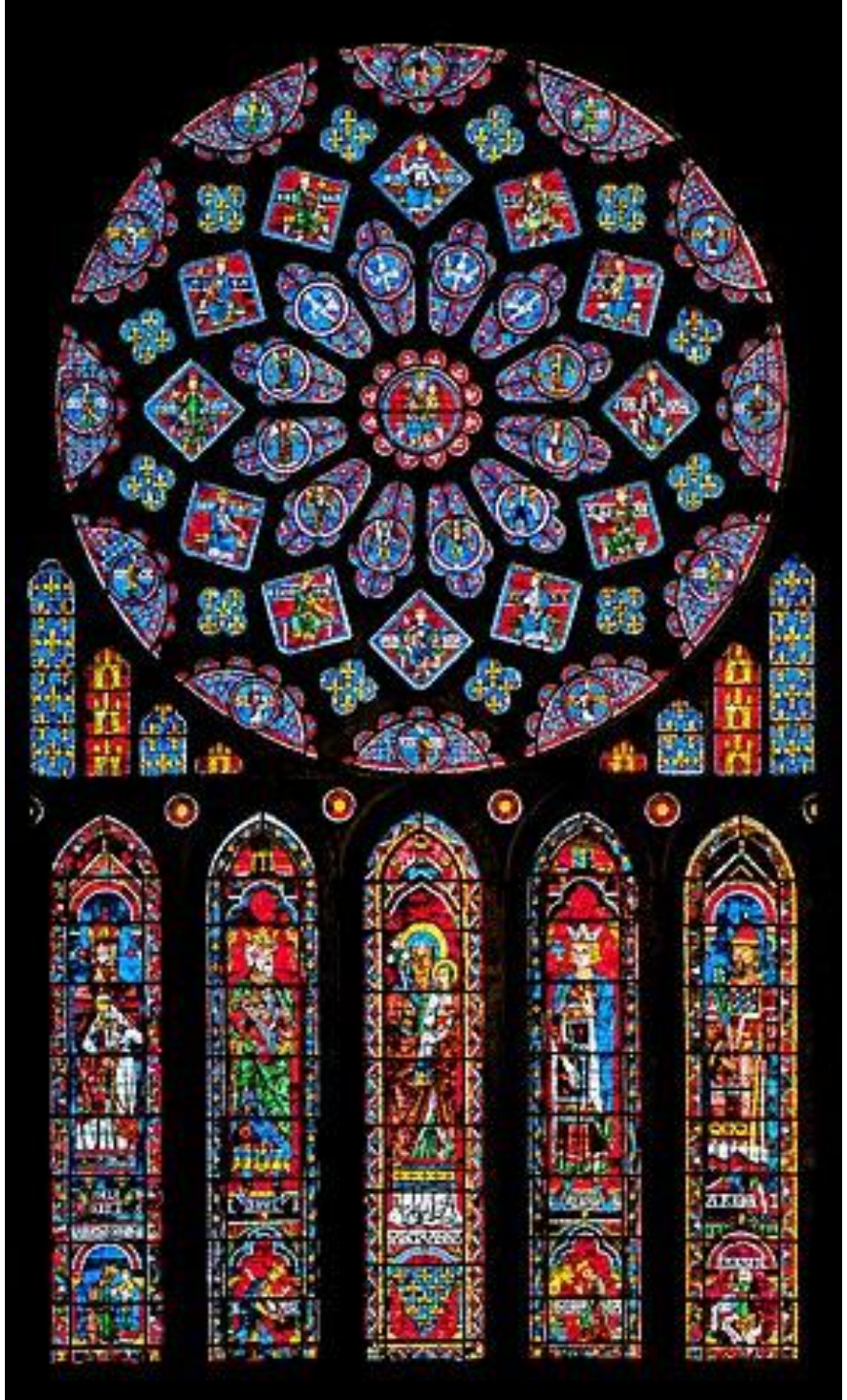
Stained glass

Painting with Light and Colour

Jennifer Hunt
SBU3A Science

Chartres

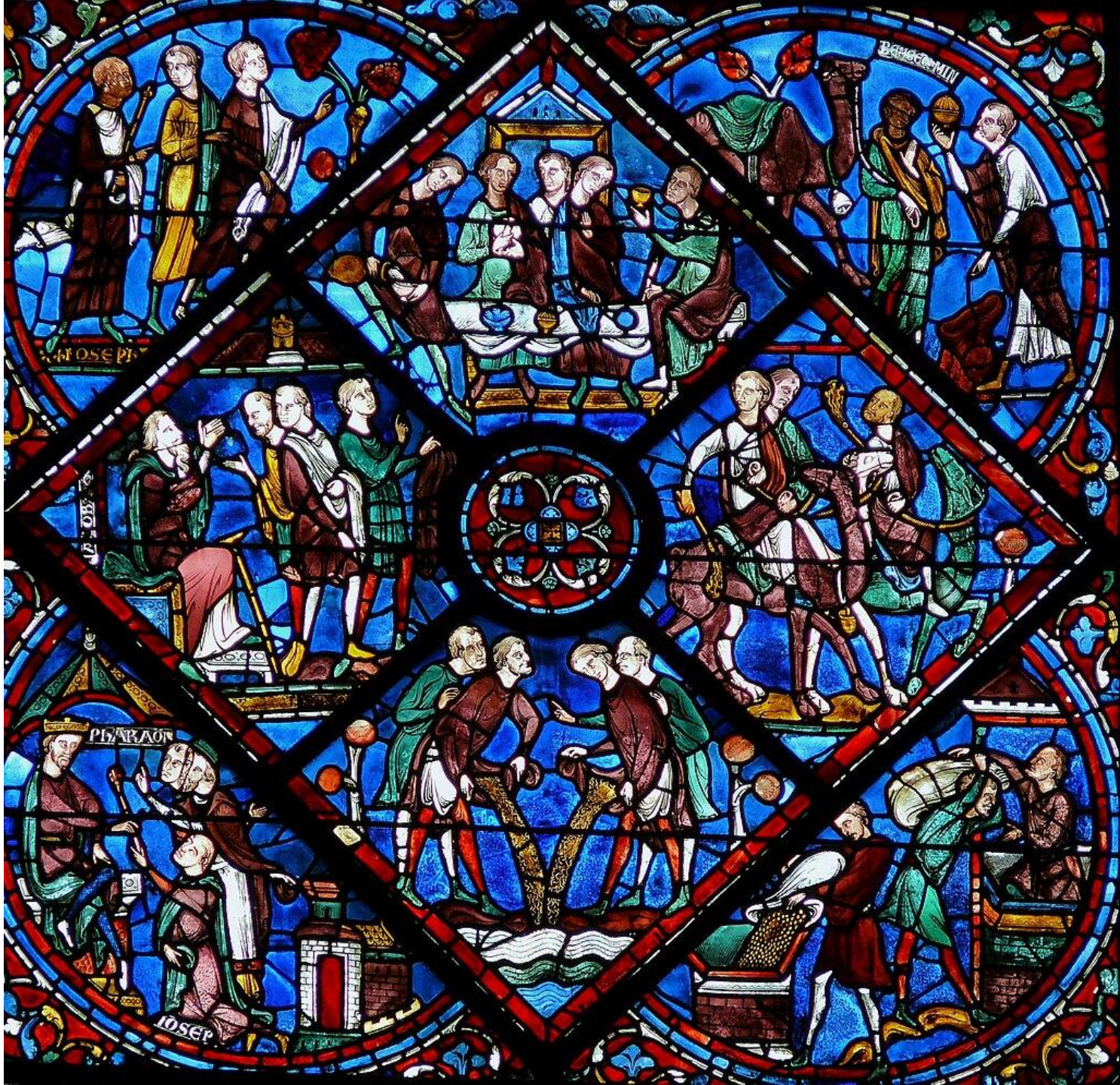


Chartres

La Vie de Joseph

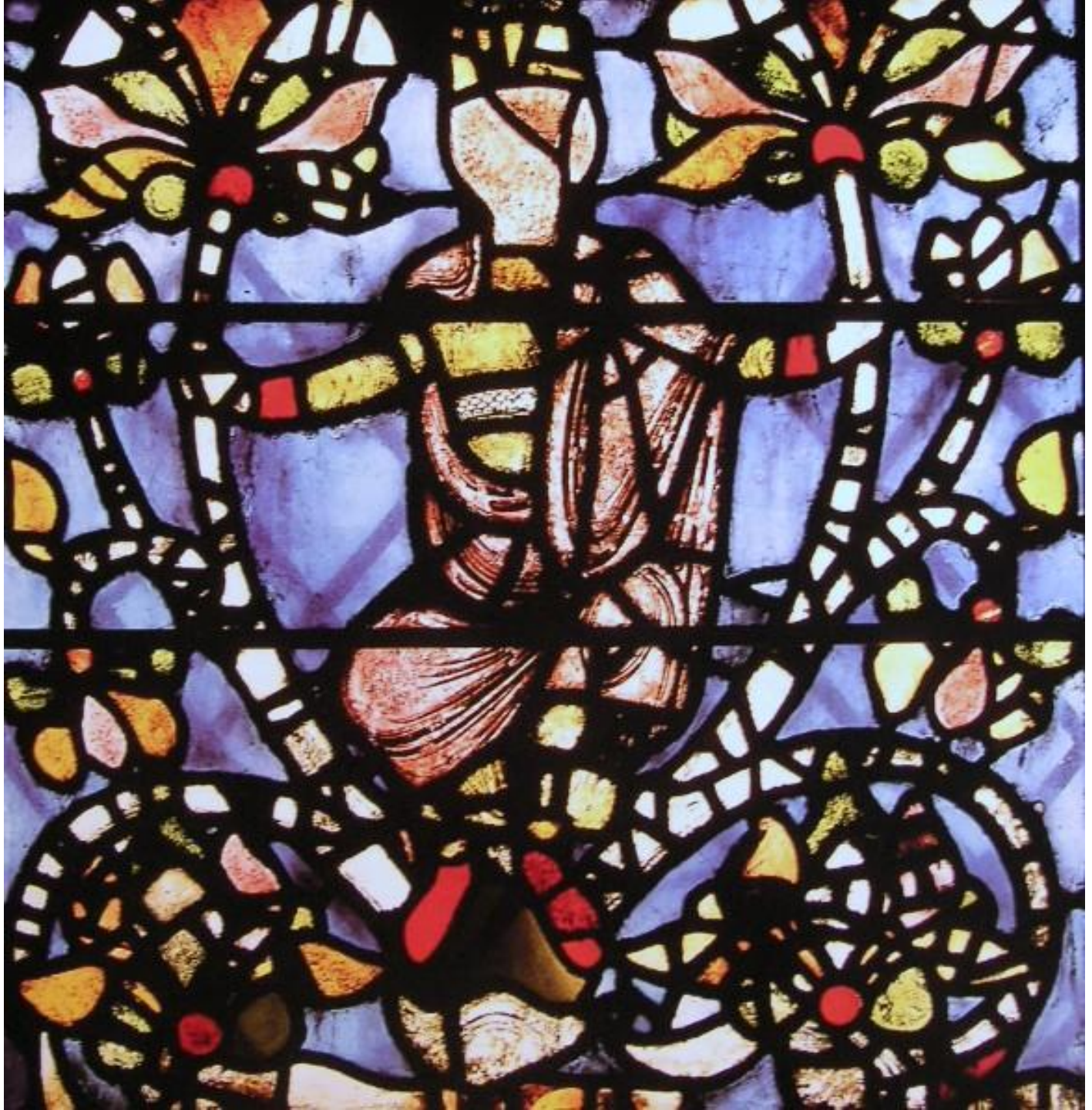
13th C

Cobalt blue



York

Jesse Tree
Oldest known British
Stained Glass
1170C



What is Glass ?

1. **Glass is an amorphous solid. Plastics and gels are other examples.**
2. **The arrangement of its atoms and molecules are not set out in a fixed lattice like other solids but neither are they random as in a liquid but are something in between.**
3. **Up to 90% of man-made glass is made from three main materials: sand (silicon dioxide), limestone (calcium carbonate) and sodium carbonate**
4. **Commercial glass is mainly soda-lime-silica**
5. **Specialist glasses: Fused silica which is chemically inert and heat resistant is made from rock crystal. Adding boron oxide produces borosilicate glass(Pyrex). Adding lead oxide produces crystal glass**
6. **Natural glass is volcanic obsidian formed when felsic lava cools quickly**

Glass manufacture

1. **Mixing:**

Sand melts at 1700*C. Ordinary glass mixes sand with flux of 25% sodium carbonate (soda ash) which lowers the melting point to 1000*C. Limestone (lime , calcium oxide) added to offset the water solubility of the soda. Too much makes glass liable to devitrification ie precipitation of crystalline phases in certain ranges of temperatures. Optimum composition is 75% silica, 10% lime,15% soda.

Other materials such as magnesia (4% magnesium oxide) and 2% aluminium can be added for bottle glass.

Other materials can be added to assist in refining (removing bubbles): Selenium and cobalt oxide together with traces of arsenic trioxide and sodium nitrate neutralise the natural greenish colour of glass from silica sand which contains natural,impurities. This produces “white” or decolourised glass

Glass manufacture

2. Melting:

Mixed glass batch placed in furnace until molten then refined by raking to remove bubbles or impurities

3. Forming:

a. moulding as for bottles

b. Float glass

Molten glass is poured into a container of molten tin (naturally immiscible ie cannot mix). The glass floats on top of the liquid metal as it gradually cools in a smooth even thickness. Process developed by Pilkington in the 1950s

c. Annealing: Final cooling passes through a kiln so temperature is gradually lowered to 600*C

4. Fusing, slumping, cutting.

Properties of glass

1. Amorphous solid – rigid like a crystal but disordered in its molecular arrangement

2. Unique structure allows light to pass through + transparency

3. When cold is a poor conductor of electricity and heat

4. Easily fractured –conchoidal

5. Transparency – light passes through ie light energy (photons) pass through glass rather than being reflected or absorbed. Darker or more saturated colours tend to be less transparent

6. (transparency detail)

7. Opacity - altered by adding elements or compounds to glass during manufacture eg fluorides or phosphates, which act by diffusing light as it passes through. Etching or sandblasting can modify the surface creating irregularities that disperse light in different directions

9. Opalescent glass contains embedded opalescent particles giving a white or milky effect by diffusing light passing through

Properties of glass

10. Thickness- Thicker glass is less transparent as it absorbs and scatters more light

11. Density. - regular glass is 2.3-2.6gms per cubic cm. Stained glass ranges from 2.8 – 3.5 gms per cubic cm caused by introduction of various metallic oxides

12. Light properties;

a. **Refraction – as light travels into the glass its speed changes causing it to bend. Coupled with colouring effects from metallic salts this causes interplay of light and colour**
b. **Reflection – light rays hit glass surface and rebound**
c. **Diffraction – light spreads around the edges or through small openings**

Nasir el Molk Mosque

Types of glass used in stained glass

Pot glass

Cylinder or mouth blown (muff) glass

Crown glass (bull's eye)

Rolled glass (table glass) (cathedral glass)

Flashed glass

Colouring techniques

1. Metallic salts added to glass mix

2. Glass paint = mixture of powdered glass, iron or rust filings with a binder eg gum arabic, fired to burn away ingredients to give black colour

3. Silver stain = compounds of silver nitrate and a binder applied to glass and fired producing wide range of yellow to orange

4. Sanguine or Cousin's rose = iron based fired paint producing red colour

5. Scratching (sgraffito) = most often to make inscriptions on medieval glass

Roundel 1510-1520

St Lambrecht of Maastricht

Using only black and brown paint and silver stain

Paris
Arts Decoratifs

Domestic window by Dirck Crabeth

For Adriaen Dircxzoon van Crimpen

of Leiden

1543

glass colours

Transparent soda lime glass = slightly greenish

Green = iron oxide (glass bottles)

Yellowish green = chromium

Purple Blue = cobalt, plus copper oxide = turquoise, plus nickel = violet

Peacock Blue = copper,

Red = metallic gold, ruby gold or cranberry

Pink, pale or yellowish = selenium

Pink, pale = tellurium

Yellow = silver stain, plus sulphur = amber, plus cadmium = deep yellow

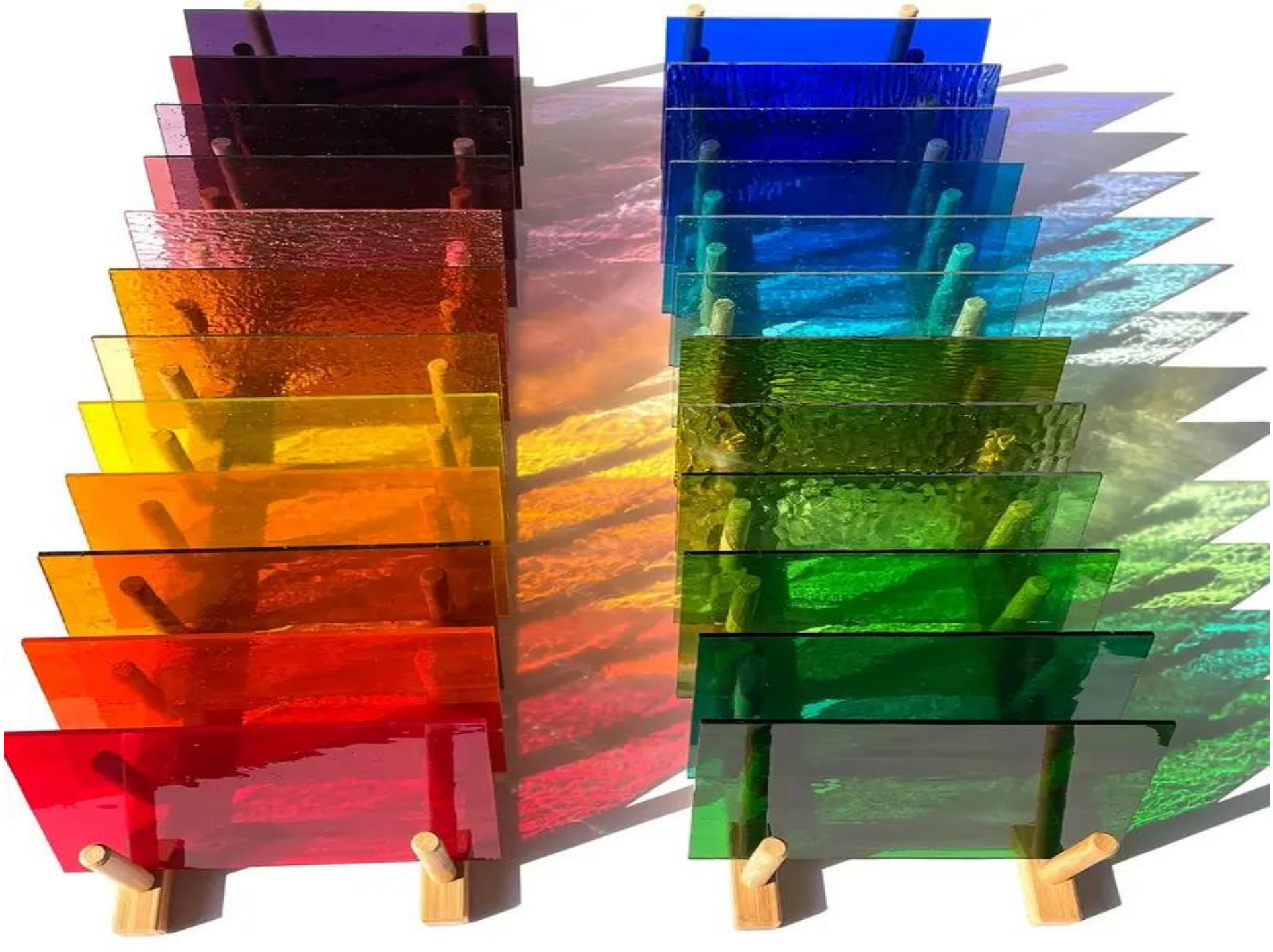
Pale yellow = lead

Yellow = finely divided vegetable charcoal

Fluorescent yellow or green (dichroic) = uranium

Purple = manganese (used since Egyptian times)

White = antimony (used by Tiffany to create opalescent glass)



Creating stained glass windows

Make accurate template of opening

Design a viable pattern for the piece

Draw a cartoon for every light (opening)

Determine the types and colours of glass to be used

Cut out the pieces of the design using templates

Cut and grind each piece of glass

Wrap each piece in copper foil tape and burnish the edges

Solder the pieces together with H-section lead cames

Apply mastic to edges

Add decorative touches

If required add iron rods across to support weight

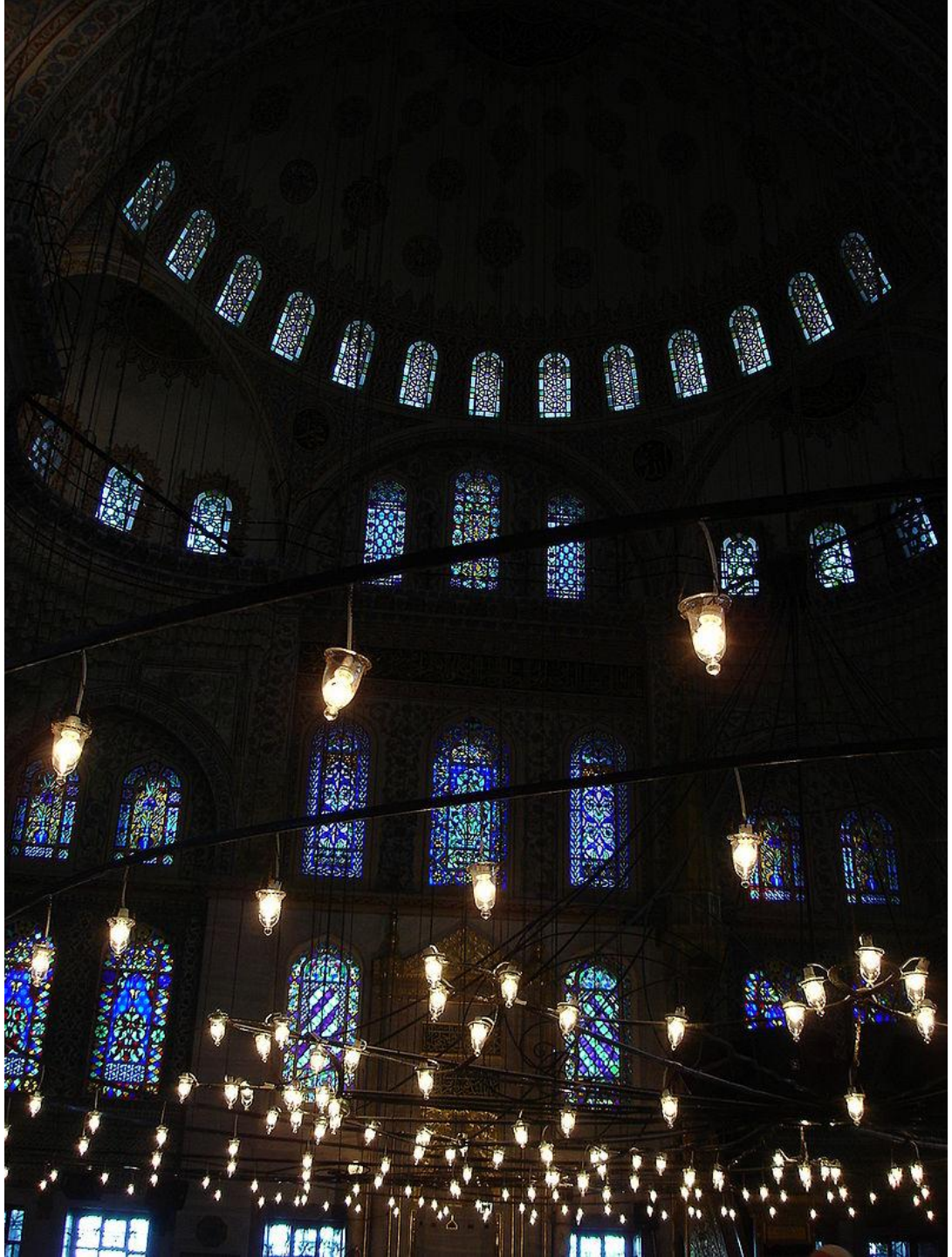
Canterbury

Thomas Becket Window
Showing pot glass, painted glass, lead H-sectioned, modern metal rods, copper wire attachments

John Piper in his studio

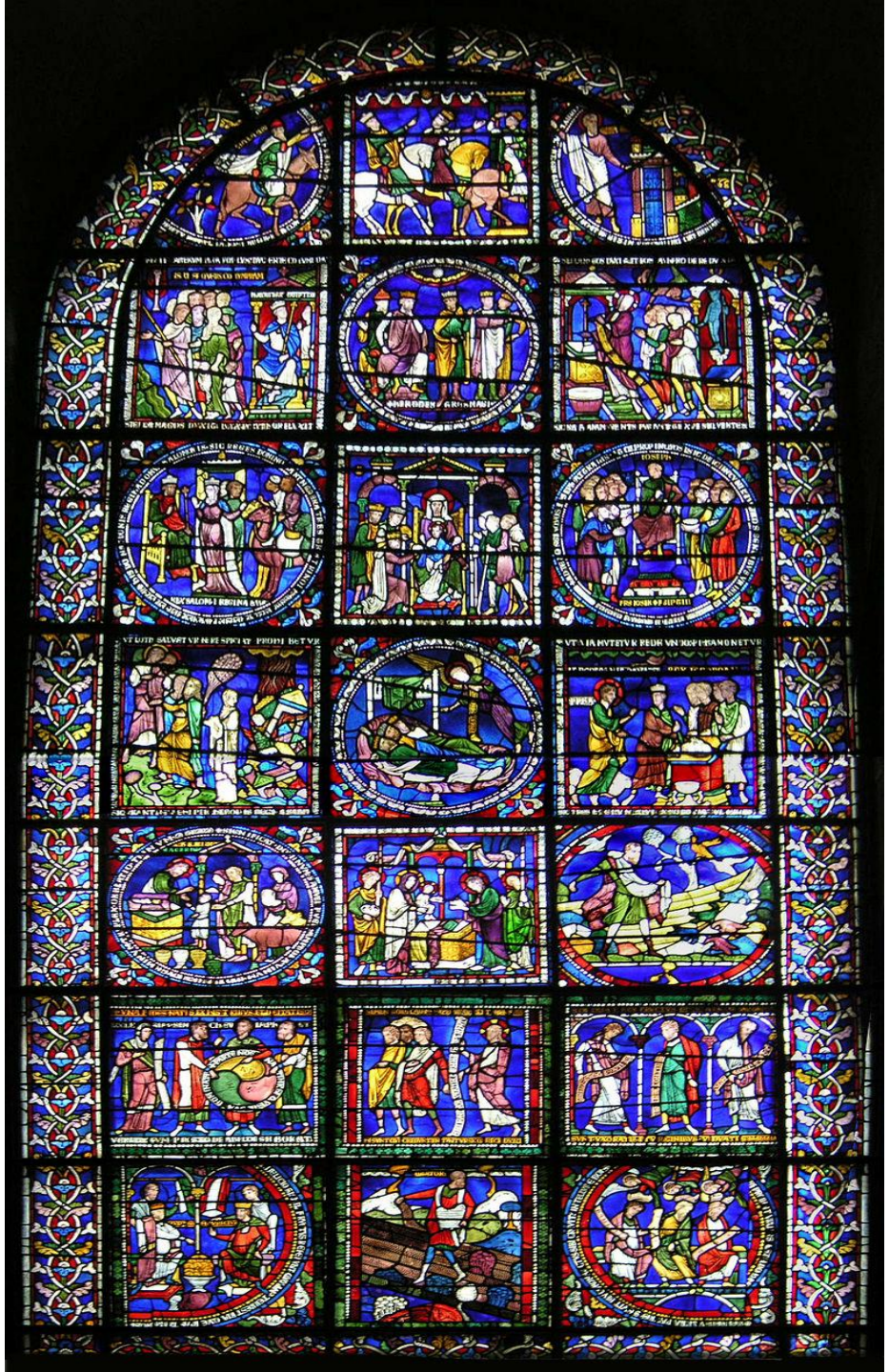
History of stained glass

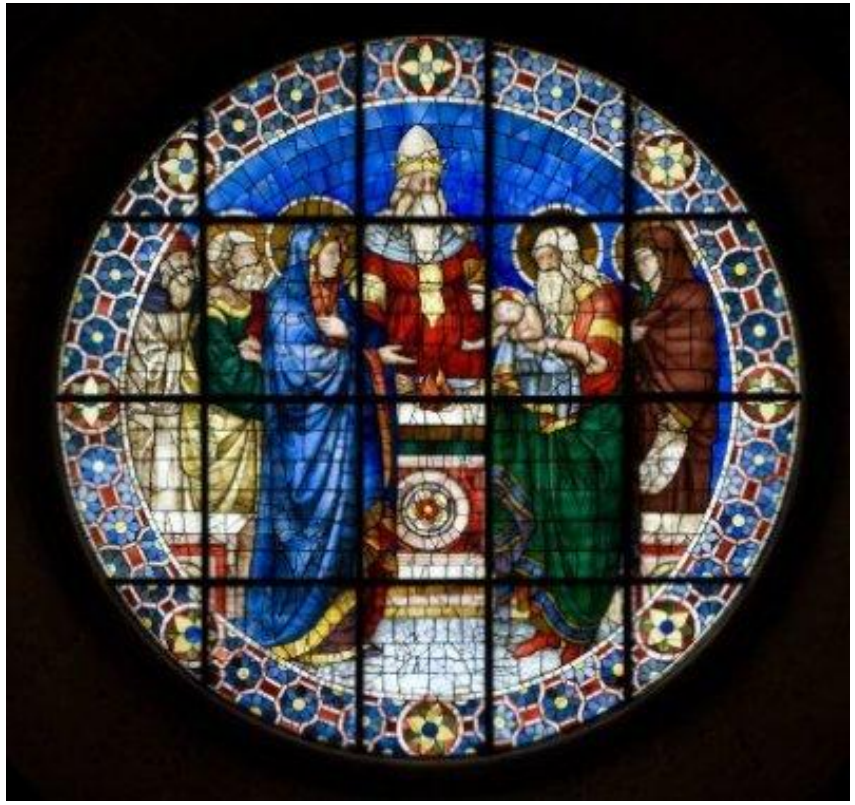
Blue Mosque, Istanbul



Canterbury

Poor Man's Bible





Renaissance

Florence Cathedral

1405-1445

Ghiberti, Donatello, Uccello,

Andrea del Castagna

St Andrew’s, Sydney

Apostles 1861-1867

John Hardman

Noted for Purity of colour and elegant arrangement of figures in Gothic Revival style

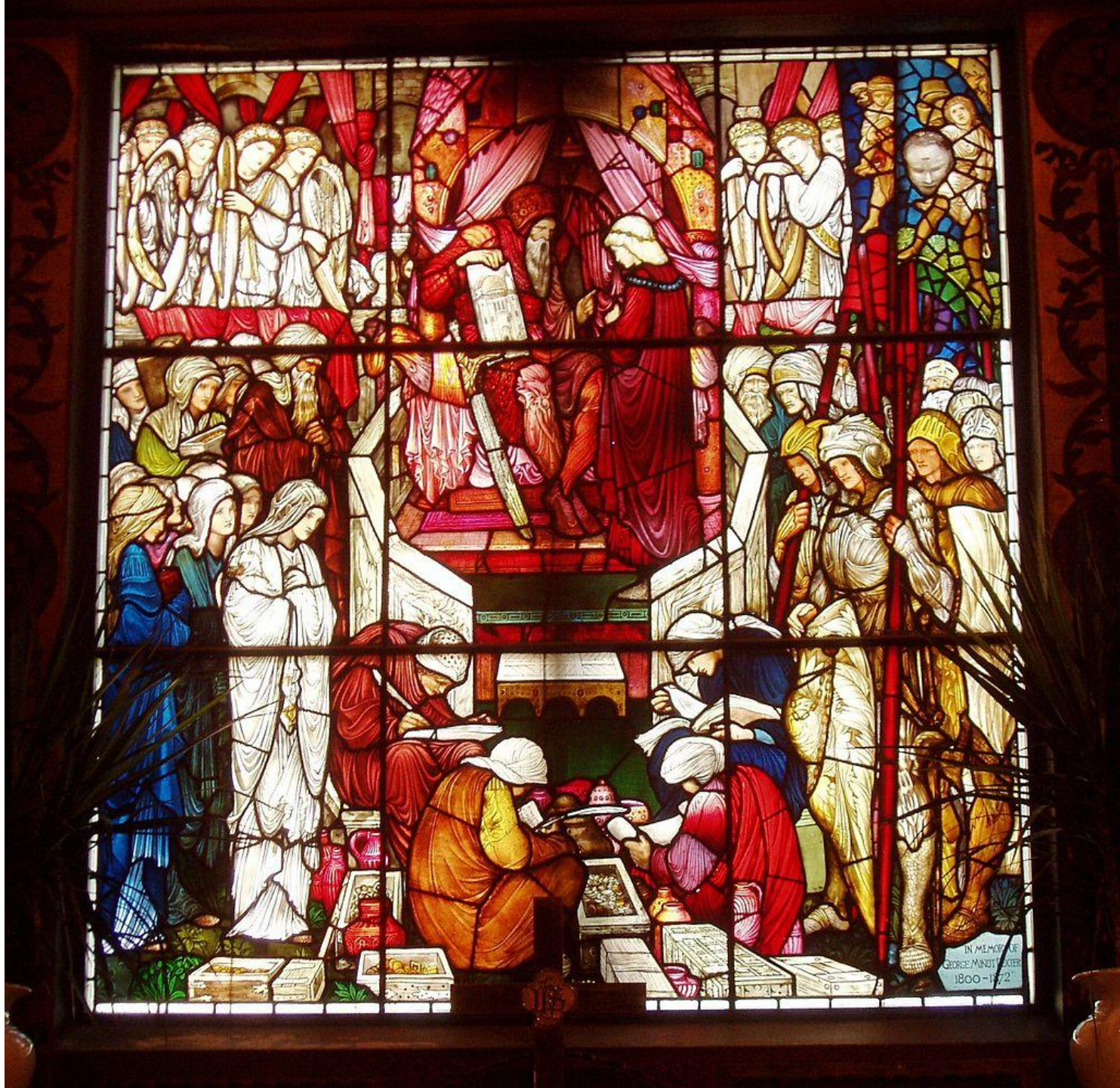
Trinity Church Boston

David's charge to Solomon

1882

Burne- Jones

Strong linear design and use of flashed glass



St Vitus, Prague

Alfons Mucha

Montage of images rather than tightly organised

Visual structure creating an Expressionist effect

Musee de l’Ecole, Nancy

Jacques Gruber, Art Nouveau 1904

Glass harmonising with the curving architectural forms

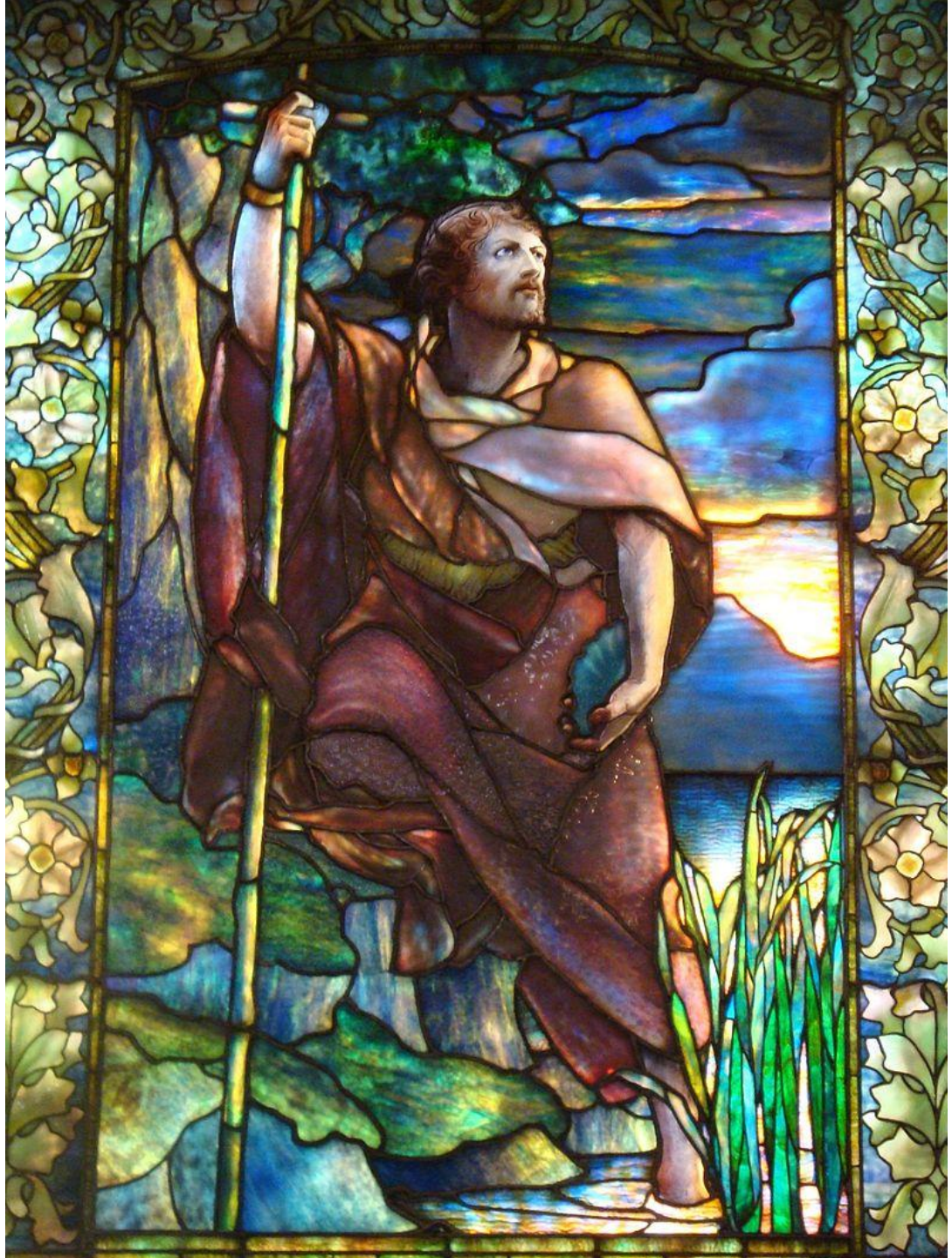
Tiffany

St John the Baptist

End 19th C

Multi-coloured flashed,

Streaky glasses



Buckfast Abbey

Dom Charles Norris

Slab glass

All Saints Tudeley, Kent

Marc Chagall

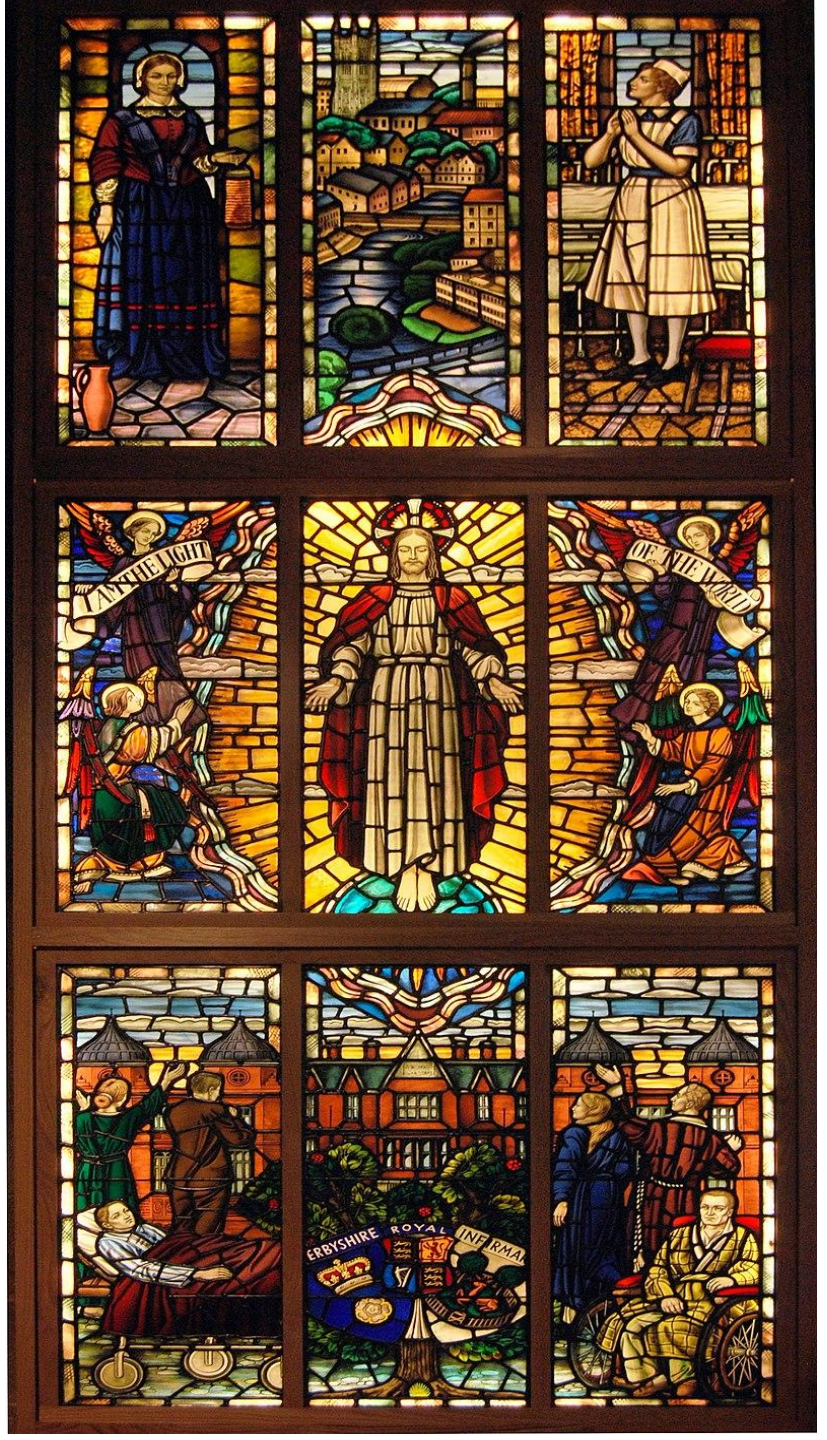
Expressionist

St Peters, Derby

Mid 20C showing a continuation

of ancient and 19thC methods

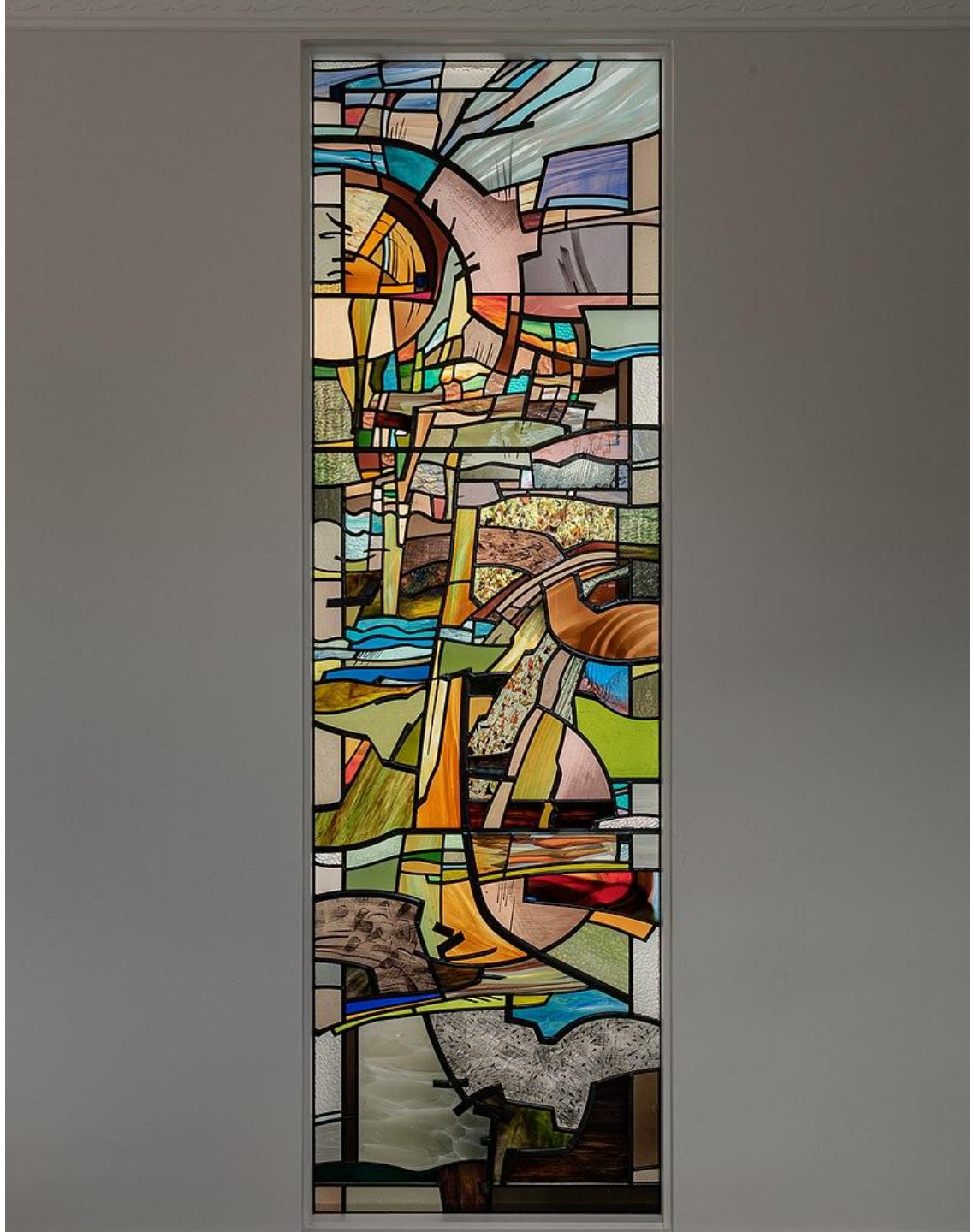
applied to a modern historical subject



Household of musicians, Sydney

Jeffrey Hamilton 2021

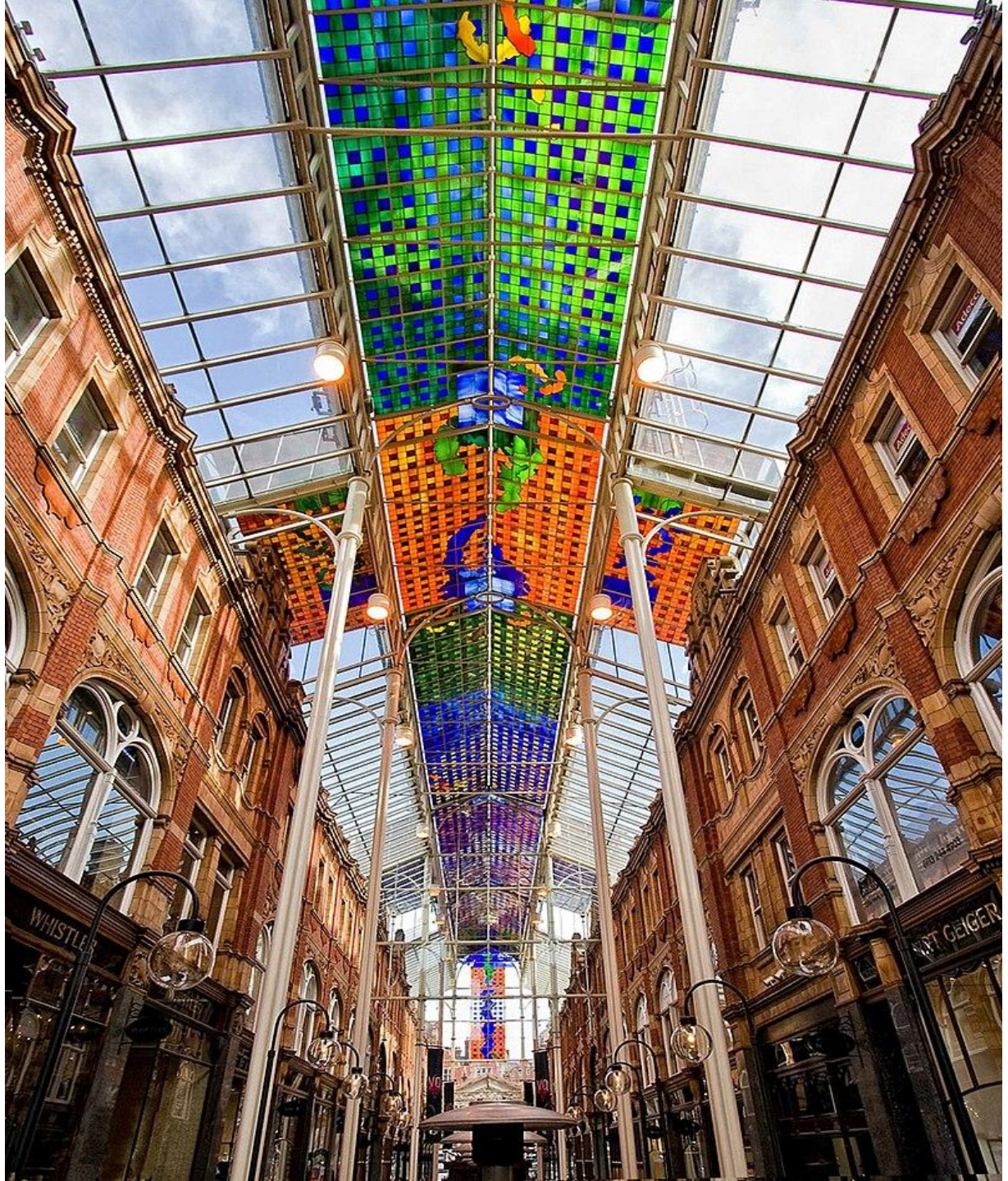
Dividing screen



Metro Station Montreal

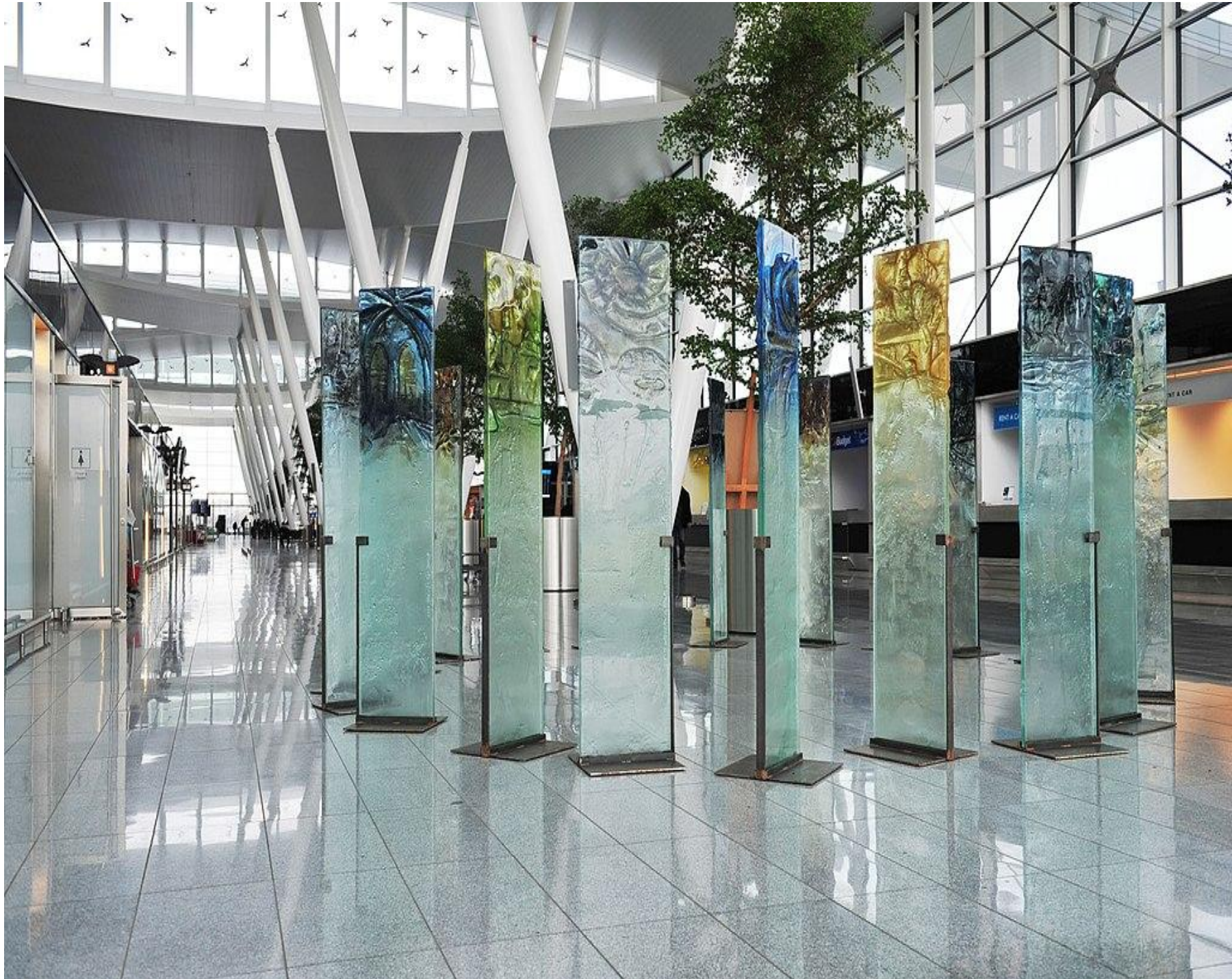
Marcelle Ferron

Victoria Quarter Leeds



Archiglass Wroclaw Airport

Thomas Urbanowicz
2013/2014
Freestanding Glasshenge Series



Memorial window for John Betjeman

John Piper/ J A Nuttgens

1984

All Saints, Farnborough

John Piper Fawley exhibition

Liverpool Cathedral

John Piper/ E Reyntiens

The Nuttgens Family of stained glass artists

Jozef Eduard Nuttgens 1892- 1982

Joseph Ambrose Nuttgens 1941 -

Piggott's Hill

Nuttgens Family home and Studio

St Peter, Gorleston

J E Nuttgens

1937

The only church designed by Gill

St Teresa's Beaconsfield

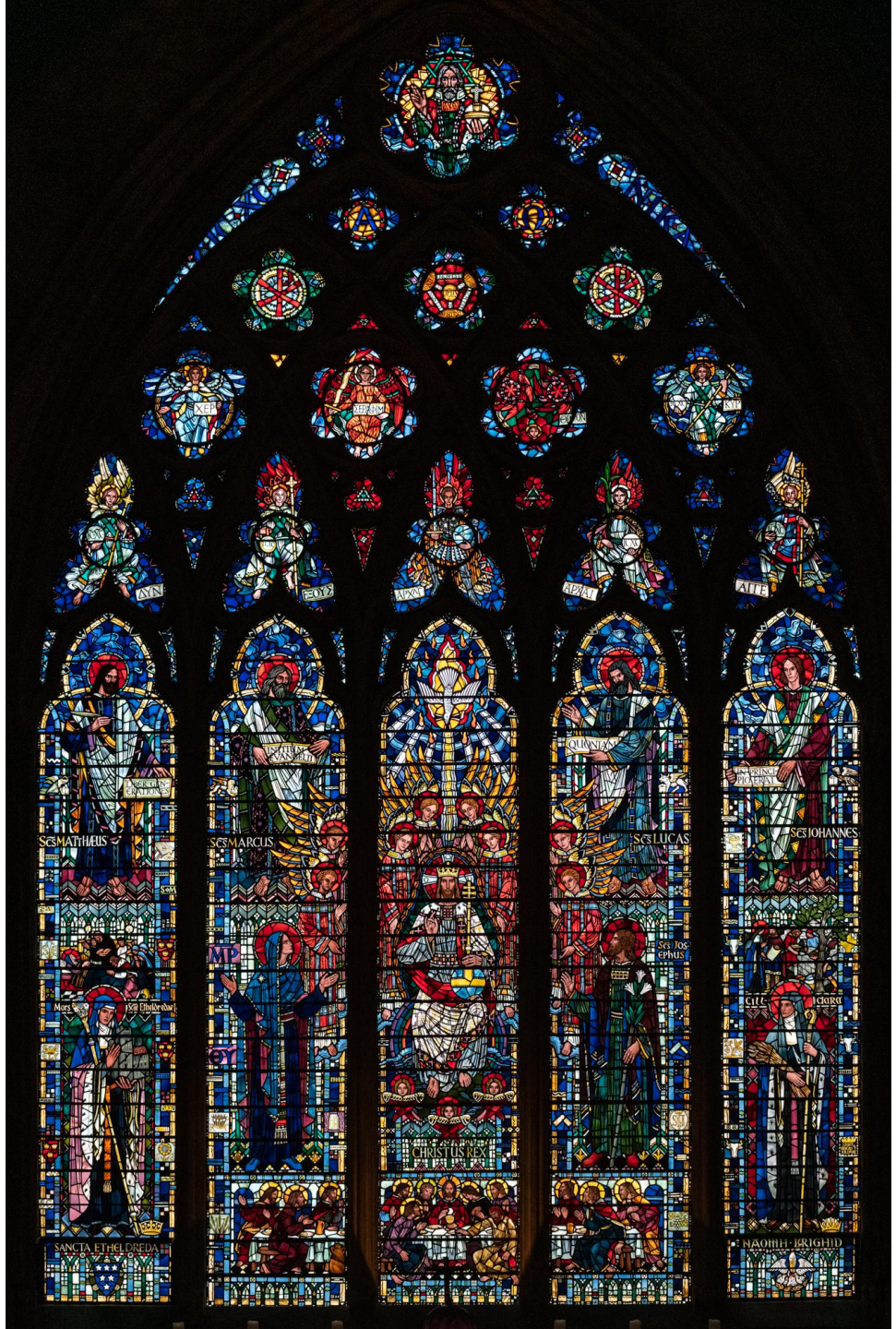
J E Nuttgens

St Teresa's Beaconsfield

J E Nuttgens
Early style reflecting traces
of the style and philosophy
of the Arts and Crafts movement

St Etheldred Ely Place

Eddie Nuttgens



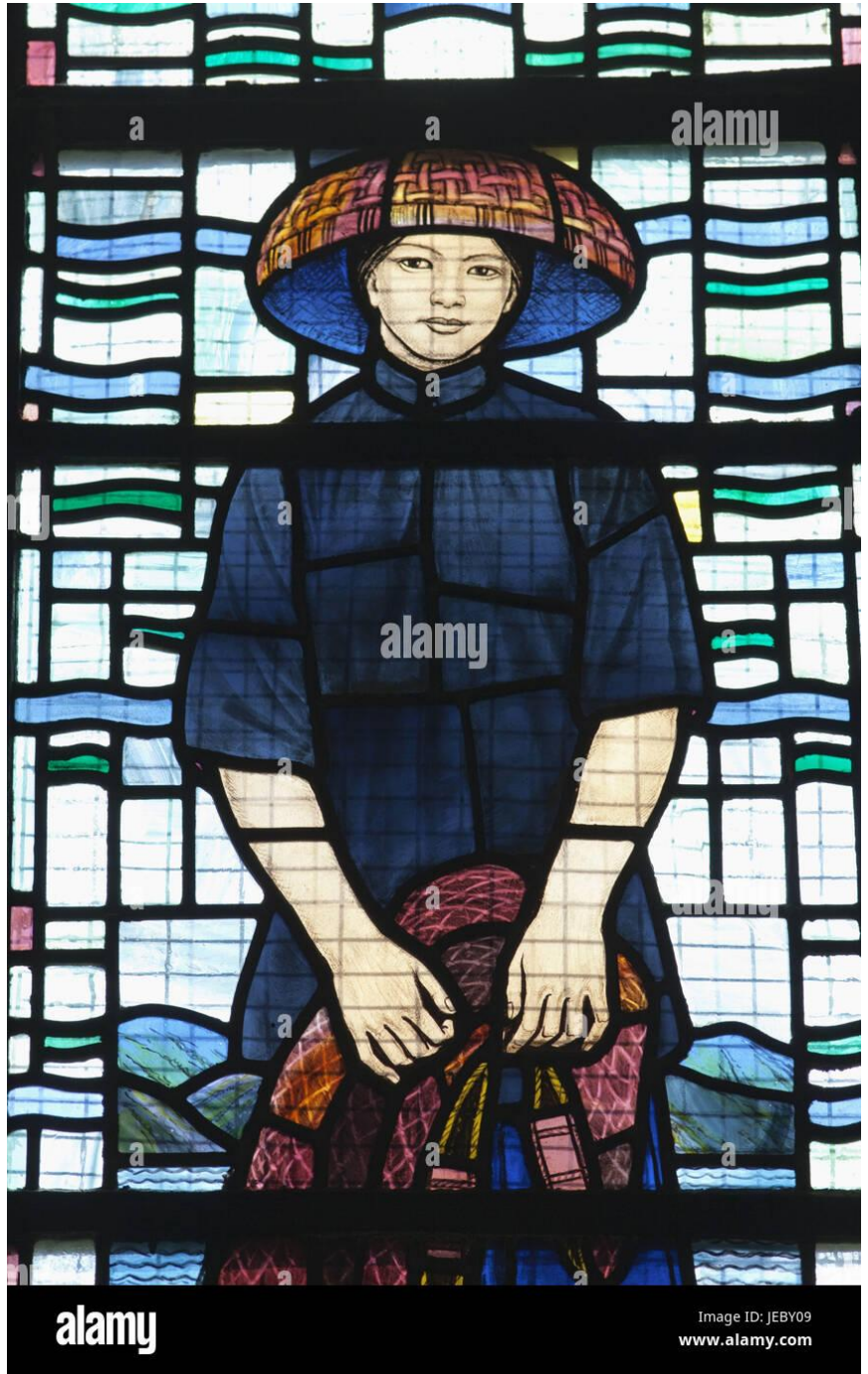

LIBER GENERATIONES
SCS MATTHÆUS
INITIUM EVANGELII
SCS MARCUS
QUONIAM
SCS LUCAS
IN PRINCIPIO ERAT
SCS JOHANNES
Mors
Sctæ Etheldredae
SCS JOSEPHUS
CHRISTUS REX
SANCTA ETHELDREDA
NAOMH · BRIGHID

St John's Cathedral Hong Kong

J E Nuttgens

Original windows by Morris

Recreated by E Nuttgens



Uncle Eddie's plaque

Joseph Ambrose Nuttgens

Over forty windows for churches, private and memorial listed on Joseph Ambrose Nuttgens website

Major works include:

Addis Aba

John Piper Memorial

Durham Cathedral Millenium window

Turret window for Andrew Lloyd Webber

Royal Private Chapel

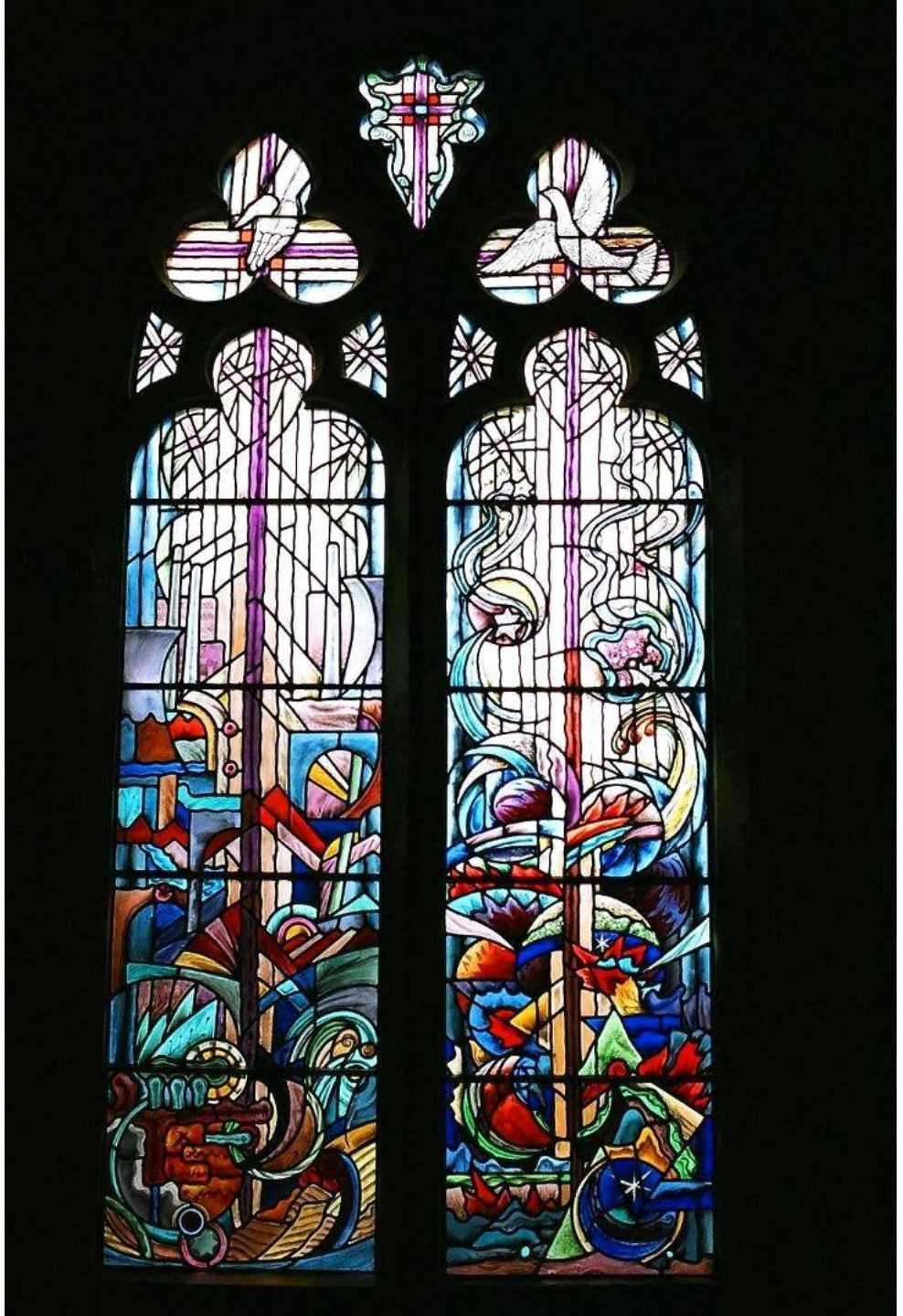
Restoration in Windsor Castle

St Teresa's Princes Risborough

St Teresa's Beaconsfield

King's College Chapel

St Peter's Burnham



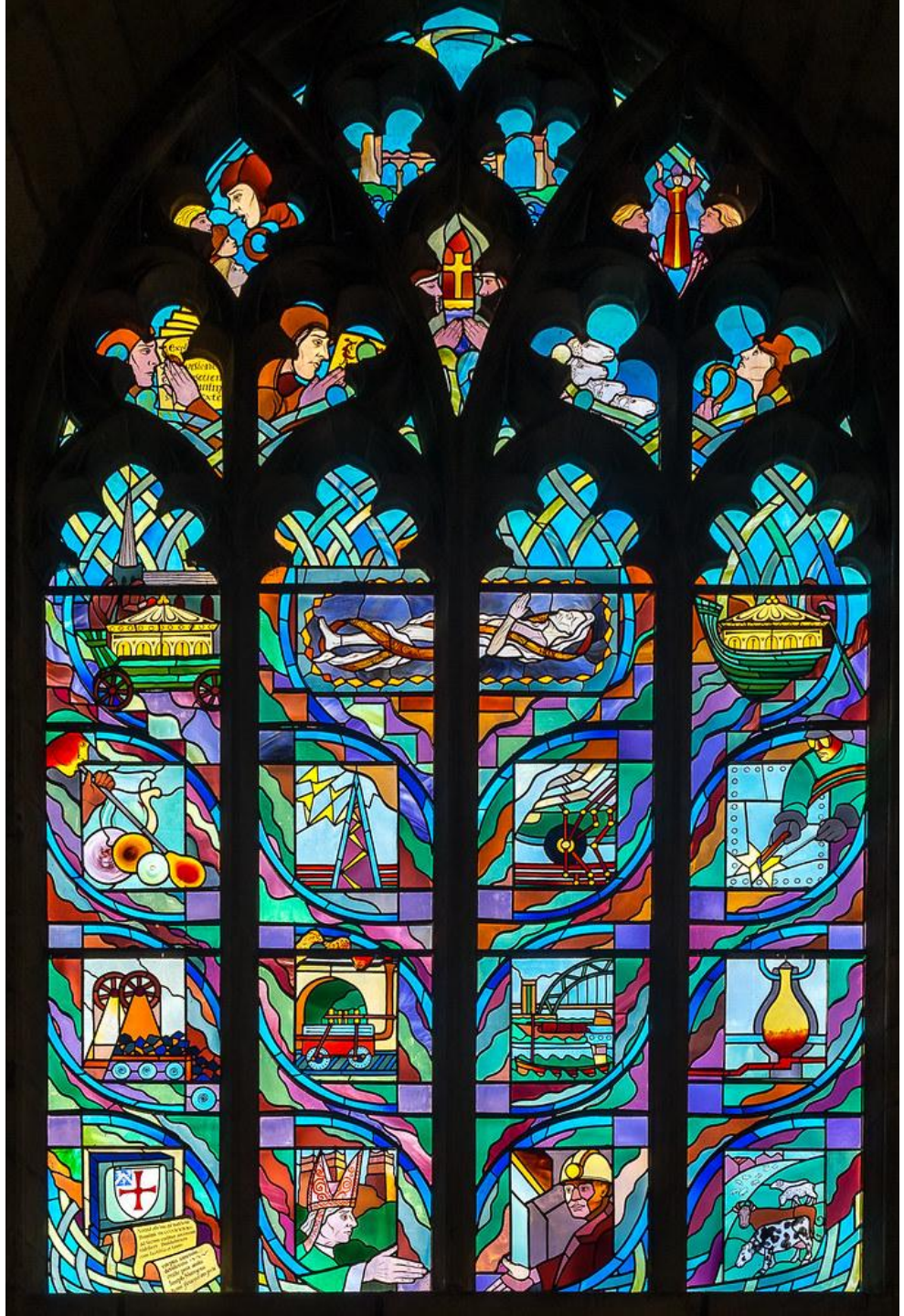
St Martin’s Basildon

St Mary's, Newcastle

Industrial Heritage

Durham

Millenium Window



Princes Risborough

St Teresa's

1 2 3 4 5 6 7 8 9

Light 1: The Creation. - **Light 2:** As the Deer Pants for the Water. - **Light 3:** Forty days of the great flood.

Light 4: Parting the Red Sea. - **Light 5:** The Baptism of Jesus. - **Light 6:** Jesus calms the storm.

Light 7: Jesus heals the man born blind. - **Light 8:** Jesus and the Samaritan woman.

Light 9: Jesus appears by the Sea of Tiberias.

St Teresa's Princes Risborough

Detail

Rhythms of Coincidence

Joseph Nuttgens

Stained Glass: art or anti-art?

John Piper 1968

Art, Craft, Engineering, Physics, Chemistry

Science

Painting with light and colour

The End