: "sections of hollow tubes of larger thickness, strung on a 'spit,' were softened in the fire of the furnace." (The original quote reads: " . . . *si ammollivano dei pezzetti di canna forata di grosso spessore, infilati in una sorta di spiedo, al fuoco della fornace* . . .)." It is interesting that Gasparetto (1958:186) uses *spiedo* (spit) rather than *mandrino* (mandrel). However, elsewhere he also states that "the pontil of the smaller size is called spit" (Gasparetto 1958:242). The original reads: "*Il 'pontello' pi'u piccolo chianasi anche 'speo'* (*spiedo*) . . . ." The final shaping was done with hand tools or a bronze mold (Gasparetto 1958:187). This method corresponds to Allen's (1983b:28) Type 3 finishing technique. More research is needed to place this technique in its proper chronological position.

The large, blue, facetted beads (Figure 1c), popularly called Russian trade beads, are made according to one theory by marvering six, seven, or eight sides to a drawn bead gather (Woodward 1964, pers. comm.). However, examination of these beads shows striations, concave facets, and other surface textures that argue logically against this hypothetical manufacturing technique. It has been suggested by Ross (1975, pers. comm.) that these beads are made by some undefined extrusion technique. Gasparetto (1958:241) states that facetted beads are made by placing the gather in a metal mold.

According to a similar but doubtful theory of marvering, the rosetta bead (Figure 1d); also known as chevron, star, star chevron, *Paternoster*, aggry, or sun bead (Karklins and Sprague [1980] found chevron the most common and accepted term in the literature, but Allen [1983a:19; 1983c:177] gives a convincing argument for rosetta as generic, star as unground, and chevron as ground.) was made by dipping two colors of glass, one after another, and then marvering across a corrugated surface, followed by two more colors and marvering again until the number of desired layers had been built up. After being drawn out and cut into segments the star beads were often ground on the ends to expose the various layers and give the traditional chevron appearance (Neuburg 1949:54, 1962:22). Kidd (1979:14) reverses his earlier work (Kidd and Kidd 1970:49) and concludes that rosetta and square beads, like faceted beads, were made by blowing the gather in a mold of the proper shape. Smith and Good (1982:17) go into even more detail in reference to Nueva Cadiz square beads and conclude that "the hollow bubble of molten glass, either in one or multiple layers, is blown into an open, square, bucket–like mold to form a square cross section." Thus the evidence is becoming stronger that rosetta, square, multi–sided, and even melon beads were all formed in a mold, not by marvering. Allen (1983c:185) disagrees to the extent that he says the gather is formed in a mold, not blown. Allen (1983a:22) clearly points out, however, that all descriptions of "rosetta bead manufacture are *essentially speculative in nature*" (original italics). He (Allen 1983b:24) summarizes the most likely process thus: "1) forming of the core layer of the *gather,* that surrounds the bubble of air, 2) layering the gather with additional glass (*casing* [plating]), 3) molding the gather, and 4) drawing the gather." Steps 2 and 3 may be repeated. According to Revi (1959:262) the term plated is more appropriate than casing when the "casing" is external.

The large, facetted beads often have additional facets ground on the ends at approximately a 45° angle to the axis of the bead. These were apparently ground by hand on stone wheels. This is an example of Allen's (1983b:27–28) Type 1 finishing technique. Other facetted drawn beads were not hot tumbled but sold with sharp and irregular edges (Figure 1e). These might be thought of as a fifth technique of "no finish." Woodward (1965:11) calls these short bugles. The 17th century great bugles were much longer, one to four inches. It is difficult to interpret him without illustrations, but Woodward (1965:11–12) seems to imply that the typical blue faceted beads were called short bugles, "O.P." beads, or rods.

According to Désiré F. deTremaudan (1969, pers. comm.), a major importer of beads in Victoria, British Columbia, during the 20th century, seed beads were packaged in special units of measure: 10 threads = 1 tassle and 10 tassles (100 strings) = 1 bunch. Gasparetto (1958:200) lists units of measure used by the women stringing beads, but these apparently were not used outside the stringing process. Terms used in the selling of strung beads to the next processor could be translated as: 20 strings = 1 bunch, 12 bunches (240 strings) = 1 complete bunch [bundle?]. A source early in the century (Anonymous 1919:607) states that "for very small beads the string was about 10 in. long and for longer beads about 18 in. long. A bundle then consisted of 480 strings." This source also gives some indication of how beads were sold at that time:

> Some classes of beads are bunched for weight and others for number. Many of the small beads are sold by number. Such beads are sometimes referred to as "count beads," while those sold by weight are known to the English trade as "pound beads" [Anonymous 1919:608].

Some seed beads are made today, especially in Japan, by a machine technique that among other things can produce a round seed bead with a square hole (Hoffman and Ross 1974:74). The first successful automatic system was invented by Edward Danner in 1917 (Douglas and Frank 1972:46–51). The Danner process as defined in his three basic patents (Danner 1917a, 1917b, 1917c) is clearly a mechanized process for producing drawn beads. The fact that the machine can include a rotating mandrel (see below) should in no way lead to the erroneous conclusion of some researchers that this is a wound process. Danner (1917a) in his first patent titles it a "process of drawing" and describes the drawing of both tubes and rods.

Wound Beads

In terms of the number of beads that have been recovered archaeologically, the second most common technique of manufacture is the wound bead (Figure 1f–1m), also known as wire wound, wire wrapped, mandrel wound, turned (Anonymous 1884:819), or coiled. By spun, Cleland (1972:184) presumbaly means wound. Because wound beads are usually strung rather than sewn to a backing, they are often called necklace beads. Francis (1979b:9) calls Italian–made wound beads, lamp beads (*perle a lume*), and Kidd (1979:21) calls them *suppialume,* a term better applied to the makers of lamp beads (Gasparetto 1958:245). The spiral bead of van der Sleen (1967:26) is also in reality just another type of wound bead.

In the wound process a cane or rod of glass without a central hole, made in essentially the same manner as the drawn bead, is heated over a small flame until it is in a plastic state and is then wound around a wire or mandrel. The mandrel may be coated with graphite, clay, or other materials to aid in removal of the beads after cooling. A German patent in 1922 was for a coating of half aluminum oxide and half koalin (Paisseau 1922). The winding can be once around with a fairly noticeable joint, or it can be done with very fine filaments several times around. During some periods a slight projection will be left where the rod is broken loose from the bead (Figure 1g). A dexterous worker can make beads in this manner very quickly. Often the beads were made so close together that they occasionally became fused together forming a variant form of a double or multiple bead (Figure 1f). The Bonnet bead making machine (Cousen 1924), an improvement of the 1920s, is little more than a machine rotating the wire in contrast to the former practice of the worker manipulating the glass and the wire.

As mentioned above, inclusion bubbles in drawn beads elongate in the direction of the perforation. On the other hand, bubbles in wound beads tend to elongate around the axis of the perforation. It is also often possible to observe the separate filaments used in the winding or to observe the juncture of the winding. It has been assumed in the past that there is also a tendency for wound beads from Italy to show black graphite or iron oxide inside the perforation while those from China tend to have accumulations of white clay; however, Francis (1983b:202) has shown this to be less than accurate. The most common Chinese beads, also popularly known as Canton or Peking beads, are wound beads characterized by numerous bubbles and an especially glossy surface. According to Liu (1975:14) the process for making wound Chinese beads as explained by Chu and Chu (1973) would explain the presence of clay inclusions within the actual glass of the bead. Chu and Chu (1973:138) state:

> One man who remembers watching his aunts at work in South China not far from Canton [Guangzhou] (for glass beads were made in many locations throughout China) told us that long bamboo reeds were dipped into troughs of wet clay slip, then taken out and dried. When the reeds were ready—and it is assumed that large piles of them were prepared in advance—two people would hold one reed as a third poured threads of molten glass at intervals on it. The two end people twirled the reed, making the glass form into beads. When the glass had hardened but not yet cooled, the reed was laid on a bed of dry clay. When completely cool, the beads were shaken off into water to be washed.

Francis (1979c:12) has shown an important distinction between the usual European wound bead technique described above using solid glass rods over a flame and two other techniques involving molten glass. In one the workers "wind the mandrel directly into the molten glass in the furnace," and in the other, they "draw the glass out and wind it onto the mandrel outside of the furnace." Francis (1981b:39) described these processes in another source thus: 1) "made by dipping the mandrel into the glass box in the furnace and twirling the mandrel until sufficient glass is gathered" and 2) "the scoop wound (glass drawn out by scoop and dripped over a rotating mandrel) method." Pazaurek (1911:1) lists the "at the glass furnace" winding as the oldest technique and "today no longer popular." He fails to mention more advanced methods for making wound beads.

Francis (1983b:194) has also reported an important difference in the smoothing of wound beads with a pincher tool or a half–mold. Italian beads with the pincher tool will not have the ends smoothed so that the winding will still show while Czechoslovakian and Japanese beads, made with a half–mold, will be smoothed over the entire surface. Chinese beads must have been smoothed by a technique similar to the latter method. According to Francis (1982:11) in one area of India, wound beads are also smoothed on a half–mold:

> While still hot, the beads are shaped to near perfection in iron half–molds. These are dies made of small metal cubes with depressions on one face corresponding to half the ultimate section of the bead. Grooves running from the center of the depression to the edge of the die allow the wire to rest in them. The bead and wire are laid on the half–mold and the wire is twirled, shaping the bead by this rolling action in the depression.

The wound bead is also the basic background for many forms of additional work in inlay or appliqué for forming "fancy" or "polychrome" beads. Allen (1982) presents the most detailed discussion of mosaic beads. Francis (1979b:14–15) lists special types of wound beads as: *millefiori* (thousand flowers; Figure 1h), eye (Figure 1i; see Smith 1982 for a full discussion of drawn construction eye or "flush–eye" beads), floral spray or arabesque (Figure 1j), combed, and squiggle (Figure 1k). The crumb or frit surface bead (Figure 1l) is still another probable Italian fancy bead found in the 19th century. As early as A.D. 200–552 the Japanese are reported to have been "inserting bits of hard glass into the bead while still soft" (Salmon 1976:48).

The best description of the making of fancy beads in English is found in an anonymous source (Anonymous 1867:760):

> The art of bead–making at the lamp, "Perle alla Lucerna," is, as we have said before, quite a separate business. In working at the lamp, tubes and rods of glass and enamel are used. It is impossible to describe all the manipulations of this ingenious art, over which the taste and dexterity of the artist so entirely preside. But we may give an example: a black bead, decorated with roses, forget–me–nots, and leaves of aventurine. The artist first takes a rod of black glass, and melting it in the blow pipe flame of the lamp, twists it about an iron wire until he has made a small ball of the required size, rolling it on a kind of iron mould with a circular groove, and smoothing it with an iron tool until it has acquired a perfectly spherical shape. He then takes a small rod of aventurine, and softening it in the flame, traces on the black glass ball leaves of [or] any other pattern that may be required, and smooths it again with the iron tool. He next traces with a small rod of rose–coloured enamel the roses on the ball, smoothing it as before with the smoothing tool. The forget–me–nots are next traced on the bead with a small rod of blue and white enamel, that has been previously twisted together spirally in the flame, and drawn out to about the diameter of a shawl pin. The bead thus completed is taken off the wire, and left to cool in a box filled with sand.

A series of beads obtained in 1976 from a dealer included a defective one with the hole filled by a copper wire. This was a spherical bead made to imitate turquoise, perhaps a modern example of one of the so–called Hubble class of beads. It was speculated that such wound beads could be left on the copper wire and the wire removed by nitric acid or other strong acids. A film observed in Rochester, New York in 1982 also showed modern Italian beads being made according to this procedure. This technique is referred to as an older, less satisfactory method of manufacture in a 1922 German patent issued to a Parisian, Paisseau (1922). A 1925 German patent (apparently also 1924 in France) to the same individual (Paisseau 1925) describes the use of multiple wire cores and asbestos wire covered with sodium or potassium silicate. The requirement was for a core that was easily dissolved chemically but still able to withstand torsion, flexion, and the lateral pressure of mechanical bead manufacture. Beads wound on a wire *could* be finished with a pincer type of mold, perhaps the mold actually cutting the wire.

The special type of bead, popularly called a *Cornaline d'Aleppo*, was made during the 19th and 20th centuries by both drawn and wound methods. From personal observation, the chronology for this ancient bead type in western North America begins with a two–color bead composed of a light green core that appears almost black without sufficient backlighting; this is covered by a brick red outer layer. By 1830 this had been replaced by a dark ivory center still with a brick red outer layer. Around 1860 the core had become white, and by 1880 the outer layer had become a much more brilliant red due to the introduction of modern dyes. This bead, in the drawn form, often has a third layer of clear glass over the red. The chronology and the term Hudson's Bay for this bead as suggested by Francis (1979a:39, 58, 66) are not supported by the evidence in the Northwest. The source of this confusion may be Orchard (1929:88–89). More Northwest collectors call the blue facetted "Russian" bead a "Hudson's Bay" bead than use the term for the *Cornaline d'Aleppo*. No less than nine times, Quimby (1978) equates "Russian" beads with "Hudson's Bay" beads.

The inherent problem with rigid classifications for beads such as the one suggested by Kidd and Kidd (1970) is illustrated by one *Cornaline d'Aleppo* type recovered from the Ozette site on the coast of Washington. This bead type, which has been personally observed, is composed of a drawn white core with a wound red exterior. Karklins (1982:95), working from the same specimens, calls these "wound–on–drawn" and suggests that it is a manufacturing class separate from both drawn and wound. Karklins (1982) also suggests how to expand the Kidd and Kidd system to include entirely new forms. Smith (1983:4) however casts doubt on the complete success of Karklins' proposal.

Mold-Pressed Beads

Utilizing dictionary definitions, the terms molded (moulded) and pressed are obviously interchangeable. Mold or molded can mean "to give shape to [a] malleable substance," "to form by pouring or pressing into a mold," or "blown in a mold" (Gove 1976:1454). Pressed is defined as "compacted or molded by pressure: squeezed together into some form" (Gove 1976: 1795). To further confuse the situation, pressed glass is defined as being manufactured "by being pressed into a mold while still plastic" (Gove 1976:1795). My translator of Pazaurek (1911:19) suggested "stamped bead" for the German *Druckperlenerzeugung*, a possible term to be added to the literature. An earlier draft of this work attempted to make a distinction between molded and pressed, an effort now abandoned as not meaningful. The suggestion is made that they only be used together as mold–pressed (Karklins, pers. comm.).

The techniques used for separating a bit of viscous glass for mold–pressing beads includes several of those used for basic bead manufacturing such as drawing, winding, folding, or blowing. This gives some weight to the contention of Kidd and Kidd (1970:48) that all beads originally were drawn or wound (or both). While the inspection of mold–pressed beads will sometimes indicate the first stage in manufacturing, more often than not there will be no clue hence the need for the mold–pressed bead class. There is also no reason why the proper quantity of glass can be measured out only through drawing or winding. Karklins (1982:96) makes a distinction between mold–pressed beads made from one piece of glass and those made from two pieces brought together in a two piece mold. Often in the second type the two gathers may show a noticeable boundary line.

Mold–pressed beads as noted, can be called molded, pressed, pinched, tong molded (Francis 1979a:111), or a special variety described by Ross (1974:17) as mandrel pressed. After the middle of the 19th century the manufacture of mold–pressed beads in Bohemia within today's Czechoslovakia became much more important in the world market of trade beads.

The process as described in 1886 (Schwarz 1886:350) for the manufacture of small glass objects in Bohemia was undoubtedly applicable to bead manufacture. Glass canes were heated and "the softened end is fastened upon by a pair of pincers, drawn out a little, and introduced into a mold in which is carved the figure of the object into which it is designed to be formed, and which is firmly snapped upon it by closing the mold and the application of pressure." At about the same time another author (Anonymous 1884:820) stated clearly that "the manufacture of pressed beads is effected by pincers of suitable form." Pazaurek (1911:1) says that mold–pressed beads were made from "bars (rods, canes) . . . with molded iron tongs and perforated at the same time."

Mold–pressed beads usually can be identified by the ridge formed where the two halves of the mold come together (Figure 1m). Some beads, especially elongated shapes, will have the seam parallel to the axis of the perforation rather than the normal equatorial seam (Figure 1n). This type could be made as suggested by Beck (1928:61–62) for the double strip bead:

> in this method two strips of glass were taken and placed on top of each other with a rod between them. They were then pressed together and cut off at the correct length to form the diameter of the bead, which was finished by rounding it to shape by pressure whilst the glass was still plastic.

Some expensive varieties, usually faceted and especially of the elongated shape, will have the seam ground down (Figure 1n). Mold–pressed beads also tend to have tapered perforations.

Mandrel pressed beads have all of the characteristics of other mold–pressed beads including an even more tapered hole plus a chipped scar or "bulb of percussion" around the small end of the perforation (Figure 1o). Recent radiographic work shows the hole to be a regular cone.

Ross (1974:17, 20) has postulated a technique for the manufacture of these beads:

> they were made by pressing two pieces of molten (or plastic) glass together in a mold. The resultant bead blank had a conical hole which did *not* pass through the entire bead. This blank was placed upon a mandrel and random facets were ground over the entire surface; and after faceting, the remaining portion of the hole was punched through the bead.

Based on his prior experience with glass, Robert Elder (1976, pers. comm.) of the Smithsonian Institution vehemently disagrees with Ross's hypothesis but has offered no alternative theory. Possible support for Ross's hypothesis is offered in an anonymous German source dated 1913. The beads of unknown type were apparently pressed in iron forms from glass rods which had been remelted. The description (Anonymous 1913:61) goes on to say: "Since the beads were only partly pierced, they had to be singly perforated with a punch" ["*Da die Perlen nur teilweise durchstochen wurden mussten sie einzeln mit einen Dorn durchschlagen werden*"]. It should be added however, that the same source stated: "For several years machines have been employed which press and pierce the bead with a single application of pressure" (Anonymous 1913:61).

The process of modifying drawn, wound, and blown beads with hand tools that do not destroy the basic perforation but alter to some degree the shape has been called marvering. To be absolutely correct, marvering is only that shaping done by rolling the glass on the marver. Any shaping done with paddles or other tools should be called modeling. This is not another manufacturing class but only an additional process added to the basic manufacturing process. Francis (1979a, 1979b) apparently would apply the term impressed to some such secondary modification of a pressed bead from a drawn or wound bead. He also suggests that this procedure is more typical of the Italians than the Czechoslovakians.

Fired Beads

It is suggested here that the class of beads manufactured from granular material that is compressed and further heated be called fired beads. This process is sometimes called sintering or fritting; however, some fired processes are not sintering, and fritting is actually the process of reducing the raw material to small–sized pieces so that it can be sintered. Fired is the manufacturing process formerly called molded (Sprague 1966.). The term compressed bead could be used, but fired beads can be made by pressing in molds or by hand modeling, hence confusion would still be possible with mold–pressed beads. The important distinction is between molten glass being treated (pressed) *vs.* glass constituents or frit being compressed and then subjected to heat (fired). The terms baked and porcelain have been used (Gibson 1976:104), but the first of these, in the Old World literature, usually refers to one specific type of African process, and the second is in the popular literature in reference to any glass beads, usually opaque white, of a high quartz content.

Fired beads have a great antiquity, perhaps the oldest glass making technique known. The Middle Eastern donkey bead (not to be confused with the pony bead) is still being made as it probably was in ancient Egyptian times by modeling damp quartz sand and an alkaline flux, such as potash or borax, into globules by hand or pliers, inserting a thorn, or sun drying and drilling with a bow drill to make a perforation. The beads were then fired in a furnace. A blue salt-glazed surface was achieved by throwing copper salts into the fire or packing the beads in powdered ingredients before firing (Figure 1p; Wulff et al. 1968). It can be argued that such beads are more correctly called faience than glass.

Another fired bead technique is found today in Africa (Figure 1q). According to Liu (1974) ground glass is placed in clay molds, fired and then sometimes ground, especially on the ends. Some are made in individual holes in the mold (Wild 1937) while others are made in a grooved mold and then broken apart (Sinclair 1939). Such beads are called powder–glass beads (Francis 1979a:88), pot beads (Liu 1974:8), or baked beads (van der Sleen 1967:27). Van der Sleen also suggests that this technique was used in ancient Egypt to make faience beads. This may be close to the technique used by the Arikara Indians for making beads as well as their better known native glass pendants (Stirling 1947; Ubelaker and Bass 1970).

For many years, the appearance of so-called tile beads (Figure 1r,s) had been disturbing, and as a result they became the subject of a conference paper (Sprague 1973). These beads are generally classified along with glass trade beads but have a ceramic, mold-made appearance (Sprague 1983). Several years ago in a discussion with DiAnn Herst of the National Historic Parks and Sites Branch, Ottawa, the Prosser process for making ceramic buttons was described. A review of the literature suggested that tile beads and some other molded beads, usually round, are probably made by a process similar to that for making Prosser buttons.

The Prosser process was patented in 1840 by Richard Prosser in England and by his brother, Thomas Prosser, in the United States in 1841. Slightly moist clay is impressed in steel or iron dies of the proper shape and compressed to about one-fourth its original bulk. The buttons are then fired at high temperature to produce a bisque object that is then glazed and refired.

Prosser beads (Sprague 1973), or Prosser molded beads, the term used by Ross (1974:18), are characterized by a very smooth, round appearance at one end of the bead (Figure 1r) and a rough pebbly or orange peel appearance at the other end (Figure 1s). Not only is the hole tapered, but in the case of tile beads, the whole bead is slightly tapered. The term tile generally is limited to the cylindrical type of bead; however, Karklins (1982:99) implies that all Prosser beads are called tile. Tile beads appear to have a granular structure not typical of true glass, but chemically they are virtually identical to glass (Sprague 1983:172).

Blown Beads

Blown beads are also called hollow blown, hollow sphere, and hollow bubble. Again, these alternative terms imply the geometry of the bead rather than simply the technique of manufacture. Blown beads can best be likened to small Christmas tree ornaments (Figure 1t). Because of their fragile nature they are not often found in an archaeological context. Ross (1976:766–767) has described several different styles of blown glass beads found at Fort Vancouver. Good (1977:32) summarizes the literature on proposed methods of manufacturing blown beads. These four hypothesized techniques include those in which 1) small spheres were blown and perforated on opposite sides before cooling (Harris and Harris 1967:137); 2) a closed, grooved tube was formed by blowing glass into a mold, and an expanded central portion was created by heating only a section of the tube and blowing air into it (Ross 1974:18, 21); 3) either a small bubble (Type 3a) or a portion of a glass tube (Type 3b) was blown into a bead, forming a smooth ball, or (Type 3c) it was blown into a mold that had a more decorative form; 4) tubing was heated in a mold and air was blown into the tube, forming a connecting chain of beads broken apart after being removed from the mold.

Karklins (1982:98) classifies these several techniques more logically and suggests (Karklins 1981, pers. comm.) correlations with Good (1977): 1) free blown bubble on a blow tube (cf., Good's Type 1 and Type 3a); 2) tube blown in a mold (cf., Good's Type 2, Type 3c, and Type 4);

and 3) bubbles in a blown glass tube (cf., Good's Type 3b).

Karklins' Type 2 is described in more detail by Francis (1982:9) including the use of a foot pedal to close the brass two–piece mold. A mechanism for blowing six to ten Type 3 beads at one time is described in a 1927 German source (Anonymous 1927).

Examples of additions to these basic processes include such variations as multiple (chain) production and fancy work (Figure 1u) such as that hypothesized by Ross (1974:18):

> . . . a closed, grooved tube was formed by blowing glass into a mold. Next, a single upset (in some cases two) was produced by heating one portion of the tube while rotating and forcing air into the tube. Finally, the ends were formed by heating and crimping the tube, snapping off unwanted portions and subsequently fire polishing the broken edge [Figure 1u].

Round blown beads made in imitation of pearls were first made in 1656 (Lardner 1832:235–236; Beckman 1846:265–268). M. Jaquin, a French inventor, filled the inside of blown glass beads with a coating made from fish scales and then filled the beads with white wax. The first description in English of this process appears to be Rees (1819); however he does not describe the making of the actual glass beads. The blowing of such "false pearls" is described by Sauzay (1870:245–249). He states that the blowing is done by hand from glass tubes without the use of molds, "the only exception to this is for pearls called fluted, which must be done in a mould."

Pazaurek (1911:19), probably after Tayenthal (1900:23–24), states that the chronology for blown beads in the Jablonec (Gablonz) region is "first manufactured with a blowpipe, later with the bellows, and most recently at the 'blowtable;' no longer singly but in molds up to 30 pieces." These molds were invented in 1876 (Tayenthal 1900:23). The silvering of blown beads was made practical by "Dr. Weiskopf" in the 1850s (Tayenthal 1900:23).

Other Processes

Additional minor techniques for the manufacture of glass beads can be found throughout the world. Van der Sleen (1967:26) lists folded beads as a manufacturing type. Oftentimes, a folded bead is just a poorly or incompletely wound bead, however some beads *are* clearly made in this way as shown by Beck (1928:61) and Neuburg (1949:54).

Francis (1979a:113) describes the manufacture of a twirled bead thus: "The method of making small beads like seed beads [is] by putting a bit of glass on a wire and twirling it around quickly so that the glass can obtain a spherical shape."

Van der Sleen (1967:27) also lists hand perforated beads which he suggests are made thus: "drops from a molten rod of glass on a soft earthenware dish are perforated with the aid of a hot iron nail, while plastic." Francis (1983a:5) clearly points out that van der Sleen was basing his conclusions on the writings and observations of M. G. Dikshit.

The " 'Allen book of beads', a 32 page booklet issued by Allen's Boston Book Shop" and dating about 1920 (Liu 1975b) relates still another way in which fancy beads were made in Italy:

> The glass which forms the bead comes in bars or rods (sometimes called glass "canes"), approximately the diamter of the bead to be made. The bars are placed in a small furnace over an open fire, until the end becomes sufficiently soft. With a pair of plyers, a piece is pinched off large enough to form one bead. The bead, being now in a semi–fluid state, is pierced with a long wire or needle and is then turned and twisted over the hot flame till it can be shaped into either a round, lozenge shape, square, octagonal or olive shape.

Again, it should be pointed out that this is not marvering but modeling. Recently such beads have been reported from South America and have also been produced experimentally (Harris and Liu 1979:60).

Gibson (1976:104) and Bone (1977:17) suggest facetted beads as a manufacturing type; however, facetting is a by–product of the basic manufacturing process in the case of mold–pressed beads and a finishing modification during or after the basic manufacturing process in the case of facetted drawn beads. Nevertheless, the literature review by Gibson (1976:104–106) on the possible methods for the manufacturing of facetted beads is the most complete in print.

Physical Appearance

The shape or geometry of beads can be determined best through reference to the basic source by Beck (1928) or the more recent summary by van der Sleen (1967). There are several levels of bead shape or geometry, the first of which is standard geometric description using such terms as sphere or cylinder. When they are used, such terms should be geometrically accurate. For example, the term "round" is not round at all, but spherical. Spheres and disks are both called round but are very different shapes. Karklins' (1982:101–102) recent discussion of shape has only added to the confusion, a point also made by Francis (1984) in his review of Karklins' work. This is not to suggest that historical terms should not be noted but that the specific description should be accurate; in other words the emic and etic descriptions should be kept separate. In addition to the standard geometric shapes there are specialized names such as melon, raspberry, collared, corn, etc. Contrary to Kidd and Kidd (1970), the term "doughnut" is not a specialized shape but rather should be designated "torus," a specific and quite common geometric shape. The difference between a spherical bead and a torus bead is a good example of the importance of perforation size. Most geometric terms ignore the perforation, but some terms, such as torus or ring, do consider the perforation, hole, or bore, usually when it is relatively large.

Since each bead factory had its own set of screens for determining sizes there is no standard or objective way of establishing common sizes today that correspond to those used by the factories (e.g., 000, 00, 0, 1, 2, 3, etc). The trend among serious researchers of trade beads is to measure them in millimeters giving length, greatest diameter, and hole diameter. Among flattened beads, the maximum and minimum width should be recorded. Karklins (1982:109) calls these width and thickness. Most researchers working with large quantities of beads have gone beyond the "small, medium, and large" stage suggested earlier by Kidd and Kidd (1970:66). Personal experience with this (Sprague 1971) led to ridiculous subdivisions including "very small, extra very small, super extra very small," etc. The small, medium, and large designations are of little or no help for statistical analyses to determine factory bead sizes such as Ross (1976) has been able to do with the Fort Vancouver material, but they are of some use for describing relative bead sizes.

In the past the use of standard screen mesh sizes, standard twist drill sizes, or even knitting needle sizes has been suggested (Sprague 1969), but these are now rejected as inadequate. Measurement to the nearest 0.1 mm with a micrometer or dial caliper is recommended as is the use of a flat scale gauge graduated in 0.1 mm increments which is useful for measuring bead perforation diameters. A jewelry tool supply house can provide one of these gauges for under $100.

Some objection has been raised to measuring the bead hole or bore, but until more is known about bead manufacture and dating, it is important to include this information for all bead classes except perhaps for the more common varieties of drawn beads.

Bead color should be designated by general and widely understood terms such as red, green, robin's egg blue, etc., but when possible they should also be given a Munsell color designation. The Munsell charts are very expensive but can often be borrowed through interlibrary loan or from university or scientific laboratories. The Munsell color charts remain the standard of both industry and science, hence one must view as very unfortunate, the use by some of lesser known, out of print, or less discriminating charts such as the Container Corporation of America Chart, the Bustanoby Chart, the Maerz and Paul Dictionary of Color, or the Letraset Pantone Letracolor Color Paper Picker (Motz and Schulz 1980:50). One reasonably priced substitute for the Munsell chart that is also easily available and should continue to be so is the ISCC-NBS Centroid Color Chart, available with the *Color Universal Language and Dictionary of Names* (Kelly and Judd 1976) from the National Bureau of Standards. Smith and Good (1982:17) recently demonstrated the practical use of ISCC-NBS Centroid Color Charts *but* in conjunction with Munsell designations.

Bead color is oftentimes best determined by wetting the surface while making the color determination. Motz and Schulz (1980:50) make all determinations while the bead is wet. Karklins (1982:106) suggests wetting the bead if it is "eroded, dull or slightly patinated." It is also advisable to have a consistent light source. Kelly and Judd (1976:5–6) recommend a north facing window as a light source. Artificial light, unless a special and expensive color–corrected system, should be avoided. An old fashioned gooseneck lamp with a hole punched in the center of the shade just above the light bulb is useful so that very dark glass beads (e.g., black and deep purple) can be held over the hole to determine the color of the transmitted light. Both transmitted and reflected light have been proposed for determining bead color. Good (1976:242–243) suggests the term "diaphenetic color value" from the Munsell designation "when held to the light." The more easily understood terms "reflected light color" and "transmitted light color," are preferred.

The capacity of beads to transmit light, technically called diaphaneity, should be noted for each bead. The usual designations are opaque, translucent, and transparent. Opaque beads do not transmit light. Translucent beads transmit light but do not permit vision through the glass. Transparent beads permit vision through the glass. Motz and Schulz (1980:50) define translucency as when "any part of the glass is capable of transmitting light when back-lighted by a frosted 100-watt incandescent lamp." Smith and Good (1982:21) present criteria for making all three levels of diaphaneity as follows:

> A bead is classified as transparent if its perforation is visible when it is held sideways to the light, and/or if there is little variation in the Munsell color classification when the color of the bead in reflected light is compared to its color in transmitted light. Likewise, it is considered translucent when light does penetrate the bead, and opaque when it does not.

Any special ornamentation on the bead must be noted. These include ground facets as already mentioned but also such techniques as painting, glazing, inlay, overlay, or appliqué. Francis (1979a) best defines these modifications. Karklins (1982:109) also discusses internal decoration, defined as "decorative elements, such as coloured cylinders, spiral bands, and metal foil, located within the body of the bead."

Closely related to ornamentation and color is luster. Karklins (1982:109) defines luster as "the appearance of the bead in reflected light." His basic types are "dull" and "shiny" (glossy). Bead luster can be altered significantly by weathering in the soil, sandblasting in a surface site, absorption of oil through wearing and handling both before and after excavation, and other factors of aging. Luster also may involve specialized descriptive terms such as pearl, opal, metallic, greasy (vaseline glass), and satiny; the last is said by Karklins (1982:109) to be "characterized by a fibrous structure." Luster can be recorded conveniently with the descriptions of bead color and ornamentation.

Laboratory Analysis

The laboratory analysis of beads is limited only by the imagination and budget of the researcher. The first and most obvious analysis is the chemical composition of the bead. This can be determined by any number of chemical and physical techniques including, among others, spectographic analysis, x-ray diffraction, or ion activation. Other laboratory analyses can reveal micromorphology, index of refraction, fusability, fluorescence, specific gravity, etc. Eventually, such studies should result in the determination of the place of bead manufacture; however, for the most part, studies of this type thus far have been less than rewarding. Kidd (1982) quite correctly points out that for such studies to be of any utility thousands of determinations are needed not just the few hundred now available. Inexpensive and non-destructive techniques such as energy dispersive x-ray fluorescence should make this possible.

Historical Analysis

A basic question that constantly confronts a researcher in bead analysis is the original source of its manufacture. Research in the last ten years has shown that the locations of bead manufacturing are much more widespread than was formerly thought. The older notion that all beads came only from Venice and Czechoslovakia is no longer accepted by the serious researcher. On the other hand, it is probable that not as many beads were made in Holland as van der Sleen (1967) would have had one believe. The source of manufacture should not be confused with the country making the sale to the trader, the country of origin of the trading company, the flag under which the trading ship sails, or the nationality of the trader.

The second question in historical analysis is the chronological one. The age of a specific bead can be approached from several levels including the date of manufacture, the date of initial trade, and the date of use. Even the questions of trade and use can involve several levels including multiple use and thus different dates. Beads were (and still are) often considered important heirlooms handed down from generation to generation. Take also for example, the prevalent story among bead merchants in the first half of the 1970s concerning "old and rare" beads being found in warehouses in Venice and/or New York and sold for the "hippie" trade.

The next level of historic analysis following the temporal, is that of spatial distribution. Distributional research involves comparative analysis, often on a worldwide basis. Although some researchers have argued that site reports need to give more consideration to the provenience of each bead in the description so that intrasite chronology can be seen, sites with beads in the western United States tend to be single component thus the intersite relationships are more important for chronology building.

Cultural Analysis

The final, and to the anthropologist, the ultimate level of analysis is the cultural use of the artifact or in Linton's (1936) terms the form, function, use, and meaning of the bead in each specific culture. It is impossible to reach even the level of historical analysis, let alone the level of cultural analysis; however, until an adequate descriptive system has been developed. It is not suggested that the system given here represents the only method for the description of beads but only that it is one system that takes into account all of the bead varieties found in world wide historical research. Nor is it implied that the terminological suggestions made here are absolute or final, but only that they are a step in the direction of establishing terminology that uses one logical and basic criterion for the naming of manufacturing techniques. Aside from some terminological differences with this work, the Guebert site by Mary Elizabeth Good (1972) is a published example of excellent bead descriptions worthy of emulation.

It is obvious that as yet there is not enough known about the basic bead manufacturing methods to even list them in outline form, not to mention, a detailed analysis of the many variations through time and space. What has been attempted here is a summary of the state of our knowledge and to separate out the speculations and hypotheses from the more reliable and first-hand accounts contained in the literature. One can only agree with the warning recently sounded by Kenneth Kidd (1982) in reference to historical research on glass trade beads: "there are all kinds of pit falls, one can not be too careful."

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