19. Facts about Glass - Creating Coloured Glass; Pot-metal glass

John, who as been helping with the blog, had heard about coloured pot-metal glass, so he called in on Marie and Megan and asked, “Can you show me some examples of pot-metal glass on the Boppard panels?” Instead of the expected, “there’s a little bit here and a section over there”, Marie pointed out that ALL the glass that was coloured, was pot-metal glass. Not what John had expected, but very enlightening!

Glass can have colour applied to it through a variety of methods which we will discuss in later blogs; such as glass painting, enamelling or silver stain, but all the glass that is coloured in itself has had metallic oxides added to the molten crucible (or pot) of glass. Up until the end of the Middle Ages the range of coloured glass available for use in stained glass remained basically the same. To create colour in glass metallic oxides or salts were added to the crucible or pot of molten glass and mixed in, colouring the glass throughout its thickness. Glass made in this way therefore became known as “pot-metal” glass. The metal is not dissolved into the glass but is dispersed evenly throughout the glass at a microscopic level, creating a uniform colour.

Producing colour in glass was a complex process since it not only depended on the metal oxides added, but on the temperature of the kiln, levels of oxygen in the kiln, and the length of time the glass remained at the highest temperature.

Controlling the kiln was particularly important as it affected both the temperature and the amount of oxygen being consumed by the fuel. Fresh fuel added to the kiln uses more oxygen and creates a “reducing kiln” in which oxygen is drawn out of the furnace atmosphere which in turn affects the metal oxide.. The changes in oxygen levels within the kiln can alter the metal oxide to create a different range of colours; for example if iron is added in the form of ferrous oxide this produces blue glass, but if oxygen is added ferric oxide is formed which produces yellow or brown colours in the glass.

Glass workers often kept their recipes secret, so little is known about medieval glass making techniques.

However some information survives thanks to the work of Theophilus{1}, a 12th century monk who wrote about the process of making coloured glass in his treatise, De Diversis Artibus “The Diverse Arts”. He described for example, how the same mix used to produce flesh coloured glass could also be used to create purple glass. Once the sheets of flesh coloured glass had been made the remaining mixture would be returned to the kiln for another 2-3 hours to create a light purple or 3-6 hours for a deep purple. This change was probably a result of the time in the kiln and the changes in levels of oxygen.

Early colourants that were used include:

- Blues – Cobalt Oxide
- Violet and purple – Magnesium Oxide
- Red and ruby but also turquoise – Copper Oxide
- Greens and yellows but also reds – Iron Oxide

Other colourants introduced over time include:

- Dark green to black - Chromium
- Rich greens - Chromium, tin oxide and arsenic
- Deep yellow - Cadmium salts
- Yellowish brown - Titanium
- Purple - Nickel salts
- Burgundy red - Gold
- Yellowish orange to red - Silver salts
- Green or lilac red - Didymium
- Whites - Tin oxide and antimony

Ruby glass was problematic, as a lot of copper oxide was needed and the resultant glass was so dark it was almost black. To overcome this problem, streaky glass was made with red and clear glass running through the body, to keep the colour bright. Quite how this was achieved is under question.

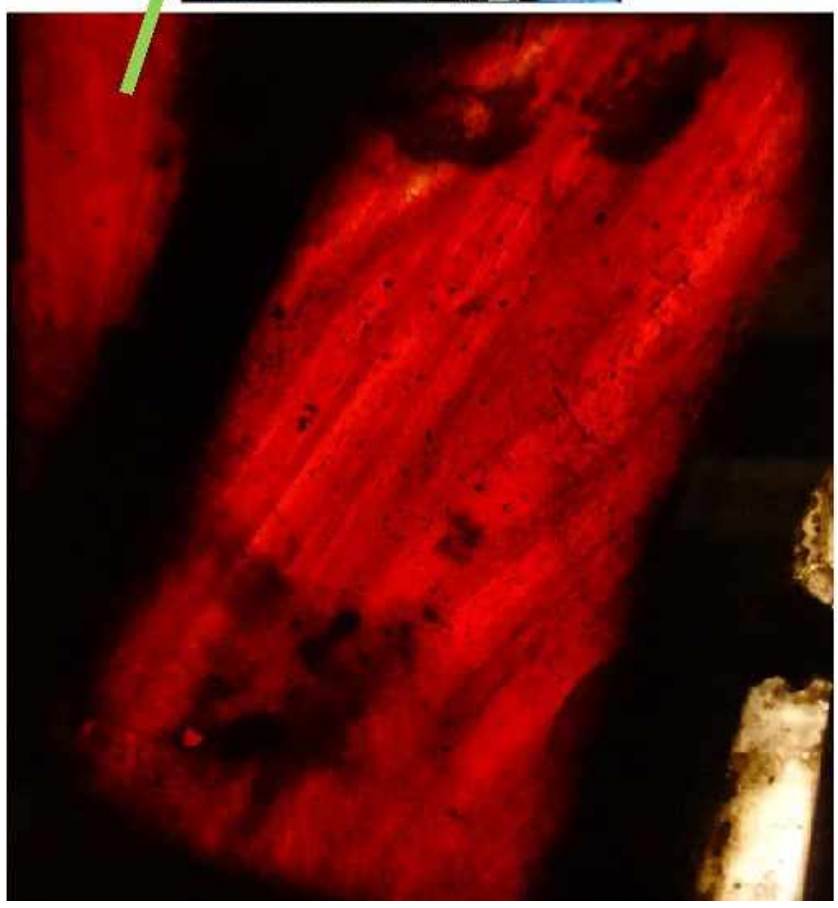
The examples, therefore, have been chosen to show the distinctive streaky ruby in early glass.

[1} Information taken from “On Divers Arts” by Theophilus, J.G. Hawthorne and C.S. Smith ed. ; “Conservation of Glass” R. Newton and S. Davison.

Examples of early streaked ruby glass:

Prophet Jeremiah

The Prophet Jeremiah window dates to about 1145 and was installed under the direction of Abbot Suger into the Abbey of St.Denis near Paris.



Arms of Somery

The Arms of Sir John de Somery, of Dudley Castle, Worcs., dates to the early 14th Century and uses a range of wonderful richly coloured glass.

Marriage at Cana

The Marriage at Cana is a French window dating to before 1236 and was purchased by Sir William Burrell from the collection of William Randolph Hearst. The streaked ruby red has been used to excellent effect enhancing the flame effect of the cook's fire.