

BAROQUE-ERA ROSE CUTS OF COLORED STONES: HIGHLIGHTS FROM THE SECOND HALF OF THE SEVENTEENTH CENTURY

Karl Schmetzer

Colored stones from the Baroque era fashioned as rose cuts have received little attention to date. Even the colored stone rose cuts incorporated in notable collections, such as the Cheapside Hoard discovered in London in 1912, have not been studied in detail, and only very limited further examples are depicted and described in gemological texts. Recent work with five objects of liturgical insignia and electoral regalia belonging originally to the archbishops and prince-electors of Trier and Cologne has thus offered an opportunity to augment available information. All of these pieces date to the second half of the seventeenth century. Although the table cuts from that era were still quite simple, consisting of an upper flat table facet surrounded by one or two rows of step-cut facets, the rose cuts were enormously varied and complex while still generally following a symmetrical pattern in the facet arrangement. The goal of the study was to contribute to filling a gap in the historical information on gem cuts by offering an overview of the many rose cuts used for colored stones in the second half of the seventeenth century.

Rose cuts encompass a variety of faceting arrangements, all of which lack a flat table (figure 1). In contrast to the considerable literature on the use of rose cuts in diamonds, there has been a dearth of information regarding their use in colored stones.

The story of diamond fashioning started with the polishing and/or slight modification of the crystal faces of natural diamond octahedra, creating what is known as the point cut. Thereafter, simple table cuts were developed from the fifteenth century onward, becoming more complex over time (Lenzen, 1966; Falk, 1975; Tillander, 1995; Klein, 2005; Gilbertson, 2007; Ogden, 2018). Diamonds with rose cuts came later as a typical product of the sixteenth and seventeenth centuries, employing a cutting process that began with a rough cleavage fragment from a diamond octahedron. The standard appearance generally consisted of a flat base topped by a dome with six triangular facets at the center. Between the dome top and the base was an intervening layer with six, 12, or 18 additional facets (figure 2). Despite some inconsistency in terminology, these cuts are primarily denoted as Antwerp roses (6 + 6 facets), half-Dutch

roses (6 + 12 facets), and full-Dutch roses (6 + 18 facets), respectively (Eppler and Eppler, 1934; Stranner, 1953).

Visual evidence of the foregoing historical progression in diamond cuts is readily found in references depicting jewelry objects from bygone eras and in seventeenth-century sketchbooks of goldsmiths or jewelry designers such as T. Cletcher (1629) or G. Légaré (1663) (figure 3; see, e.g., Gans, 1961; Walgrave, 1993a,b; Scarisbrick, 1993). Political and economic circumstances related to the development of rose-cut diamonds are discussed by Kockelbergh et al. (1992) and De Bie (2014).

In the decidedly less voluminous literature on colored stones cut without flat tables, the first appearance of such a faceted gemstone in art is found in a sixteenth-century painting by A. Bronzino (1542) portraying Venus, Cupid, Folly, and Time (an allegory of lust) (see Prim, 2018). The oval gemstone in that work shows a crown covered by multiple facets in the form of elongated rhombuses. Other isolated art and jewelry pieces from the second half of the sixteenth century and the seventeenth century likewise offer several examples (see, e.g., Prim, 2019). A notable influx of items displaying colored stones cut without flat tables then occurred with the 1912 discovery of the so-called Cheapside Hoard, dated before the Great Fire of London in 1666. Exemplars are contained in the catalog prepared for the 2014 exhibition

See end of article for About the Authors and Acknowledgments.

GEMS & GEMOLOGY, Vol. 56, No. 4, pp. 458–482,
<http://dx.doi.org/10.5741/GEMS.56.4.458>

© 2020 Gemological Institute of America



Figure 1. In the present study, five richly decorated liturgical insignia from the second half of the seventeenth century were examined. This photo shows part of the monstrance from the Treasury of Cologne Cathedral decorated mainly with larger garnets, peridots, blue sapphires, and quartz with yellow foil backing. The smaller stones are diamonds, amethysts, and emeralds. Many of the gemstones used to decorate the insignia are rose cuts without flat tables, showing a great variety of cutting styles. The large blue sapphire below measures 26×14 mm. Courtesy of the Treasury of Cologne Cathedral.

at the Museum of London (Forsyth, 2013), and a further selection of objects is depicted by Ogden (2013, 2014).

Although today the interested gemologist, art historian, or jeweler might be able to find various photographs or drawings of art objects exhibiting

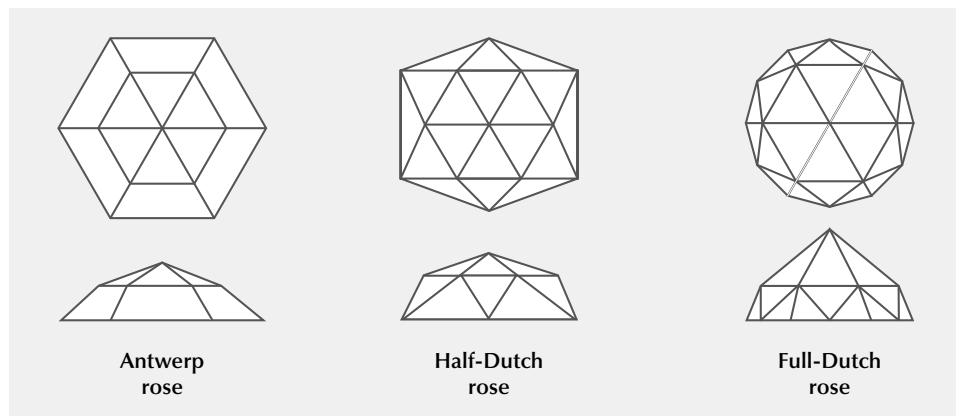


Figure 2. Sketches of the most common rose cuts used for diamonds, all consisting of a flat base, a dome topped by six triangular facets, and several additional facets between the dome top and the base. Top row: View looking down on the dome, parallel to the six-fold axis. Bottom row: View perpendicular to the six-fold axis. After Eppler and Eppler (1934).

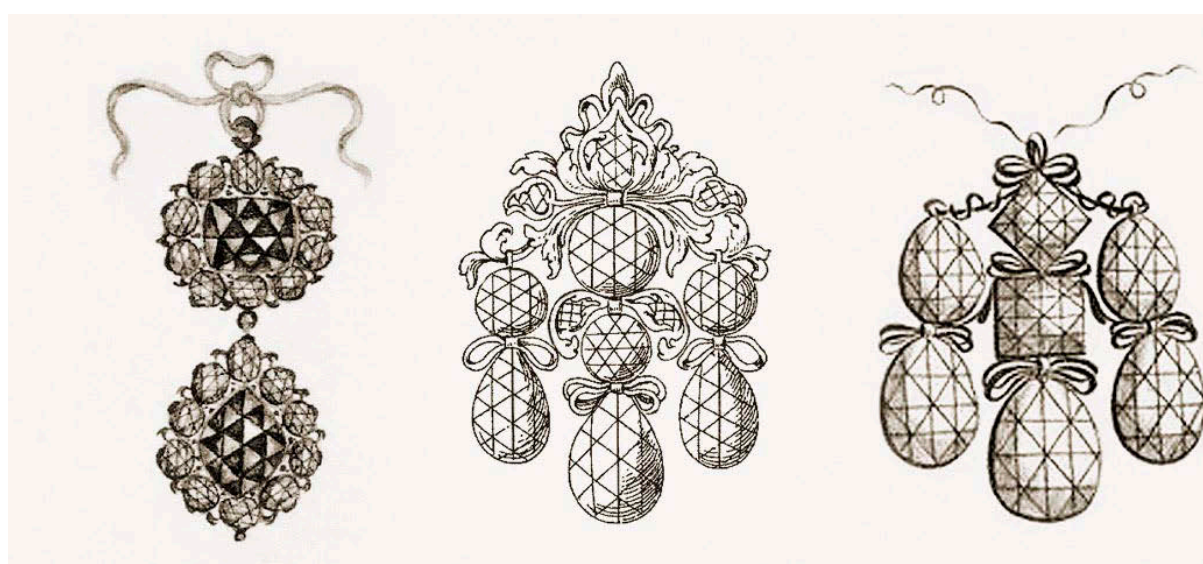
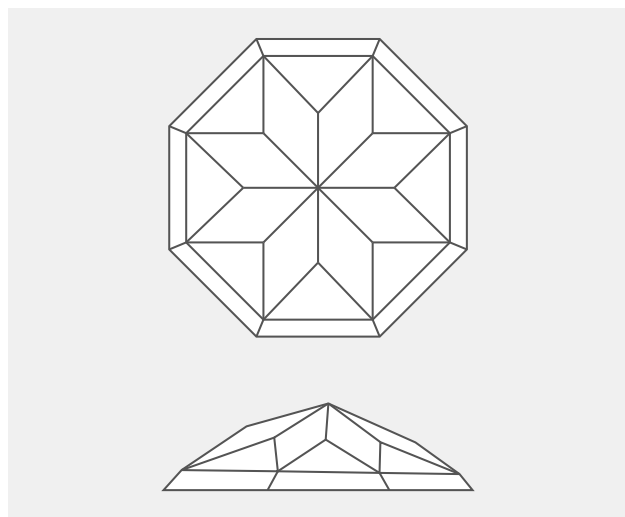


Figure 3. Jewelry designs from the seventeenth century using various types of rose-cut diamonds. Illustrations by (left to right) T. Cletscher (1629; from Walgrave, 1993a); P. Bourdon (ca. 1660; from Walgrave, 1993b); and G. Légaré (right, 1663).

rose-cut colored stones, no systematic evaluation of such cuts is available in the literature. While nineteenth-century texts may present a broad selection of table cuts, along with covering the three traditional rose cuts for diamonds, other gem cuts without flat tables are not shown or described as being

commonly available. Presumably such objects were not known to the authors of these treatises and were

Figure 4. Sketch of the so-called cross-rose cut consisting of a flat base, a dome topped by eight rhombuses, and additional triangular and step-cut facets between the dome top and the base. Top: view looking down upon the dome, parallel to the eight-fold axis. Bottom: view perpendicular to the eight-fold axis. After Schrauf (1869).



In Brief

- Colored stone rose cuts from the second half of the seventeenth century present widely varied and complex facet arrangements while generally following a symmetrical pattern.
- Five objects of liturgical insignia and electoral regalia originally belonging to the archbishops and prince-electors of Trier and Cologne were richly decorated with colored stones, including numerous rose cuts reflecting the broad variety of patterns available during the era.
- Rose-cut gems embellishing the pieces were fashioned from corundum (ruby and sapphire), peridot, garnet (pyrope-almandine and hessonite), and quartz (rock crystal and amethyst), in addition to diamond.
- The colored stone rose cuts studied can be characterized by the symmetry of the dome's center (e.g., four-fold, six-fold, eight-fold) and by the shape of the central facet (e.g., triangular, rhombus, kite).
- Cuts referred to as half-Dutch and full-Dutch roses, also seen in diamonds, and expanded Dutch roses were most common. The creativity displayed with colored stones resulted in a number of more complicated patterns that far exceeded what is known in diamonds.

thus considered extremely rare, an estimation borne out by their treatment in Schrauf (1869). There, a



Figure 5. Stones with rose cuts are still found frequently in the trade using garnet and quartz material. Left: Garnets displaying traditional patterns formed by multiple triangles, with the largest measuring 14×10 mm. Samples courtesy of Hermann Lind II, Idar-Oberstein. Center: Garnets where the rose pattern is created using rhombuses (upper left, 16×12 mm), squares (upper right, 14×14 mm), or triangles (all others). Samples courtesy of Hermann Lind II, Idar-Oberstein. Right: Quartz varieties with the rose pattern formed by rhombuses (upper left), triangles (lower left), or squares (upper and lower right), with the amethyst at the lower right measuring 10×10 mm. The samples were purchased at the Sainte-Marie-aux-Mines Mineral and Gem show in 2019. Photos by K. Schmetzer.

rose-cut garnet with a flat base and eight rhombus-shaped facets forming a central dome (figure 4) was drawn and characterized as a unique gem fashioned in the eighteenth century or before, and a similar stone with eight kite-shaped facets topping the central dome was also described as unique and very rare.

Rose cuts are still produced from multiple gem materials, primarily garnet (figure 5, left and center) and quartz (figure 5, right), and thousands of facet designs including numerous rose cuts can be found by interested users and cutters in modern texts (e.g., Long and Steele, 1979–1989) and online databases (e.g., FacetDiagrams.org). However, these are mainly cuts developed in the nineteenth or twentieth century, and the publications are silent as to whether the designs find any analogue in objects of eras past.

The colored stone rose cuts featured in the current study came to light during examination of five objects of liturgical insignia and electoral regalia. Four were from what is known as the Trierer Kurschatz (the treasury of the archbishops and prince-electors of Trier, who were one of the seven electors of the Holy Roman Empire¹). The work began principally with gemstone identification at the time the collection was publicly presented in October 2017 (“The Munich Show,” 2017). The investigation continued at the Diözesanmuseum Limburg (Museum of the Roman Catholic Diocese of Limburg), where the treasury is normally exhibited, with the focus turning in part to the cuts of the stones. It soon became apparent that these artifacts, dated to the second half of the seventeenth century, contained numerous colored stones with rose cuts differing markedly from the standard cuts presented for diamonds in gemological texts (again, see figure 2).

The study was then augmented by the addition of a seventeenth-century monstrance from the Dom-schatzkammer Köln (the Treasury of Cologne Cathedral, the Roman Catholic cathedral of the former archbishop and prince-elector of Cologne, another one of the seven electors of the Holy Roman Empire).

HISTORY OF THE LITURGICAL INSIGNIA AND ELECTORAL REGALIA

Trier/Limburg. The four pieces from the Limburg museum were crafted by different goldsmiths during the terms of two archbishops and prince-electors of Trier: Carl Caspar von der Leyen (Karl Kaspar von der Leyen), reigning 1652–1676, and Johann Hugo von Orsbeck, reigning 1676–1711 (figure 6; see also Kloft, 2016, for a synopsis of the history of the Limburg cathedral and museum). Information about the age and production of the various masterpieces, and the artisans responsible, derives primarily from accounts remaining from the respective periods of production, which were examined in detail by Michel (1925).

The monstrance (figure 7, top) was created in 1667 by the goldsmith Christian Schweling from Cologne. The crosier (figure 8, top) was made in 1672 by Johann Daniel Treudel from Frankfurt, and the processional cross (figure 8, bottom) was produced by the same goldsmith one year later, in 1673. The miter (figure 7, bottom) was started by Christian

¹The seven prince-electors constituted the electoral college that selected the emperor of the Holy Roman Emperor. In addition to the archbishops of Cologne, Trier, and Mainz, there were four secular electors: the King of Bohemia, the Count Palatine of the Rhine, the Duke of Saxony, and the Margrave of Brandenburg.



Figure 6. The liturgical insignia and electoral regalia now in the collection of the Museum of the Diocese of Limburg were commissioned in the second half of the seventeenth century by Carl Caspar von der Leyen, archbishop and prince-electoral of Trier (left, reigning 1652–1676), and his successor, Johann Hugo von Orsbeck (right, reigning 1676–1711).

Schweling in 1674. After his death in 1675, his son Cornelius Schweling took over and pursued the project until 1678. Following a decade-long interval, work on the miter was continued by Peter Boy from Frankfurt in 1688 and finished in 1691. Attribution of the various aspects of the miter's ornamentation to a particular craftsman has remained a subject of discussion (Clasen, 1993). The ensemble, together with other objects no longer extant such as a ceremonial sword, is referred to collectively as the Landrentamtspretiosen and contains some of the most richly decorated liturgical insignia and electoral regalia known. For instance, the miter alone is embellished with more than 3,300 gemstones, while the monstrance displays more than 3,100 gems.

During the reign of Johann Hugo von Orsbeck, the main residence of the archbishops and prince-electors of Trier was moved from Trier to the city of Koblenz, where the Ehrenbreitstein fortress was located. With the end of the Electorate of Trier, which took place

between 1801 and 1803, and the resignation of the last archbishop, Klemens Wenzeslaus, the territories on the right bank of the Rhine were annexed by Duke Friedrich Wilhelm of Nassau-Weilburg, who reigned from 1788 to 1816. In 1806 the Duchy of Nassau was established, and in 1822, Duke Wilhelm of Nassau, who reigned from 1816 to 1839 as Friedrich Wilhelm's successor, donated the Landrentamtspretiosen collection to the Diocese of Limburg (Luthmer, 1907; Kuhn, 1976).

In connection with this donation, the different objects underwent conservation work by a goldsmith from the city of Mainz, but gemstones, mainly diamonds from the miter, were stolen and replaced with other materials. After the manipulation was detected and most of the stolen gemstones were found, the miter was fully restored. In 1906, all the pieces were the beneficiary of additional conservation, this time performed carefully without altering the gemstone embellishment. Thus, while the documented history



Figure 7. Among the insignia and regalia from the treasury of the archbishops and prince-electors of Trier were a monstrance (top, 66 × 29 cm) created by goldsmith Christian Schweling from Cologne in 1667 and a miter (bottom, 44 × 31 cm) started by Schweling and his son Cornelius from 1674 to 1678 and later completed by Peter Boy of Frankfurt between 1688 and 1691. Courtesy of the Museum of the Diocese of Limburg.



Figure 8. Included within the insignia and regalia from the treasury of the archbishops and prince-electors of Trier were a crosier (top, 38 × 21 cm) crafted by Johann Daniel Treudel of Frankfurt in 1672 and a processional cross (bottom, 39.5 × 32.0 cm) fabricated by the same goldsmith in 1673. Courtesy of the Museum of the Diocese of Limburg.



Figure 9. Several inscriptions on a monstrance in the collection of the Treasury of Cologne Cathedral indicate that the object was donated in 1657 and 1658 by Maximilian Heinrich von Bayern, archbishop and prince-elect of Cologne (left, reigning 1650–1688), and his prime minister Franz Egon von Fürstenberg (right, serving 1650–1674).

would appear to suggest that only limited restorative work and substitution of damaged materials was undertaken, this does not exclude the possibility that single stones were lost through simple usage and replaced without explicit documentation (see Beitz, 1928).

Cologne. The monstrance in the collection of the Treasury of Cologne Cathedral bears two inscriptions evidencing its donation to the cathedral through transactions in 1657 and 1658. Maximilian Heinrich von Bayern, archbishop and prince-elect of Cologne (figure 9), who reigned from 1650 to 1688, is believed to have been the principal donor. Per the inscriptions, he was joined in the donation by Franz Egon von Fürstenberg (Clasen, 1983, 1989), his friend and the prime minister from 1650 to 1674. Filling multiple roles, Franz Egon also became the bishop of Strassburg in 1663. Creation of the monstrance (figure 10)

has been attributed to Christian Schweling, primarily through comparison with the Limburg piece, because contemporaneous documentation or accounts identifying the goldsmith responsible were not preserved (Beitz, 1928).

In 1975, the Cologne monstrance was stolen along with several other objects from the treasury. After an intensive police investigation in several countries, some of the stolen objects were found and returned, albeit partially damaged. The monstrance's return, with the remains having been located in five countries, was accompanied by detached portions of its decoration ranging from single loose stones to single stones within their gold settings and larger sections of the gold mounting holding several stones (e.g., a rosette with a central stone surrounded by a number of smaller gems). The state of disrepair revealed that most of the gold framework had been melted following removal of the stones.



Figure 10. On the basis of its design and craftsmanship, the monstrance (52 × 21 cm) from the Treasury of Cologne Cathedral has been attributed to the goldsmith Christian Schweling of Cologne (compare with figure 7, top). This photo of the Cologne monstrance was taken shortly before its theft in 1975. Courtesy of the treasury of Cologne Cathedral.

The monstrance was reconstructed using the original stones (approximately 85% of the original decoration consisting of more than 3,100 gemstones), with and without the original settings, and from the original gold. The work was performed by the goldsmith Peter Bolg from 1978 to 1987, spending two

days per week on the project (Peter Bolg, pers. comm. 2020; see also Clasen, 1983, 1989; Mösch, 1995; Bolg and Zieleskiewicz, 1995). Most of the larger colored stones, with the exception of two peridots and certain garnets and emeralds, were returned after the theft. Comparison of photographs taken before (fig-



Figure 11. Photos of the Cologne monstrance in its present state reflect the high quality of the goldsmith's work in the reconstruction with gemstones even being restored to their original locations (compare with figure 10). Photos by K. Schmetzer.

ure 10) and after (figure 11) the theft shows that the goldsmith succeeded in a reconstruction remarkably close to the seventeenth-century original.

Gemstone Provenance and Origin. Original documents concerning the provenance of the gemstones used in the artifacts contain limited information. Accounts available in the archives of the archbishops of Trier demonstrate that, in the majority of cases, the archbishops and prince-electors purchased the gemstones from local stone dealers or goldsmiths and, once the group of gems intended for a particular object was completed, submitted the collection to the goldsmith commissioned to prepare the masterpiece (Beitz, 1928).

A less frequent alternative is evidenced by financial records reflecting that the goldsmith was paid by

the archbishops and prince-electors for both the artwork and the stones (Kuhn, 1989, 1999). This suggests that the goldsmith had to purchase the stones, either from local middlemen or from a foreign cutter or dealer. Schweling is known to have taken both approaches, even traveling to Antwerp—a city hosting a large cutting industry at the time—to acquire gemstones (Beitz, 1930). Only one example is documented where gems were purchased by the archbishop and prince-electors of Trier directly from a foreign stone cutter or dealer in Antwerp and were then provided to Schweling for a chalice.

A high percentage of the rose-cut gems in the various regalia and insignia from Limburg and Cologne were garnets (see below), a fact that offers certain insights regarding potential origin, given the historical context. With respect to Germany, the art of cutting



Figure 12. Gemstones decorating the Limburg pieces, such as the monstrance shown here, were identified using energy-dispersive X-ray fluorescence (EDXRF) spectroscopy. Photo by H.A. Gilg.

garnet as rose cuts was brought to Nuremberg in 1590 by the Frenchman Claudius de la Croix. Competition thereby ensued between the cutting industries in Nuremberg and Freiburg and Waldkirch, a pair of cities neighboring one another in the Rhine Valley and the Black Forest. The resulting dispute was eventually resolved through the granting in 1601 of a privilege by Rudolf II, Holy Roman Emperor, in favor of Freiburg and Waldkirch.

The privilege stipulated that Bohemian garnets were to be cut and polished solely in Freiburg and Waldkirch. Nonetheless, available references indicate that only the relatively small Bohemian chromium-bearing pyropes, mainly up to 6 mm in size, were cut there during the seventeenth century, and the industry's importance declined with the French occupation of Freiburg from 1677 to 1697 (Trimborn, 1940; Kaiser, 2003). Thus, it is unlikely that the much larger pyrope-almandines and hessonites in the objects examined for this study came from the production at Freiburg and Waldkirch.

MATERIALS AND METHODS

The present study of colored stone rose cuts was based upon examination of five objects of liturgical insignia and electoral regalia: the miter, monstrance, processional cross, and crosier in the collection of the Museum of the Diocese of Limburg and the reconstructed monstrance in the collection of the Treasury of Cologne Cathedral. As mentioned above, the eval-

uation began when the author and Professor H. Albert Gilg (Technical University of Munich) were invited to examine the pieces from Limburg during their presentation at the 2017 Munich Show. On that occasion, work was restricted to determining gemstone identity, primarily through energy-dispersive X-ray fluorescence (EDXRF) spectroscopy in combination with Raman spectroscopy. Examination subsequently continued in Limburg in February 2018. At that time, Professor Gilg proceeded with identifying the gem materials (figure 12) while the author, together with Heidi and Helmut Bürger, gem cutters and cut designers, started to evaluate the various cuts employed. It soon became apparent that several thousand of the colored stones decorating the four objects were fashioned as different table and rose cuts.

The rose cuts were examined for further visual detail during April 2019 in Limburg by the Bürgers and the author using the unaided eye, a loupe, and optical microscopy at low magnification (figure 13). Sizes of gemstones in settings were estimated with a simple caliper. In general, sketches were drawn by the author and reviewed for accuracy by the Bürgers, and photos of the rose cuts were taken. Using the sketches and information from the photos, the author then prepared final drawings showing approximately 40 different cuts. In November 2019, those drawings were verified by the author through comparison with the objects at Limburg, and several ad-

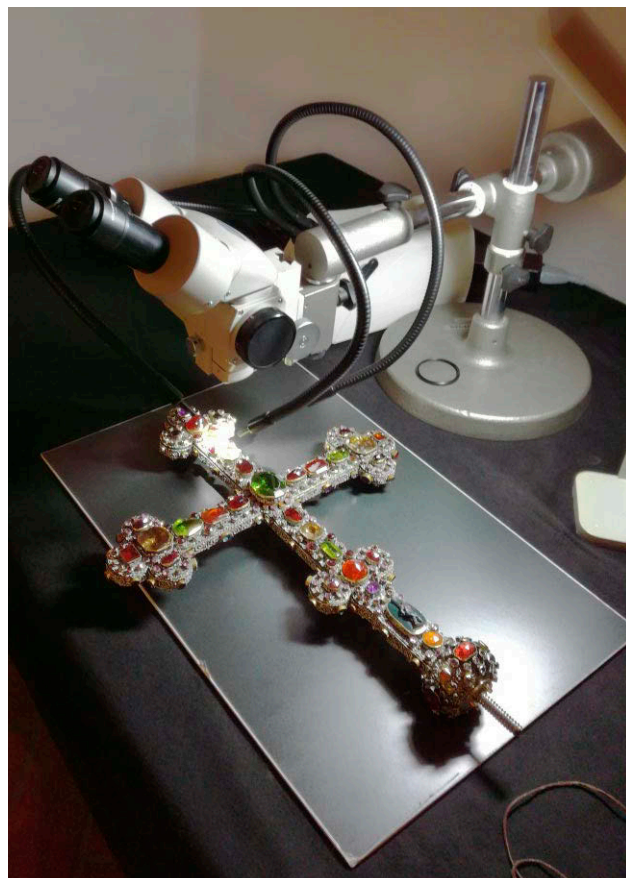


Figure 13. The cuts of the colored stones decorating the Limburg artifacts, including the processional cross, were examined by optical microscopy at low magnification. Photo by K. Schmetzer.

ditional sketches were prepared for gemstones that had proven to be of interest in the photos but had not previously been examined in detail.

In connection with restorations done in the nineteenth and twentieth century (see above), some lost gemstones were replaced, but without any detailed documentation. This was obvious for a limited number of stones with modern faceting styles such as table cuts and mixed cuts. There is, however, no indication that historical rose cuts were studied and gemstones were cut in the “old style” to replace lost stones.

The monstrance at Cologne was examined visually by the author in November 2019. As noted above, the monstrance was reconstructed after the 1975 theft, making extensive use of the original gem material recovered (Clasen, 1983, 1989; Bolg and Zieleskiewicz, 1995). To ensure that the study focused on historical gems cut prior to the 1658 dona-

tion to the cathedral, rather than material purchased for the reconstruction, the author in 2020 consulted with the goldsmith Peter Bolg and the gem merchant August Wintermantel, who supplied all the diamonds and colored stones for Bolg’s reconstruction. Visiting the Wintermantel firm in Waldkirch in 2020, the author was also able to review and copy a list of missing stones, several hand-drawn sketches identifying their position within the piece, and notes and invoices in the archives of the company.

The insight obtained may be summarized as follows:

- Missing rose-cut diamonds were replaced with rose-cut diamonds of appropriate sizes taken from other historical jewelry pieces or cut to the sizes needed.
- Missing colored stones were either selected from the stock of the A. Wintermantel firm (e.g., garnets of appropriate size and shape) or cut from rough to the desired form (e.g., cabochon sapphires and garnets or table-cut emeralds).
- Invoices indicate that five garnets cut as standard full-Dutch roses (10 mm or smaller) with a crown of 24 facets were used to replace missing stones.
- The more complex rose cuts of the original colored stones remaining were not examined in detail in the reconstruction years from 1978 to 1987, and no attempt was made to facet any similar examples to replace missing materials.

The information collected in Munich, Limburg, and Cologne is expected to lead to three distinct works. The present paper is focused on describing the rose cuts found in the regalia and insignia from Limburg and Cologne. These results also stimulated developments in modern cut design, especially rose cuts that use pavilion facets for gemstones with high brilliancy (H. Bürger, in preparation). A comprehensive description of the four Limburg objects is likewise anticipated (H.A. Gilg, in preparation).

RESULTS

Overview of Embellishment and Gemstone Properties—Limburg Objects. For purposes of understanding the context that frames the detailed discussion of rose cuts to follow, a broad overview of the general appearance of the objects is given below. As noted previously, further specifics are not within the scope of this study and will be published elsewhere.



Figure 14. The gemstones embellishing the pieces from the Limburg museum and the Cologne treasury were grouped in decorative assemblages and mounted in closed bezel settings. Left: From the Limburg monstrance: table-cut peridots, together with a rose-cut garnet (center, 35.0 × 12.5 mm) and smaller faceted and cabochon garnets. Right: From the Cologne monstrance: table-cut peridots, together with a rose-cut amethyst (center, 23 × 18 mm) and faceted garnets of varying sizes, including rose cuts. Photos by K. Schmetzer.

Gem Varieties. The minerals and gem varieties, as well as any significant modification such as foil backing, that were identified by a combination of EDXRF, Raman spectroscopy, and visual examination most commonly included:

- Diamond
- Corundum: ruby, sapphire
- Emerald
- Peridot
- Garnet: pyrope-almandine, hessonite
- Quartz: rock crystal (colorless, yellow with foil backing, and orange with foil backing), amethyst
- Pearl

The foregoing formed the vast majority of the thousands of colored stones decorating the pieces. A few far rarer materials comprised two pink spinel cabochons, one faceted colorless topaz (presumably a replacement stone) surrounded by smaller diamonds, and several samples of glass in various colors.

Mounting and Sizes. The gemstones were secured in the mountings with a closed bezel setting (figure 14). No part of the girdle or, if present, pavilion was visible, rendering it impossible to evaluate the degree to which the bases might be flat, curved, or faceted. Definitive measurement of dimensions was similarly restricted, so only approximate sizes will be given in the figure captions. Such will afford a general impres-

sion of the sizes of gems available and used in the second half of the seventeenth century.

Diamond Cuts. The diamonds had been faceted in a variety of styles. Pyramidal point cuts, quadratic and rectangular table cuts, cuboids, full-Dutch roses, trihedral roses, and pear-shaped roses were observed. Each such type is known from the literature on diamond cutting conventions (e.g., Tillander, 1995; see also for nomenclature and definitions).

Colored Stone Cuts. The colored stones incorporated those with table facets, those shaped as cabochons, and those fashioned as rose cuts. The samples with table facets presented a multitude of outline shapes (again, see figure 14):

- Irregular forms
- Octagons
- Hexagons
- Quadrilateral forms: squares, rectangles, rhombuses, kites, isosceles trapezoids
- Three-sided forms: equilateral triangles, isosceles triangles
- Pear-shaped forms

Only the relatively small faceted rubies, about 5–6 mm in size, showed table cuts with somewhat irregular shapes. The tables were surrounded by a row of small step-cut facets (figure 15).

The other colored stones (blue sapphire, emerald, peridot, garnet, and quartz) displayed regular symmetrical cuts. Most exhibited step cuts with one or two rows of eight, six, four, or three crown facets each, parallel to the edges of the table. A few stones with more complex, modern faceting styles (e.g., mixed cuts) are thought to be nineteenth- and twentieth-century replacements of gems lost during usage. A similar assumption of later replacement might apply to the single faceted topaz and the few glass simulants.

Faceted stones without tables (i.e., rose cuts) were found only in a subset of the colored stone varieties seen in the Limburg pieces:

- Corundum: ruby, sapphire
- Peridot
- Garnet: pyrope-almandine, hessonite
- Quartz: rock crystal (colorless, yellow with foil backing, and orange with foil backing), amethyst

Cabochons with a round or oval shape also made an appearance among the colored stones, particularly the garnets.

Previous Use and Surface Indentations. There were only a small number of stones with drill holes indicating previous use in other jewelry items (figure 16, left). Samples with surface indentations were also present (figure 16, right), reflecting a technique used since the Middle Ages in India and Sri Lanka to remove impurities (see, e.g., Schmetzer and Gilg, 2020). The facet edges of some stones were highly abraded, which might indicate previous use in other pieces of jewelry.

Consideration of Embellishment for Comparative Purposes—Cologne Object. Insofar as the Cologne monstrance is thought to have been crafted by the same goldsmith as the Limburg piece, the general style paralleled that described above. The forms and facet style of gemstones with table facets were comparable with the colored stones from Limburg. Some of the gemstones that returned after the theft in an unmounted state showed faceted pavilions, but the cuts were not studied in detail (Peter Bolg and August Wintermantel, pers. comms., 2020).

As specifically relevant to this study, the rose cuts were fashioned from:



Figure 15. Rubies from group 1 are found as rose cuts with a somewhat irregular surface pattern (left column), as table cuts with large tables and one row of step-cut facets (middle column), or as irregularly shaped, polished pebbles (right column). The larger stones measure about 5.5 to 6.0 mm in diameter.

- Corundum: blue sapphire
- Garnet: pyrope-almandine
- Quartz: rock crystal (colorless, yellow with foil backing), amethyst

Detailed Description of Rose Cuts. The various rose cuts observed in the five objects studied are grouped and presented according to the form of the central facets (e.g., triangular, lozenge, kite) in combination with the number of central facets present. This reflects the symmetry of the dome's center (e.g., four-fold, six-fold, and eight-fold, or somewhat distorted four-fold, six-fold, and eight-fold). In addition, visually similar cuts were added to some of the main groups, even if the individual example did not belong to that particular main group in a strict sense. The author wants to underline that this is one of the alternatives to group the various cuts observed and present the results of the study. The accompanying line drawings are schematic representations and should help to understand the cuts shown in the different photos.

Non-Symmetrical Cuts (Group 1). While the great majority of the colored stone rose cuts displayed highly symmetrical fashioning, a few stones had no symmetrical pattern. These outliers consisted of one garnet and several rubies—the only faceted rubies without a table, approximately 5.5 to 6.0 mm in diameter—that showed facets of different sizes and no symmetrical surface pattern (again, see figure 15). Rather, the appearance was consistent with an irregularly shaped pebble that had simply been covered with random facets. It has already been mentioned

that, different from all the other gemstones, the rubies with tables also did not show completely symmetrical cuts but, in some examples, only some irregular facets inclined to the table. Furthermore, some rubies were irregularly shaped pebbles with polished surfaces. These results indicate that only small rough rubies were available in the second half of the seventeenth century and that cutters tried to keep the rough as large as possible.

Domes Topped with Six Triangular Faces: Half-Dutch and Full-Dutch Roses (Group 2). A small subset of the garnets was cut as half-Dutch roses (figure 17, A and B), while a large number took the form of full-Dutch roses (figure 17, C and D). The samples were characterized by six-fold symmetry with a dome centered on six triangular faces. Round or near-round to slightly oval shapes were widespread (figure 17, A and C), but examples of elongated ovals through stretching of the triangles in certain directions were also common (figure 17, B and D).

Expanded Dutch Roses (Group 3). Larger samples often expanded on the standard Dutch rose forms with additional rings or rows of triangular facets. Round or near-round samples resulted from retaining six triangular facets at the center of the dome but increasing the number of circumscribing rings of triangles (figure 18A). More oval-shaped forms were derived if the number of triangular facets differed in two perpendicular directions (figure 18B). Yet another variation to produce larger oval stones featured the addition of trapezoidal faces between the center and girdle (figure 18C).

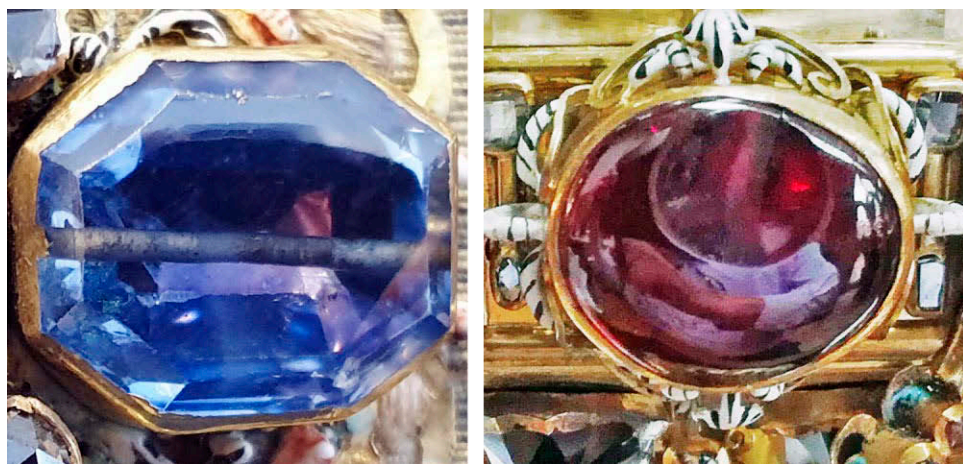


Figure 16. Drill holes were seen in a small number of stones, as here in a 12 × 10 mm blue sapphire (left), indicating prior use in other jewelry items. Also present on occasion were polished surface indentations, here demonstrated in a 19 × 17 mm garnet (right), reflecting a technique used since the middle ages to remove impurities. Photos by K. Schmetzer.

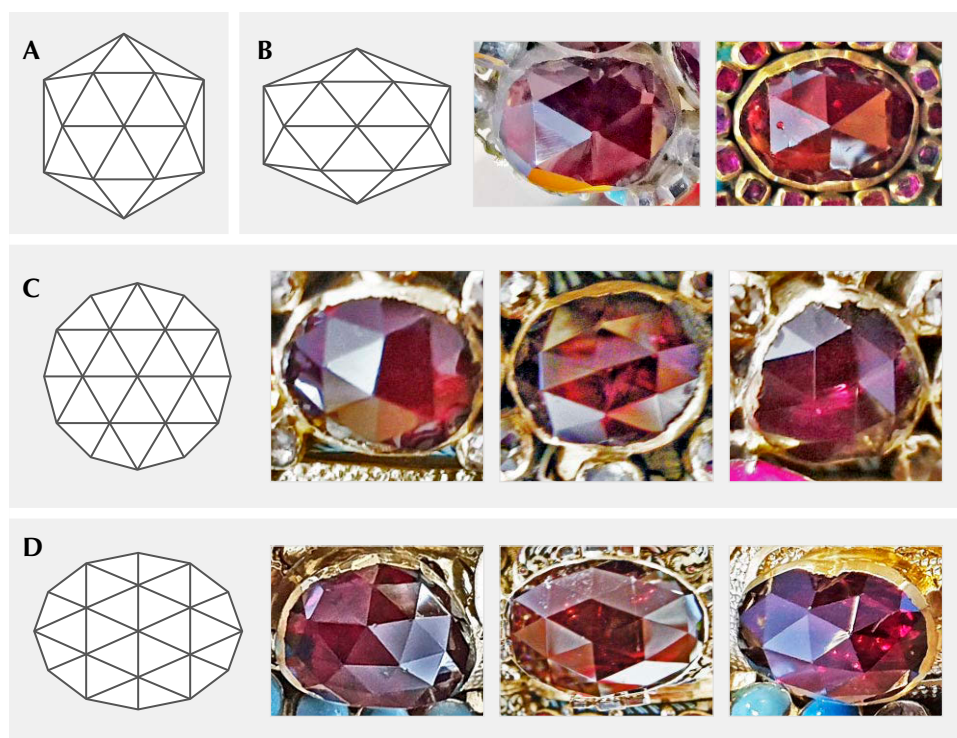


Figure 17. Group 2 garnets with half-Dutch rose cuts (A, B) and full-Dutch rose cuts (C, D) from the Limburg and Cologne insignia displayed outlines approximating round, almost round to slightly oval (A, C) or oval (B, D). B: Both 15×11 mm. C (left to right): 8×7 mm, 8×7 mm, and 7×7 mm. D (left to right): 20×16.5 mm, 30×21 mm, and 9×7 mm. Drawings and photos by K. Schmetzer.

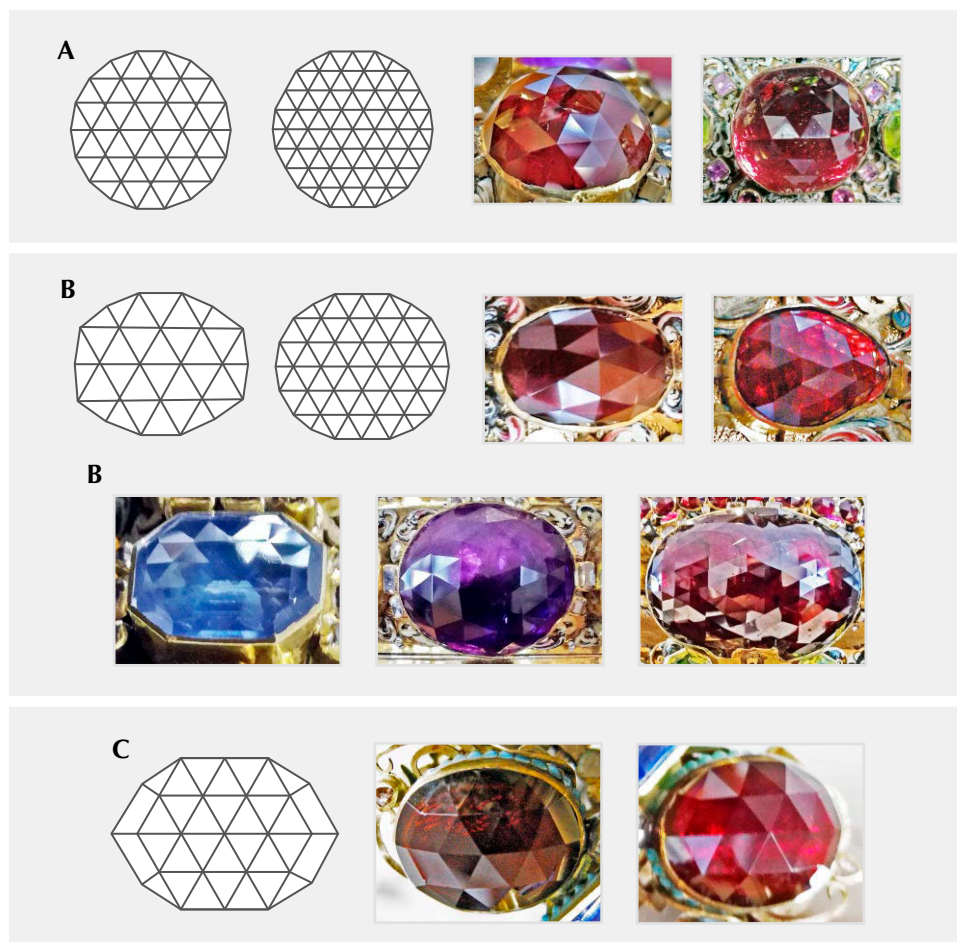


Figure 18. Larger garnet, quartz, and sapphire samples from group 3 exhibited expanded Dutch rose forms with additional rings or rows of triangular facets. Round outlines resulted from simply increasing the number of circumscribing rings (A). More oval stones derived from the addition of different numbers of facets in perpendicular directions in the horizontal and vertical rows of facets running through the center (B) or the addition of trapezoidal facets at two ends of the samples (C). A: 16.0×14.5 mm garnet (left) and 28×27 mm foil-backed quartz (right). B, upper row: 9×7 mm and 13×9 mm garnets. B, lower row: 12×8 mm sapphire (left), 34×29 mm amethyst (center), and 56×38 mm garnet (right). C: Two garnets, each measuring 18×15 mm. Drawings and photos by K. Schmetzer.

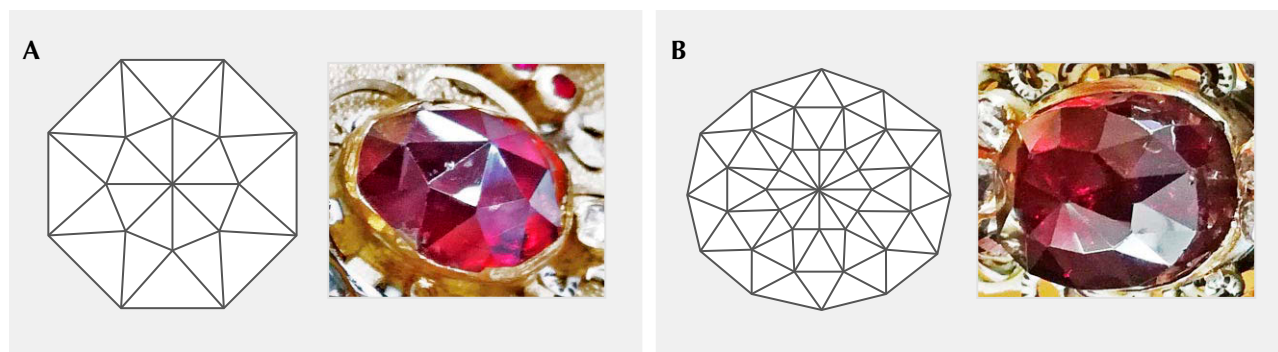


Figure 19. Group 4 consisted of a small number of samples presenting domes topped by either eight (A) or 12 (B) identical triangles. Additional triangles extended toward the girdles. A: 13 × 11 mm garnet. B: 13.0 × 11.5 mm garnet. Drawings and photos by K. Schmetzer.

Domes Topped with Eight or 12 Triangles (Group 4). A few samples incorporated a pattern where the domes centered on eight or 12 triangles and where the consequent overall symmetry was either eight-fold (figure 19A) or six-fold (figure 19B), respectively.

Domes Topped with Four Triangles Meeting at Right Angles (Group 5). Certain gems featured four triangular facets meeting at right angles in the center and grouped into a square or rhombus. That pattern could

be repeated several times to produce a nearly circular (figure 20A) or octagonal (figure 20B) outline, among others. Step-cut facets might also be added along the girdle, resulting in a range of octagonal shapes, depending on the arrangement and number of faces (figure 20, C and D). A sample with an analogous cut shifted the pattern to place two triangles at the center (figure 20E).

Domes Topped with Four or Eight Triangles Not Meeting at Right Angles (Group 6). The domes of

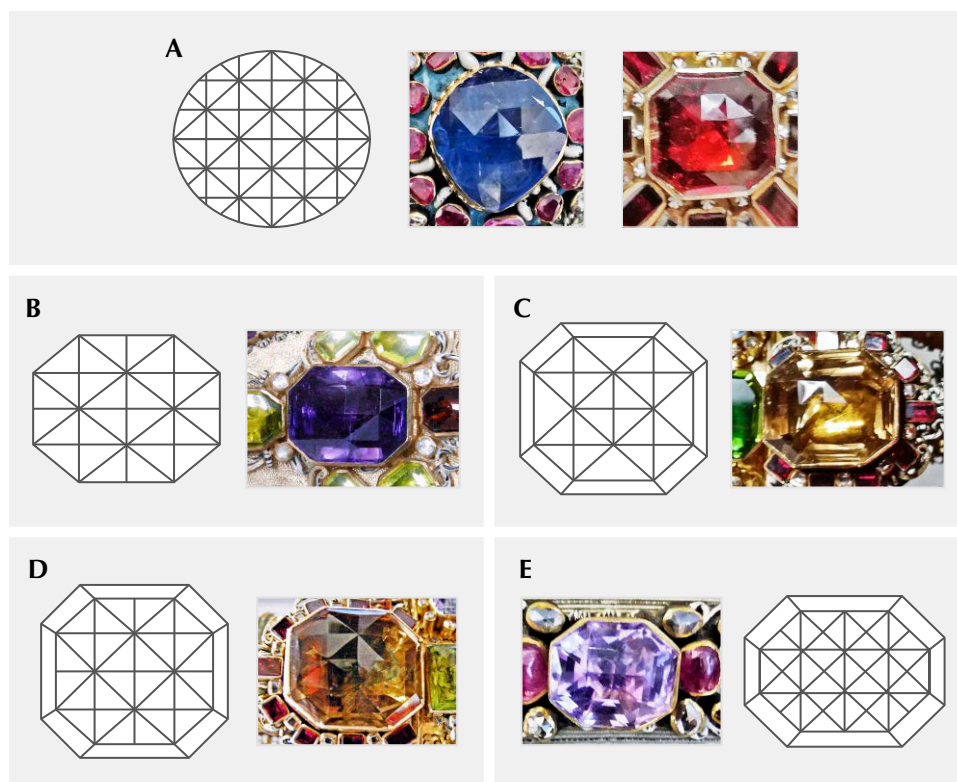


Figure 20. In group 5, the domes centered on four triangular facets meeting at right angles. The pattern then generally repeated outwards (A, B) and could also be augmented by the addition of step-cut facets close to the girdle (C, D). An analogous sample shifted the pattern so that just two triangles met at the central point (E). A: 28 × 25 mm sapphire (left) and 19 × 19 mm garnet (right). B: 23 × 18 mm amethyst. C: 30 × 25 mm foil-backed quartz. D: 28 × 25 mm foil-backed quartz (left) and 12 × 10 mm amethyst (right). Drawings and photos by K. Schmetzer.

some samples were topped with four or eight triangular facets not meeting at right angles and grouped into a rectangle or rhombus. The simpler form used four triangles (figure 21A), while the splitting of each of those four triangles led to eight triangles (figure 21, B–E). Beyond the central rectangle or rhombus, the outer patterns varied widely, with some relying entirely on different arrangements of triangles (figure 21, B–D) and others combining triangles, trapezoids, and a step-cut facet close to the girdle (figure 21A). An example of a rather complex pattern is seen in figure 21E. A sample with a similar cut showed only two triangles meeting at the center (figure 21F). This cut could also be assigned to group 13 (domes cut with mirror symmetry).

Domes Topped with Three or Four Rhombuses or Kites (Group 7). Some gemstones exhibited a dome topped by three (figure 22A) or four (figure 22B) identical rhombuses. Between those rhombuses and the

girdle, a range of different trapezoidal, triangular, or quadrilateral facets could be used. The outer perimeter might also incorporate four or eight additional step-cut facets to form a rectangular (figure 22C) or octagonal (figure 22D) outline. A related variation used four kites in the center (figure 22, E and F), as opposed to rhombuses.

Domes Topped with Six Rhombuses or Kites in Three Different Orientations (Group 8). In another group of samples, the central pattern consisted of six rhombuses or kites forming a six-rayed star (figure 23A). That pattern could be expanded outward through repetition of rhombuses oriented in three directions (figure 23B). Together with triangular or quadrilateral facets on the perimeter, oval or almost rectangular gemstones could result (figure 23, C and D). Hexagonal outlines were created when step-cut facets abutted the girdle (figure 23, E and F).

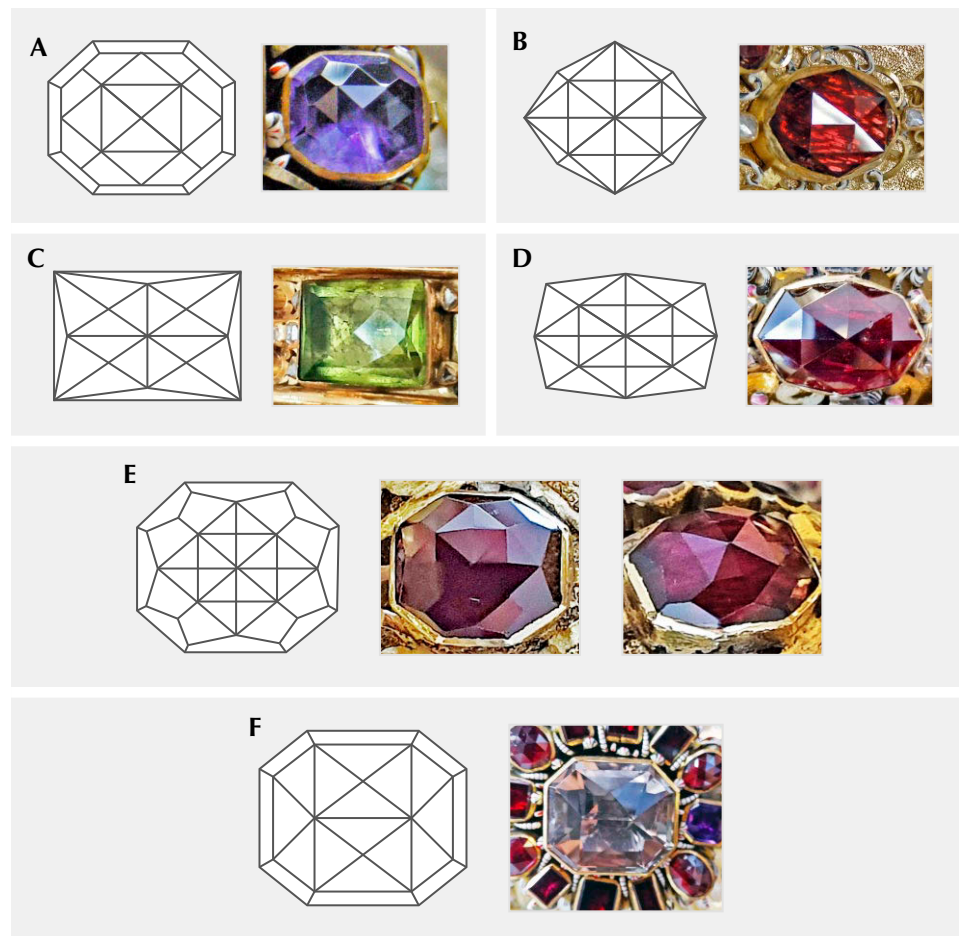


Figure 21. Group 6 stones featured at the apex of their domes, either four (A) or eight (B–E) triangular facets not meeting at right angles. Surrounding those facets were further triangles (B–D) or triangles plus trapezoids (A), and the pattern could become rather complex (E). A variation with a similar appearance had been cut such that only two triangles topped the dome (F). A: 8 × 8 mm amethyst. B: 19 × 14 mm garnet. C: 16 × 11 mm peridot. D: 19 × 14 mm garnet. E: Two garnets, each measuring 11 × 8 mm. F: 19 × 17 mm quartz. Drawings and photos by K. Schmetzer.

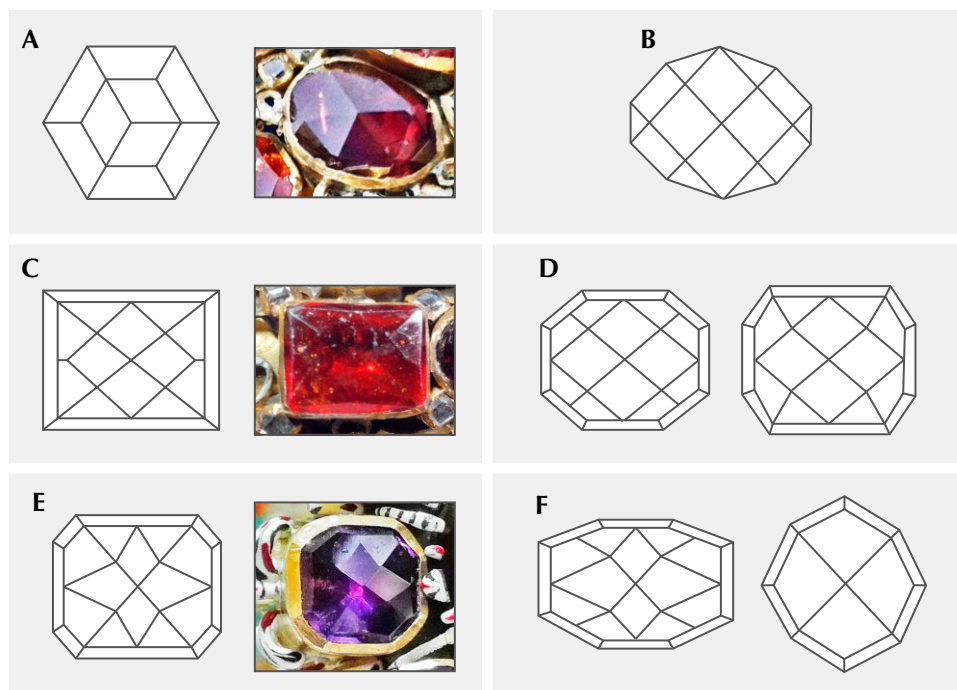


Figure 22. Samples in group 7 displayed domes topped by three or four rhombuses (A–D) or kites (E, F). A: 10 × 9 mm garnet. C: 11 × 8 mm garnet. E: 7 × 6 mm amethyst. Drawings and photos by K. Schmetzer.

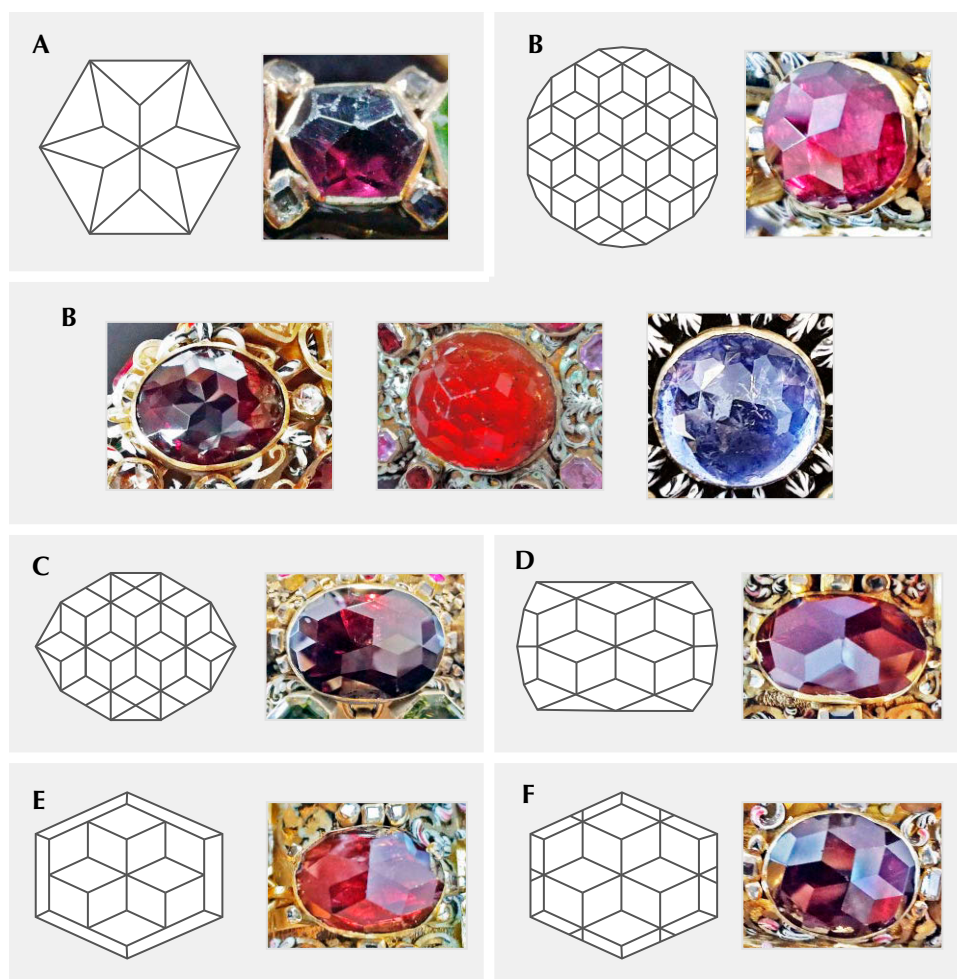


Figure 23. In group 8, a pattern of six rhombuses or kites in three orientations resulted in gemstones centered on a six-rayed star (A, B). The addition of other facet shapes as the design radiated could lead to oval or almost rectangular outlines (C, D), while augmentation with step-cut facets abutting the girdle produced hexagonal outlines (E, F). A: 7 × 7 mm garnet. B, upper row: 8 × 7 mm garnet. B, lower row: 28 × 22 mm garnet (left), 21 × 19 mm foil-backed quartz (center), and 12 × 12 mm sapphire (right). C: 28 × 22 mm garnet. D: 22.0 × 13.5 mm garnet. E: 20 × 15 mm garnet. F: 20 × 17 mm garnet. Drawings and photos by K. Schmetzer.

Domes Topped with Six Rhombuses in Three Different Orientations, Some or All Further Split (Group 9). More complex patterns could also be derived from the basic concept of domes topped by six rhombuses through the splitting of some or all of such facets into two components. In some samples, the rhombuses oriented in just one direction were split (figure 24, A and B). In others, the splitting occurred in all three possible directions (figure 24, C–E). A similar concept and appearance could be derived by splitting the triangles of expanded Dutch roses (figure 24F), particularly in round or oval samples (figure 24, G and H).

Domes Topped with Eight Rhombuses or Parallelograms (Group 10). Another group of stones comprised domes topped by eight rhombuses or parallelograms (figure 25, A and B), for an appearance resembling the so-called cross roses described by Schrauf (1869). Between the dome top and girdle, additional step-cut facets were frequently included (figure 25, C–E). The outline shapes were octagonal (figure 25, A–D) or rectangular (figure 25E), with varying ratios of length to width. A comparable but more complex pattern with an additional ring of triangular facets is shown in figure 25F.



Figure 24. In group 9, the central rhombuses otherwise forming a six-rayed star could be split, i.e., subdivided into two components, along one direction (A, B) or along three directions (C–E). A similar principle could be applied to splitting the triangles in gemstones with expanded Dutch rose cuts (F–H). A: 13×10 mm garnet. B: 16×14 mm garnet. C: 7×7 mm garnet. D: 10×8 mm garnet. E: 11×8 mm garnet. G: 9×8 mm garnet (left) and 23×22 mm sapphire (right). H: two garnets, each measuring 13×9 mm. Drawings and photos by K. Schmetzer.

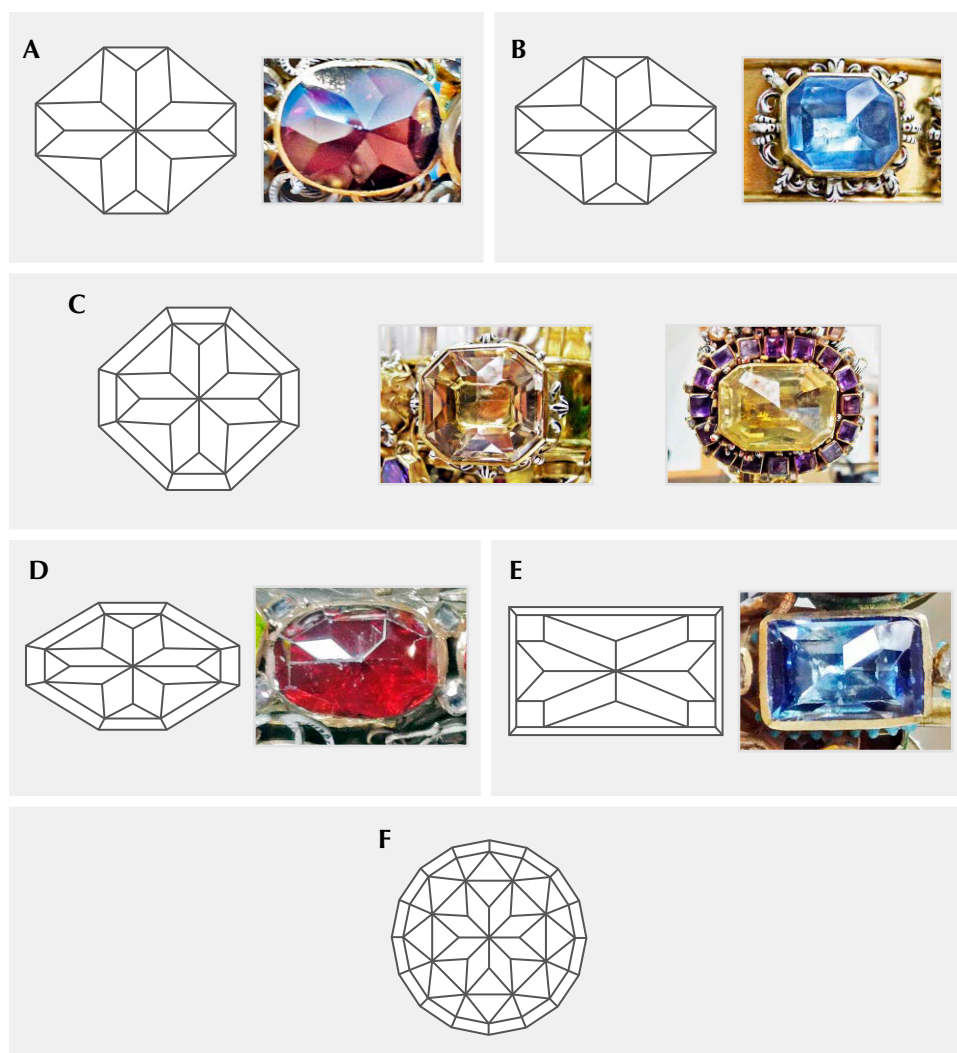


Figure 25. Domes topped by eight rhombuses or parallelograms reflected the signature feature of the so-called cross roses in group 10. Extending toward the girdle were additional triangular (A, B) or triangular plus step-cut facets (C–E). The potential complexity is illustrated by the sapphire drawn in F with a dome topped by eight kites. A: 16 × 12 mm garnet. B: 15 × 13 mm sapphire. C: Foil-backed quartz measuring 22 × 20 mm (left) and 28 × 20 mm (right). D: 12 × 9 mm garnet. E: 12 × 7 mm sapphire. Drawings and photos by K. Schmetzer.

Domes Topped with Rhombuses in Parallel Orientation (Group 11). Some stones were topped by a re-

peating pattern of numerous rhombuses in parallel orientation, terminating in triangular facets at the

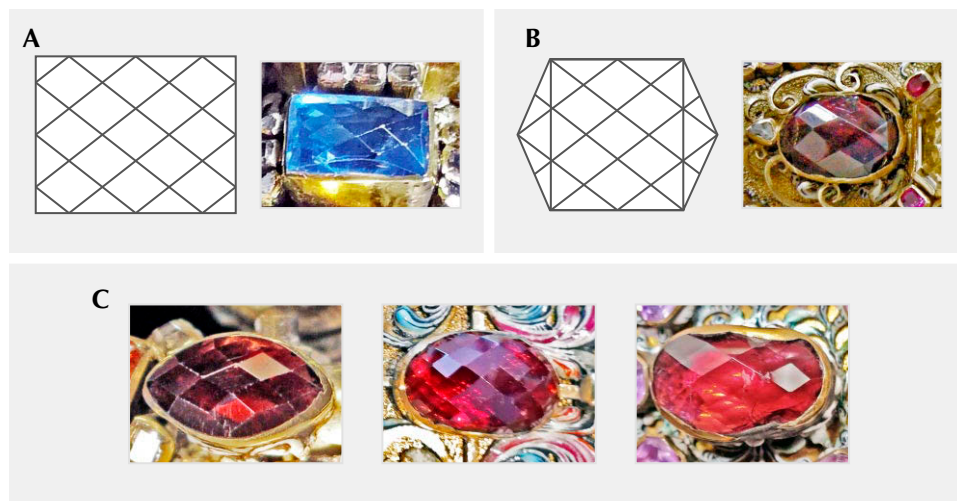


Figure 26. Repeating patterns of rhombuses in parallel orientation top the domes of group 11 gemstones with rectangular (A), hexagonal (B), or navette to oval (C) forms. A: 13 × 10 mm sapphire. B: 16 × 10 mm garnet. C: Garnets measuring 10.0 × 4.5 mm (left), 23 × 18 mm (center), and 13 × 8 mm (right). Drawings and photos by K. Schmetzer.

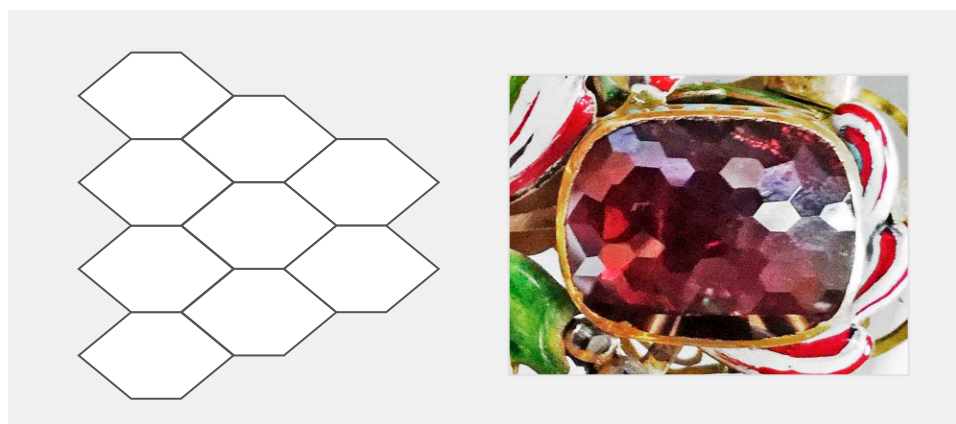


Figure 27. The one garnet in group 12, measuring 16×12 mm, was cut with small hexagonal facets covering the surface. Drawing and photo by K. Schmetzer.

girdles. The style led to rectangular (figure 26A), hexagonal (figure 26B), or marquise to oval forms (figure 26C).

Dome Topped with Small Hexagons (Group 12). One garnet was cut with numerous small hexagons covering the surface. These hexagons were slightly distorted, with small variances in size (figure 27).

Domes Cut with Mirror Symmetry (Group 13). The most complex cuts were observed in several samples

with solely mirror symmetry. Some gems showed faceting arrangements with two perpendicular mirror planes (figure 28, A–D), while others displayed only one mirror plane (figure 28, E–G).

DISCUSSION AND CONCLUSIONS

The insignia and regalia from Limburg and Cologne exhibited a wide variety in the arrangement and design of the gemstone embellishment. Stones with the same cutting style (e.g., table, rose, or cabochon) were frequently grouped together to create attractive pat-

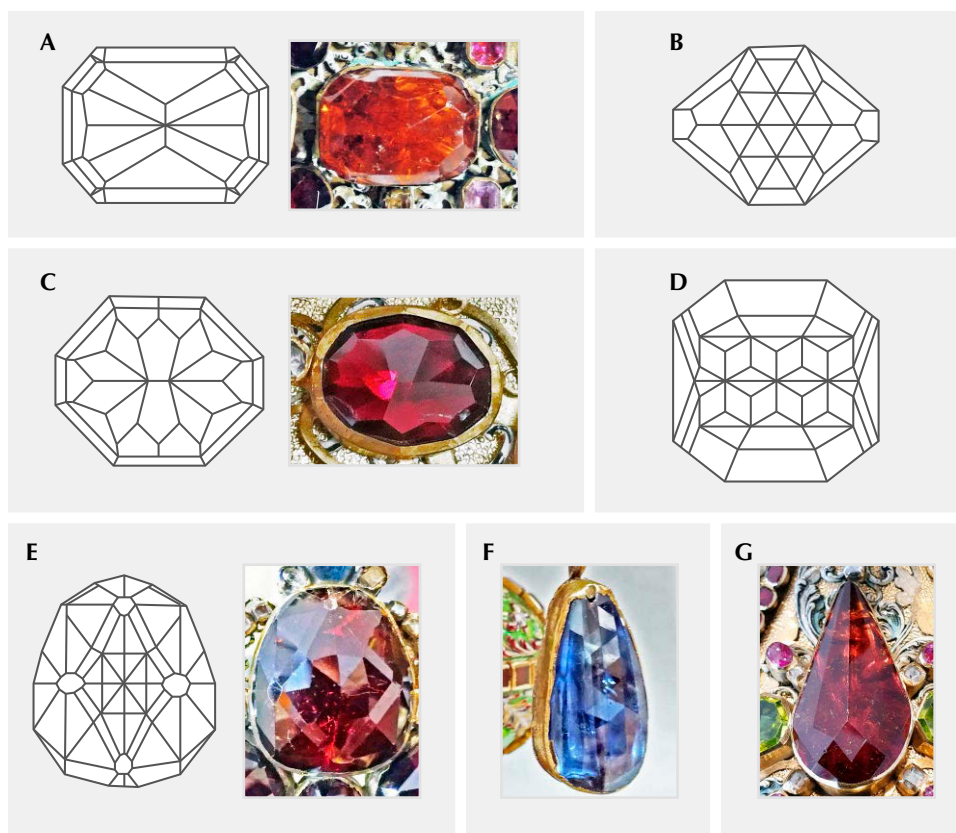


Figure 28. The small number of samples in group 13, including garnets and sapphires, offered the most complex cuts observed. They were characterized solely by mirror symmetry either along two perpendicular mirror planes (A–D) or along one mirror plane forming the longitudinal axis of the stones (E–G). A: 19×14 mm garnet. C: 13×10 mm garnet. E: 27×22 mm garnet. F: 26×14 mm sapphire. G: 35.0×12.5 mm garnet. Drawings and photos by K. Schmetzer.

terns, but groupings that mixed cutting styles were also common (figures 14, 29, and 30). While detailed description of the decorative arrangement is beyond the scope of this study, the cuts of the constituent gemstones offer notable insights about the practices of the time. Among the colored stones there were multiple table cuts, but the vast majority were similar step cuts with one or two rows of facets inclined to the table. In contrast, when surveying the rose cuts, defined for these purposes as gems without any central flat facet of substantial size, the range of creativity is striking.

The exacting nature of the cuts of colored stones in all sizes reveals the skill of the craftsmen in the second half of the seventeenth century (see the various examples in figures 17–28). The high symmetry and precise finish of the cuts, as observed in almost all samples of rose-cut gemstones studied in Limburg and Cologne, demonstrate what was considered beautiful according to the fashion of the Baroque era. Unfortunately, the historical record indicates that with the decline in popularity of rose-cut diamonds, the wide variety of colored stone rose cuts was lost as well, and only a small subset of standard cuts survived over the following centuries.

The most populous groups of colored stone rose cuts were groups 2 and 3, namely half-Dutch and full-Dutch roses and expanded Dutch roses. While other groups showed variations on the overarching theme, they tended to comprise a smaller number of examples with each cut, normally not exceeding five, with many variations only represented by three, two, or even a single gemstone. This indicates that these more complex cuts were less often produced, but it does not imply that a particularly extraordinary cut should be deemed unique. To cite a case in point, a cut with a dome topped by 10 (4 + 4 + 2) facets, as seen in figure 28C, was found in three garnet samples, evidencing an established rule or design.

If the rose cuts observed for colored stones are compared with those historically used for diamonds (see, e.g., Tillander, 1995), the half-Dutch and full-Dutch roses of group 2 readily find equivalents. Likewise having analogues in diamond jewelry of the Baroque era are the cuts summarized in group 5 (domes topped with four triangles meeting at right angles; figure 20) and group 11 (rhombuses in parallel orientation; figure 26). From other groups, certain variations are also known in diamonds, such as sample C of group 9 (dome topped with six split rhom-

Figure 29. The decorative groupings that embellished the regalia and liturgical insignia frequently mixed cutting styles. The examples here show rose-cut garnets surrounding a 12.0 × 11.5 mm step-cut garnet with a large table facet in the miter from Limburg (left) and a 19 × 17 mm rose-cut quartz surrounded by amethysts with varied forms and cuts in the monstrance from Cologne (right). Photos by K. Schmetzer.





Figure 30. The same overall pattern of gemstones—in this example consisting of five garnets, grouped together in one section of the foot of the Cologne monstrance—is prepared with samples showing a great variability in cutting style. The white arrow points to a garnet measuring 13×10 mm. Photos by K. Schmetzer.

buses three different orientations; figure 24) or sample A of group 4 (dome topped with eight triangles; figure 19). Conversely, other more complex cuts have no recognized parallel to date in diamonds. A logical

explanation could be that such large pieces of rough material as found in quartz or garnet simply did not exist for diamonds, or at least was available in only a few extremely rare pieces.

ABOUT THE AUTHOR

Dr. Schmetzer is an independent researcher residing in Petershausen, near Munich, Germany.

ACKNOWLEDGMENTS

The author is grateful to the Catholic dioceses of Limburg and Cologne and the directors of the Limburg and Cologne museums, Dr. M. T. Kloft and Dr. L. Becks, for the opportunity to examine the regalia and insignia from the respective treasuries.

Appreciation is also expressed for assistance in practical work to the members of the museum's team in Limburg (M. Benecke, D. Müller, H. Müller, M. Scheidler, O. Teufer, and M. Vollmar) and to C. Baumsteiger in Cologne. Details concerning the restoration of the Cologne monstrance and the gemstones used were helpfully provided by goldsmith P. Bolg from Cologne and gemstone merchant A. Wintermantel and the company's present director, his son B. Wintermantel, from Waldkirch near Freiburg.

REFERENCES

- Beitz E. (1928) Die Goldschmiede Christian Schweling zu Köln. *Wallraf-Richartz-Jahrbuch*, Vol. 5, pp. 95–100.
- Beitz E. (1930) Christian Schweling der Aeltere, der Meister der Dommonstranz von 1658. In Kuphal, E. Ed., *Der Dom zu Köln. Festschrift zur Feier der 50. Wiederkehr des Tages seiner Vollendung am 15. Oktober 1880*. Verlag des kölnischen Geschichtsvereins e.V., Cologne, pp. 177–183.
- Bolg P., Zieleskiewicz P. (1995) Der Domschatzraub 1975. Restaurierungs- und Wiederherstellungsbericht. *Kölner Domblatt*, Vol. 60, pp. 269–290.
- Clasen C.-W. (1983) Die Wiederherstellung der Kölner Dommonstranz mit Hilfe der Photogrammetrie. *Jahrbuch der Rheinischen Denkmalpflege*, Vol. 29, pp. 123–134.
- Clasen C.-W. (1989) Die goldene Dommonstranz von 1657/58. Ihr Schicksal und ihr Meister Christian Schweling. *Kölner Domblatt*, Vol. 54, pp. 123–158.
- Clasen C.-W. (1993) *Peter Boy: Ein rheinischer Goldschmied und Emailmaler der Barockzeit und der Schatzfund von Perscheid*. Rhein-Merzbach, CMZ-Verlag, pp. 43–50.
- De Bie A. (2014) The paradox of the Antwerp rose: Symbol of decline of token of craftsmanship? In K. Davids and B. De Munck, Eds., *Innovation and Creativity in Late Medieval and Early Modern European Cities*. Ashgate Publishing Company, Farnham, UK, pp. 269–293.
- Eppler A., Eppler W. Fr. (1934) *Edelsteine und Schmucksteine*. Wilhelm Diebener G.m.b.H., Leipzig, 554 pp.
- Falk F. (1975) *Edelsteinschliff und Fassungsformen im späten Mittelalter und im 16. Jahrhundert*. Verlag Wilhelm Kempfer KG, Ulm, Germany, 150 pp.
- Forsyth H. (2013) *The Cheapside Hoard: London's Lost Jewels*. Museum of London, London, 248 pp.
- Gans M.H. (1961) *Juwelen en mensen*. J.H. de Bussy, Amsterdam, pp. 79–160.
- Gilbertson A. (2007) *American Cut – The First 100 Years: The Evolution of the American Cut Diamond*. Gemological Institute of America, Carlsbad, California, 214 pp.
- Kaiser M.J. (2003) Das Edelsteingewerbe in Freiburg und Waldkirch im Spiegel archäologischer und historischer Quellen. *Fundberichte aus Baden-Württemberg*, Vol. 27, pp. 1045–1172.
- Klein G. (2005) *Faceting History: Cutting Diamonds & Colored Stones*. Published by the author, 242 pp.
- Kloft M.T. (2016) *Dom und Domschatz in Limburg an der Lahn*. Karl Robert Langewiesche Nachfolger Hans Köster Verlagsbuchhandlung, Königstein im Taunus, 123 pp.
- Kockelbergh I., Vleeschdrager E., Walgrave J. (1992) *The Brilliant Story of Antwerp Diamonds*. MIM n.v., Antwerp, 303 pp.
- Kuhn H.W. (1976) Zur Geschichte des Trierer und Limburger Domschatzes. *Archiv für mittelhessische Kirchengeschichte*, Vol. 28, pp. 155–207.
- Kuhn H.W. (1989) Peter Boy. Goldarbeiter und Emailmaler des Barock. *Jahrbuch für westdeutsche Landesgeschichte*, Vol. 15, pp. 117–157.
- Kuhn H. (1999) Der Frankfurter Goldarbeiter und Emailmaler Peter Boy (um 1650-1727) und seine Arbeiten für den Kurfürsten von Trier zu Ehrenbreitstein – Spurensuche nach einem vergessenen Meister. *Jahrbuch für westdeutsche Landesgeschichte*, Vol. 25, pp. 305–361.
- Lenzen G. (1966) *Produktions- und Handelsgeschichte des Diamanten*. Duncker & Humblot, Berlin, 280 pp.
- Long R., Steele N. (1979-1989) *Facet Design*. P/M Marketing, Seattle Faceting Books, Seattle, Washington. 7 Volumes.
- Luthmer F. (1907) *Die Bau- und Kunstdenkmäler des Lahngebiets*. Kommissionsverlag von Heinrich Keller, Frankfurt, pp. 103–115.
- Michel F. (1925) Der Silber- und Juwelenschatz der Trierer Erzbischöfe der Barockzeit. *Trierischer Volksfreund*, Gewerbeschau 1925, Vierte Sondernummer zur Rhein. Tausendjahrfeier, pp. 2–8.
- Mösch M.T. (1995) Der Kölner Domschatzraub 1975. Zwanzig Jahre danach. *Kölner Domblatt*, Vol. 60, pp. 245–268.
- The Munich Show (2017) Pressemitteilung (press release), https://munichshow.com/uploads/media/PRESSEMITTEILUNG_MunichShow2017.pdf
- Ogden J. (2013) Gems and the gem trade in India. In A. Jaffer, Ed., *Beyond Extravagance: A Royal Collection of Gems and Jewels*. Assouline, New York, pp. 346–377.
- Ogden J. (2014) Mughal gems in context. *InColor*, No. 26, pp. 36–47.
- Ogden J. (2018) *Diamonds: An Early History of the King of Gems*. Yale University Press, New Haven, Connecticut, 388 pp.
- Prim J.K. (2018) The rise of gem cutting and the occult in Renaissance Europe. <https://medium.com/justin-k-prim/the-rise-of-gem-cutting-and-the-occult-in-renaissance-europe-f3535b78599b>
- Prim J.K. (2019) Fashioning fire from pebbles. The history of gem cutting in the Czech Republic. <https://medium.com/justin-k-prim/fashioning-fire-from-pebbles-66d937273b94>
- Scarisbrick D. (1993) 17th-century diamond jewellery and the ornamental print. In A. Kinsbergen et al., Eds., *A Sparkling Age: 17th-Century Diamond Jewellery*. The Executive Board of the Province Council of Antwerp, Antwerp, pp. 23–36.
- Schmetzer K., Gilg H.A. (2020) The late 14th-century royal crown of Blanche of Lancaster – history and gem materials. *Journal of Gemmology*, Vol. 37, No. 1, pp. 26–64.
- Schrauf A. (1869) *Handbuch der Edelsteinkunde*. Carl Gerold's Sohn, Vienna, 252 pp.
- Stranner H. (1953) *Edelsteine und Metalle in der Bijouterie*. Rascher Verlag, Zurich, 87 pp.
- Tillander H. (1995) *Diamond Cuts in Historic Jewellery, 1381–1910*. Art Books International, London, 248 pp.
- Trimborn H. (1940) Ein Beitrag zur österreichischen merkantilistischen Gewerbepolitik am beispiel der Bruderschaft der Borer und Balierer zu Freiburg und Waldkirch. Dissertation, Freiburg University, 80 pp.
- Walgrave J. (1993a) Tendencies in 17th-century jewellery. In A. Kinsbergen et al., Eds., *A Sparkling Age: 17th-Century Diamond Jewellery*. The Executive Board of the Province Council of Antwerp, Antwerp, pp. 13–22.
- Walgrave J. (1993b) Diamond cuts in the 17th century jewellery. In A. Kinsbergen et al., Eds., *A Sparkling Age: 17th-Century Diamond Jewellery*. The Executive Board of the Province Council of Antwerp, Antwerp, pp. 37–53.