

A History of Stained Glass and its Techniques from Medieval to Modern Times

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Introduction

The skill of the stained glass artists paralleled that of the fresco painters during the Renaissance throughout Europe. Stained glass reached its peak during the Gothic Era, and was still viewed as part of higher art in the Renaissance, it combined its own art forms with light, and the skills of the painters and renowned artists like Albrecht Durer.¹ Stained glass is an artistic medium of white, clear, or coloured glass that is painted or unpainted and viewed through refracted light instead of reflected light.² This essay examines a history of stained glass from the 1100s to modern times, the authors experience with the material, and the tools as well as the techniques used and how they have changed to what the author is familiar with. The modernization of the processes, the innovations in tools for the craftsmen, and the production of entirely new processes as well as new forms of glass from L.C. Tiffany, and John La Farge have brought about a quiet new era to forgotten art. Without these new innovations the art of stained glass would forever reside in the past.

Middle ages stained glass was largely created by monasteries and later taken over by guilds, these works were mostly created for churches, and not private commissions.³ These works assisted to illustrate the Bible, religion, or propaganda for the ruling monarchs to the illiterate masses. During the early Gothic era, stained glass windows were mostly single figures, but soon became large roundels with intense attention to patterns of red and blue filling the

¹ Campbell. Stained Glass: The Grove Encyclopedia of Decorative Arts. Oxford University Press. 2006: Sec 2iii, par 5.

² Campbell, 2006: Pars 1.

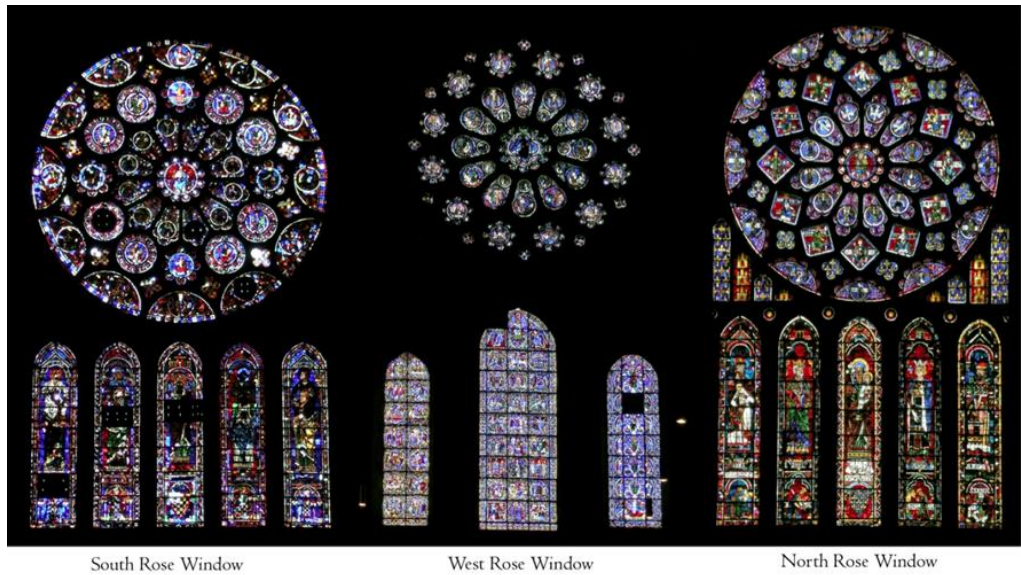
³ Campbell, 2006: Sec 1, par 2.

excess areas that would come to dominate French glass for much of the 13th century.⁴ Gothic architecture was perfect for stained glass windows, due to the framing of the buildings, the high walls and ceilings metal armatures would fit the windows and fill the rooms with extraordinary light.⁵ The architecture towered, and complimenting the style, so did the stained glass windows, each of which was exceptionally ornate and detailed. France developed the beautiful round rose windows, located in Chartres and some of the most beautiful gothic glass windows are located in Sainte-Chapelle. Both buildings are wonders of architecture as well as mastery of fixing the glass into the windows and filling the space inside with magnificent refracted blue light.

France

Chartres developed glass of unprecedented quality and was one of the largest manufacturers of glass. Chartres Cathedral is well known for the atmosphere inside, dominated by the Chartres blue glass, which fills much of the three Rose windows as well as much of the other windows

inside. Figure 1 shows images of all three windows, South, West, and North. The West Rose Window shows imagery of The



South Rose Window

West Rose Window

North Rose Window

Rose Windows of Chartres Cathedral

Figure 1: *South, West, North Rose Windows of Chartres Cathedral*. Stained glass roundels. South and North – 34.45 feet diameter. West – 39.37 feet diameter. Chartres, France 1220.

⁴ Campbell, 2006: Sec 2, ii, par 4.

⁵ Campbell, 2006: Sec 2, ii, par 2.

Last Judgement, while the Rose itself is not blue dominant; the blue glass fills most of the space in the vertical panels directly below. The South and North windows respectively feature more blue within their Roses. The paints were applied to the glass and fired multiple times so the paint would melt and fuse with the glass. Today's kilns are gas or electric and much more easily controlled than the fire kilns of old. Modern technology gives glass an unprecedented level of exactness and can be formed colors and textures unavailable to the glass artists of the Renaissance who were more concerned with how the light played with the art painted on to the glass.⁶

While Chartres depicted vast religious iconography, Sainte-Chapelle in fig. 2, “conveyed

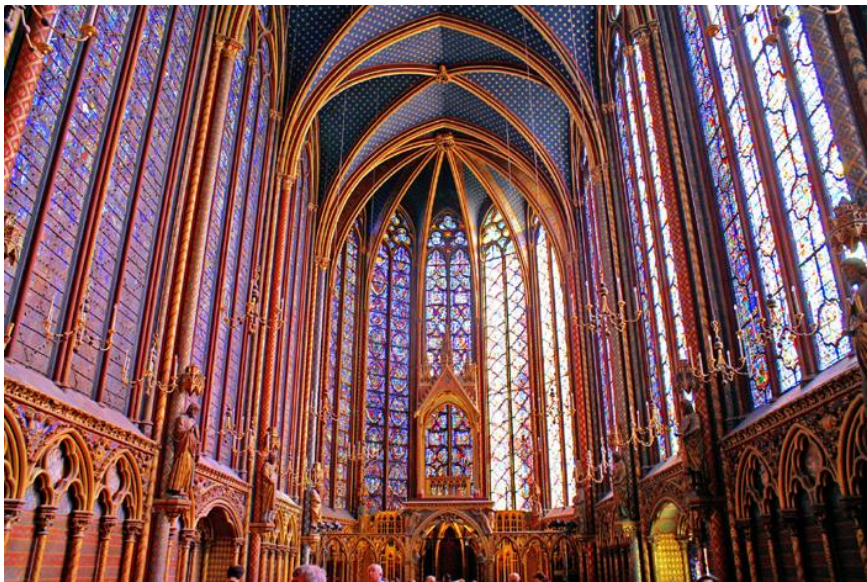


Figure 2: *Upper Interior Chapel of Sainte-Chapelle Cathedral*. 1246. Stained glass. 15, 50.52 ft. x 13.94 ft. Sainte-Chapelle Cathedral, Paris, France.

complex political and religious ideals related to kingship,” and “served primarily as a private palatine sanctuary”.⁷ Political propaganda extended its arm into any art form a patron could get their hands on. Meredith Cohen posits that the

cathedral was “designed for the public as a pilgrimage site in order to encourage devotion to the cult of kings.”⁸ The cathedral itself is a massive reliquary, heavily decorated architecture while it

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⁷ Cohen, 2008, 840-843.

⁸ Cohen, 2008: 844.

housed relics such as a portion of Christ's crown of thorns. The relic, symbolizing Christ's divine rule, essentially in the hands of Louis IX gave legitimacy to his piety and his own god given rule.⁹ So it is no wonder the cathedral's imagery furthers the notions of devotion to the king, on Earth as well as in Heaven. Sainte-Chapelle was one of the greater examples of a king's power and propaganda through stained glass art and architecture, this could be compared to San Lorenzo and the wealth and power of the Medici banking family of Florence.

Germany

Around 1500, coloured stained glass art was flourishing in Renaissance Germany, much of this art "was made for abbeys and other ecclesiastical foundations, as well as for churches in increasingly prosperous towns such a Nuremberg, Augsburg and Cologne."¹⁰ But the church was not the only patron of these works. Secular commissions were not unheard of, they ranged from classical texts, to traditional religious themes, and Renaissance motifs were incorporated by town halls, hospitals, guildhalls, private patron's homes, and noble's castles.¹¹ French and German glass have some differences, the most noticeable is the colors used in the majority of the work. French stained glass would lean heavily on reds and blues, while German stained glass would utilize more red, green, and gold.¹² "The effects of the Renaissance on stained-glass design included three-dimensional treatment, greater realism, perspective, detailed architectural backgrounds with classical features and the increased depiction of secular scenes".¹³ From this we can see how closely stained glass still paralleled other artistic mediums during the Renaissance such as painting, and sculpture. Atmospheric landscapes, highly detailed and

⁹ Cohen, 2008: 845.

¹⁰ Foister, 2007: 3.

¹¹ Foister, 2007: 3.

¹² Campbell, 2006: Sec 2, ii, par 6.

¹³ Campbell, 2006: Sec 2, v, par 1.

expressive figures and environments, and dramatic scenes can all be found on glass windows. Stained glass appears more vibrant in the light than any painting could achieve during the time. Where painters try to accurately recreate light, stained glass uses light directly from the source and constantly changing throughout the day to create dazzling differences in how the windows appear, and how the atmosphere of the room changes.

If we examine the work from the Mariawald Abbey window in fig. 3 we can see many



Figure 3: Hans Baldung Grien, workshop of Hans Gitschmann von Ropstein. German reconstruction of a window from the cloister of Mariawald Abbey. 1480-1564. Stained glass. 9.3 ft. x 2.3 ft.

different developed portions of glass and its history, combinations of coloured painted glass and white glass with gold and silver stain. The piece is rich in colour and detail, the architecture has correct perspective and the people are realistic. Through the use of paints, enamels and washes on the coloured pieces of glass, many fine details can be found on the robes, crowns, and boots. One of the developments prior to the Renaissance was that of silver-stain or yellow-stain on white glass, which can be seen throughout the panels of the Mariawald Abbey window. With this technique artists

could create a vast range of yellows and oranges as well as greys, often used to create detailed hair upon a figure which can be seen throughout the cloister of the Mariawald Abbey window. If this same technique was used upon blue glass it would create many tones of green.¹⁴ It was then in the 16th century Germany when clear distinctions were made between the craftsmen, the designer, the glazier, and the glass painter.¹⁵ In the end, a glass painter was responsible for the final outcome of a pristine glass window.

United States of America

In *The Crucifixion* (fig. 4) we can see much of the old methods still in use during the revival of the Catholic Church in Philadelphia. The colors are extravagant, the details are exceptional, and they bodies are not totally idealized. There is a mixture of white glass and coloured glass throughout. The white glass mostly taking up the skin and hair of the figures in the panels. The robes have many folds and the background is heavily patterned in red and blue as it was with the French, but also green, as it was with the Germans. The work found in Philadelphia relies

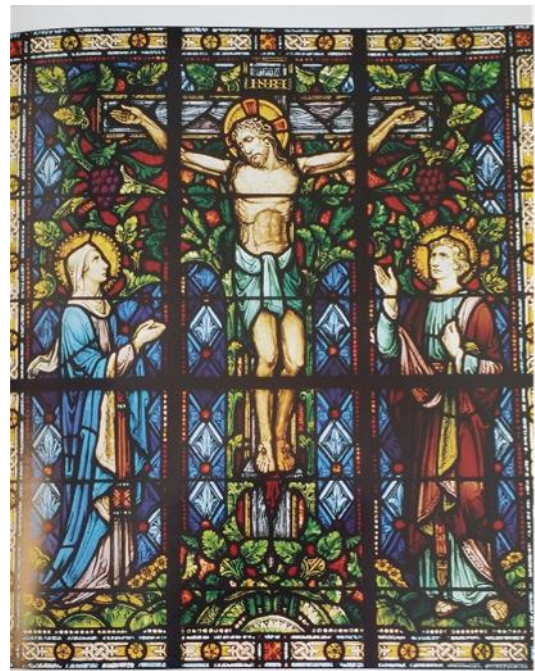


Figure 4: Edwin Joseph Sharkey. *The Crucifixion*. 1936-40. Stained glass. Church crafts. Isaac Jogues Church, Wayne (formerly in lower sacristy, St. Stephen Church, 1843-1993). Philadelphia, USA.

heavily on the iconography and details of glass of old. In *The Crucifixion*, it is subtle how the lead breaks down each piece but is not nearly as distracting as the black lead lines in fig. 3.

¹⁴ Campbell, 2006: Sec 1, iv, par 1.

¹⁵ Campbell, 2006: Sec 2, iii, par 10.

The Artists and the Craftsmen

Albrecht Durer is one of the most famous German artists during the Renaissance and lent his skills often to the design of windows, as well as architecture. Albrecht Durer took advantage of the new secularization of art in the 15th century, and the roundel came more into fashion for secular designs.¹⁶ Like painting, stained glass art could be revolutionized through time, and it accommodated the changes in painting techniques to make it even more sophisticated. Stained glass did not use a canvas, and in turn was able to utilize the very light of the sun filtering through it, to surpass painting. One of the chief interests of the German Renaissance glass artists was how to create illusionistic effects, and how could they exploit colour and light to their advantage.¹⁷ Great Italian artists such as Lorenzo Ghiberti, and Donatello provided their talents for designs of glass to “harmonize with the great fresco cycles.”¹⁸ Stained glass remained a vibrant art medium in Roman Catholic countries, but after the Reformation Protestant countries use of stained glass declined heavily, and while stained glass was in Italy, it was not preferred over the frescos or other forms of art.¹⁹ Stained glass had a much stronger hold on countries in Northern Europe, and it was seen in the Italian North more-so than in the Italian South. Simply put, the Italians preferred art mediums they had already been mastering and had already mastered, but the strength of stained glass was not in Italy, but in the Northern Europe, Germany, France, and Flanders.

It is important to distinguish between glass painters, and glass craftsmen. Glass painters would work with a naturally translucent material, and panel painters were more intent on light-reflecting materials such as gold or silver leaf and matte or polished white preparatory layers.

¹⁶ Campbell, 2006: Sec 2, iii, par 6.

¹⁷ Foister, 2007: 3.

¹⁸ Campbell, 2006: Sec 2, iii, par 8.

¹⁹ Campbell, 2006: Sec 2, v, par 1.

Multiple layers of translucent glazes over more opaque paints, and tools that an average painter would not use, such as stencils and stamps to create the high levels of detail. Many of the same techniques used by these panel painters were also utilized by glass painters. Experimentation is key to any art form, this applies to both the fresco painters, the oil painters, and the glass painters. Glass painters experimented with their art and were able to create the same effects and subtle tones as the fresco painters could, or even that of *sfumato* with oil on canvas. “They were aided by better tools; as well as needles and sticks and the large ‘badger’ brushes used for stippling, smaller silver wire brushes allowed more controlled application,”²⁰ Tools often used by painters in other mediums could also be found with the glass painters, since their works was so similar.



Figure 5: Stained glass cutter w/ glass tapper and grozing teeth.

The tools I was more accustomed to using were those of the craftsmen and are a large part of the modern history of glass. Today patterns and designs

are much easier to obtain with the internet than before its existence. It is easy to have a design printed almost any size you like. Undoubtedly one of any glass artist’s most important tools is that which breaks the glass. Until the glass cutters creation, the glass was cracked with a red-hot iron, which would then follow the line of the design. A glass cutter (fig. 5) is the most useful and readily available tool of any modern glass craftsman. Not only is it necessary, but like any other craft having a multi-tool at the ready is always a good thing. The cutter in fig. 4 has an opposite end, a ball that can tap the glass and snap along the score, however, the ball and the grozing teeth are now nearly obsolete because of newer more effective tool variety. The grozing teeth seen

²⁰ Foister, 2007: 7

near wheel end of the cutter are used to slide on to the edge of the glass, then with a leveraging motion break the glass away from the score. Some cutters come with these teeth, and others do not. Many types of pliers can also be used to grab the glass and break it away such as cut-spreading pliers, or glass pliers. Both of these methods produce a sharp and often uneven edge that will require further attention. Today, instead of a grozing-iron, one would use a diamond grinder (fig. 6), a large rotating bit is installed coated with diamonds to wear down the glass as sandpaper does to wood. These bits come in various sizes, the larger and wider the bit, the more glass can be grinded to increase time, this is also better for long sweeping pieces. The smaller the bit, the smaller the area you can grind, allowing for tighter curves. Eventually as you descend in sizes you reach a new tool, the bansaw blade. This is a high speed tungsten line coated in diamond to cut extremely quickly as well as create the tightest of curves and cut. A perfect right angle would be achievable with a bansaw blade, or a cut just thin enough to slide a piece of lead came in to accentuate a line. The glass must then be



Figure 6: Diamond glass grinder.

cleaned, especially along the edges, if the artist is to use the modern copper foil method. The copper foil has an adhesive reverse to the copper front. The copper foil method leaves almost no room for error between pieces when soldered together. Copper foil was arguably created by Louis Comfort Tiffany, and his contemporary John La Farge, independently. However, Tiffany's name is not associated with stained glass as much as it is spoken of in relation to his leaded lampshades.²¹ The other method would be to use lead came between your pieces, but this leaves a little room for error, which can be helpful later in a panel.

²¹ Duncan, 1975: 19

When multiple pieces are completed you start in the corner of your piece and place them accordingly. Some pressure should be applied to keep them in place, this is often done using farrier's nails, or horseshoe nails and works for both foil and lead came methods. When you have enough pieces completed you can finally start to use the soldering-iron and lead to bind the pieces together. If the work does not yet have all the pieces ready to be fixed, then only small drops of solder should be used, this allows for the pieces to be easily removed and edited if an error does occur. If you have space between your pieces, the lead solder can melt between the pieces and create blobs or irregularities you do not want in your finished product. This process has barely changed since medieval times, the electrical soldering-iron is now in use instead of a furnace melting the solder.²² From then on out the process is pretty much entirely the same, the entire work would be cleaned, for larger pieces they would fill the empty gaps with Plaster of Paris and cleaned again. I had to clean my glass, steel-wool all the lead, and then apply a patina to stain the lead black as not to reflect much light and to create darker lines between pieces.

My experience with stained glass was the most enjoyable of any craft art, and I started eagerly with an existing love of puzzles. I completed panels in the modern style that started in Germany during the 20th century; the glass would not be painted on, and the image abstracted to a point which was an influence of La Farge and Tiffany in the USA.²³ The detail or lack thereof would rely entirely on the colours, shapes of the glass, and the black lead comes (Latin, *calamus*: 'reed')²⁴ that held the pieces of the window together.

To start, one must gather the type of coloured glass they wish to use. Today we have a greater variety in the type of glass to choose from, it all depends on where it comes from, and

²² Campbell, 2006: Sec 1, vi, par 2.

²³ Campbell, 2006: Sec 2, vii, par 5.

²⁴ Campbell, 2006: Sec 1, vi, par 1.

who it is made by. I was given flawed stained glass from Spectrum Glass Company in Woodinville, Washington. An artist must have multiple copies of a design ready. In medieval times the small original sketch was known as a *vidimus*, after the design was accepted a larger full scale version, or cartoon, would be made.²⁵ For both figures 6 and 7 a cartoon was placed below the pieces as they were finished and another copy was cut apart to be placed on the glass for accuracy. With current glass manufacturing techniques and printing processes for designs, preparations for creating a work are much easier.

In the 21st century the tungsten steel (figure 4) or diamond tipped cutters were created to score a line along the glass where it could be easily broken and then corrected to fit.²⁶ I skipped the entire painting and firing stages and progress straight to glazing, because the focus of the class was entirely on the properties of the glass itself. Glazing is the process of placing the pieces together with the lead and soldering the joints and the frame.²⁷ Since my panels were not built for a specific window, but to be hung in a window I did not fulfill the final step of fixing. During the fixing stage all the panels would be fitted to their positions within an intricate iron frame, more modern frames are vertical in nature. The glass is then cleaned, all empty spaces are sealed with cement made with linseed oil to weatherproof the window, and it is cleaned once more.

²⁵ Campbell, 2006: Sec 1, ii, par 1.

²⁶ Campbell, 2006: Sec 1, iii, par 1.

²⁷ Campbell, 2006: Sec 1, vi, par 1-2.

The copper foil is a less expensive alternative to lead and can be used for tighter curves and smaller pieces of glass. This was the modern process I used to fix the edges of the glass. Figure 7 is a stained glass roundel eight inches by eight inches, and is intended to represent Alpha and Omega. The pieces are thin and tight and must fit together as close as possible, especially due to the size of the roundel. This particular piece needed to be created from the top middle, fanning outward in both directions equally, instead of a corner-to-corner approach. Careful watch must be kept on the pieces as they are craft, or else the composition may not fit properly into the original circular border. The modern copper foil method is the superior choice because of the thinness and flexibility of the material. The border of the piece is lead shaped like a horse shoe to create a flat outer edge. Without copper foiling, the size of the original design would have to be increased to compensate for the constant increase in space between pieces if lead came were used. Copper foil is important to the history of stained glass because it is a modern invention that can distinguish two broad forms of glass art, much like glass that uses coloured paints, and glass that uses silver on white or clear glass.



Figure 7: Aidan Terry. *Alpha and Omega*. 2011. Stained glass. 8 in. x 8 in.

With improved skills, techniques, and tools I was able to use the sturdier but still flexible lead comes used in much of historic stained glass. In fig. 8, we see a composition of Captain Kirk from the popular television series *Star Trek*, this piece blends modern as well as much older practices. The piece is almost entirely made with lead coming, the older practice is reaching back to Medieval times.²⁸ The modern copper foil method was used for the eyes and the ear since the pieces were too small and intricate for lead. A modern glass creation used



Figure 8: Aidan Terry. *Captain Kirk*. 2012. Stained glass. 19.25 in. x 15.75 in.

within the piece is that of iridescent glass, created and patented by Louis C. Tiffany in 1894.²⁹ The type of iridescent glass he created he called *Favrile*. Just these few changes over time have revolutionized the abilities of glass artists to make new awe-inspiring work.

The modern movement of stained glass is still alive; many people simply do not know the medium is continued to this day, especially because if someone speaks of the Renaissance, a person's instant thought is about Italy and painting, whereas stained glass was in the Northern European countries during their Renaissance. Stained glass is primarily a secular art form now, and most churches in the business of stained glass are having restorative work done to their already established windows. Large stained glass windows are scattered across the United States and many long standing windows can be found in churches in New York, Philadelphia, and Washington, D.C., just as they are found across major and minor cities in the churches across

²⁸ Campbell, 2006: Sec 1, vi, par 1.

²⁹ Duncan, 1975: 19

Europe. Equal in beauty but varying slightly in materials as they came from such different periods of time. With current technologies the works in America have reached a pinnacle of craftsmanship, but have lost some of the touch of the art and soul that went in to the panels from the workshops of the past in Europe.

Conclusion

It is evident throughout how stained glass was a truly masterful art form and different from all others, merely because of how light treats it. The tools and processes have barely changed and those that have made it easier for people to become a craftsperson of stained glass, as well as an artist. While King Henry VIII's Reformation may have weakened the medium in the eyes of many, its flame was never entirely put out and has found its way back to us many times over. Much of how we classify the art of the past is in how the artist himself treated what we saw, and less about the technical aspects. Stained glass is 80% technical process and 20% artistic hand, and with the technical improvements we have seen after the Renaissance, glass of unprecedented quality is achievable and all that awaits is the hand of the artist and a movement with enough strength to grasp the technical prowess and utilize it. Gothic architecture sought to move upwards to the heavens, we have skyscrapers far beyond the height of any Gothic architecture, and yet they are covered in facades of bland glass, filling the rooms with bland light. Another Renaissance of glass is achievable, and not so far-fetched, as some might think. Artistic culture and their technical achievements is how we have categorized so many civilizations before us, and with the ever continuing pinnacle of technology in our hands, we must now turn back to art to define our civilization for the future, a challenge that is hard, is the only challenge worth pursuing.

Work Cited

- 1) Aubert, Marcel. "Stained Glass in Chartres Cathedral." *The Burlington Magazine for Connoisseurs* 42(1923): 266-273.
- 2) Campbell, Gordon. "The Grove Encyclopedia of Decorative Arts – Stained Glass." Oxford University Press, 2006.
- 3) Cohen, Meredith. "An Indulgence for the Visitor: The Public at the Sainte-Chapelle of Paris," *Speculum* 83(2008): pp.840-883.
- 4) Duncan, Alastair. *The Technique of Leaded Glass*. London: Batsford Limited, 1975.
- 5) Farnsworth, Jean. Corce, Carmen. Chorpenning, Joseph. *Stained Glass in Catholic Philadelphia*. Philadelphia, Pennsylvania: Saint Joseph's University Press, 2002.
- 6) Foister, Sussan. *Art of Light: German Renaissance Stained Glass*. London, England: The National Gallery Company, 2007.