Preparing and Painting Blue Pigment in the Renaissance



The Making and Knowing Project, Columbia University
Last updated 2022-11-28, NJR

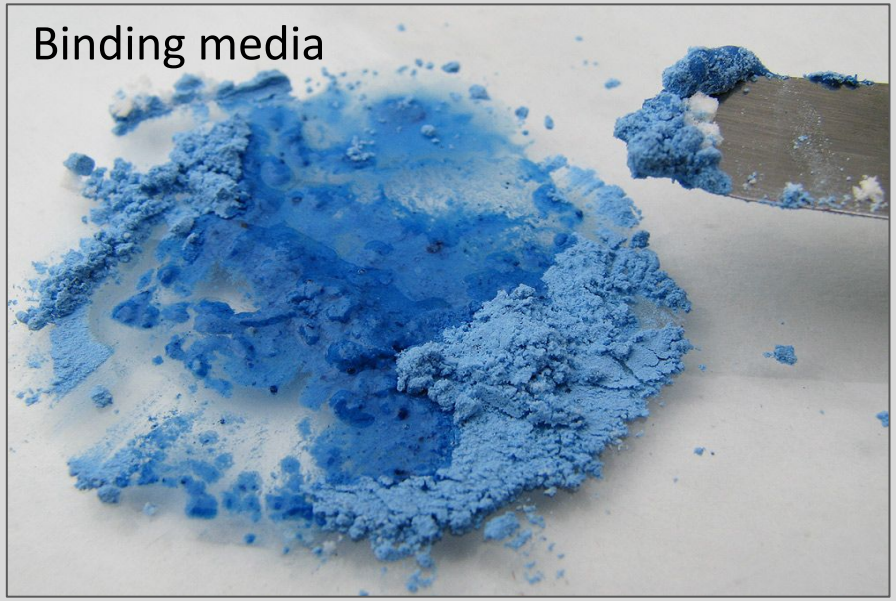
The Making and Knowing Project

PHS put in slides

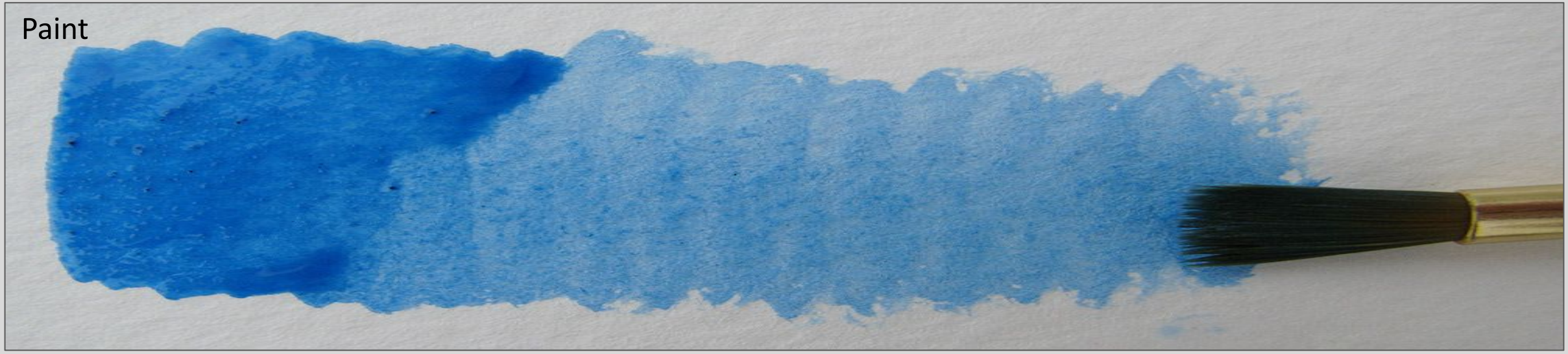
Paint = pigment + binding media

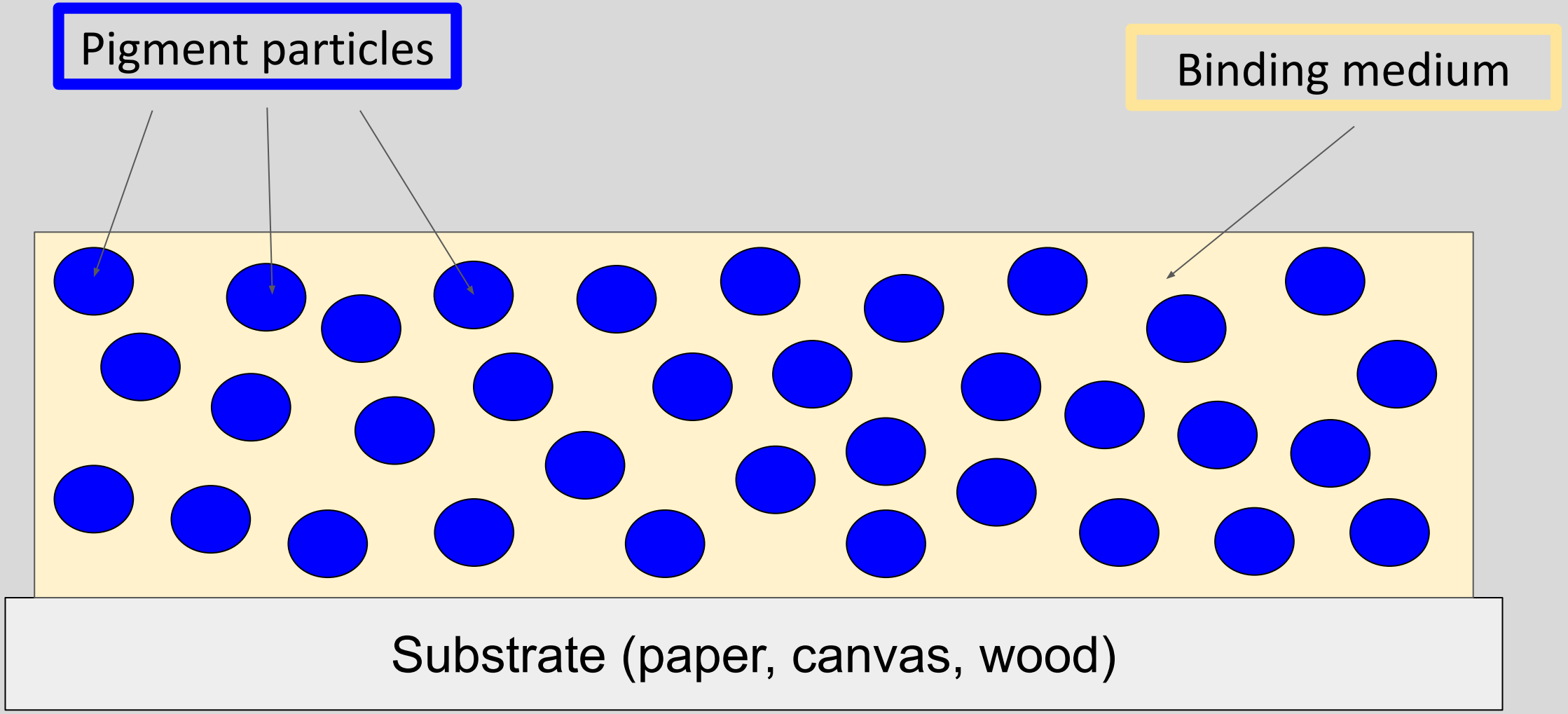
Pigment

Binding media



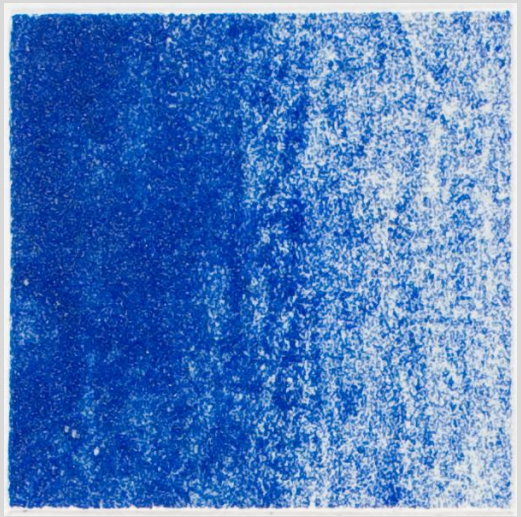
Paint



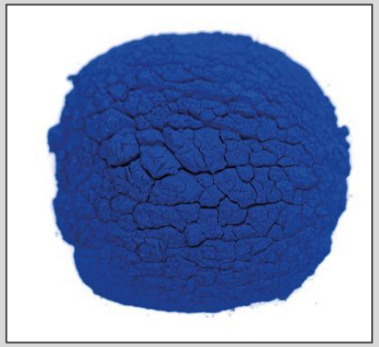

Pigment particles
Binding medium
Substrate (paper, canvas, wood)

Blue Pigments

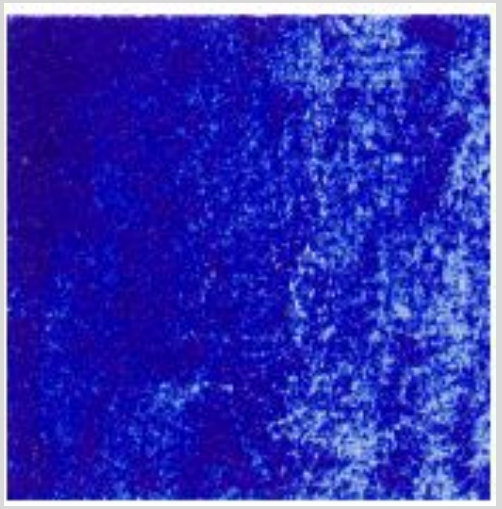
Azurite



Lapis Lazuli



Smalt



Ultramarine

- Powdered lazurite, $(Na,Ca)_8[(S,Cl,SO_4,OH)_2|(Al_6Si_6O_{24})]$

- From the 13th century, the method used to prepare ultramarine pigment mixed powdered lapis with wax, resin and oils then kneaded the mixture in a dilute lye solution; this allowed the blue particles to disperse into the alkaline water while the extraneous minerals (e.g., calcite, pyrite, silicates) are retained in the putty.
  - (CAMEO, http://cameo.mfa.org/wiki/Lapis_lazuli; http://cameo.mfa.org/wiki/Ultramarine_blue,_natural)

- *The Aldobrandini Madonna* (~1532), Titian
  - The National Gallery
  - Dunkerton, *Titian's painting technique to c. 1540*

Ultramarine (lapis lazuli)

Illustration of the process:

Preparing natural ultamarine at Kremer Pigments

The mineral is first ground in an electric mill

The fine particles are mixed with alcohol and poured over magnetized channel to remove the magnetic pyrite particles

The resulting mass is kneaded with wax and water and pressed through fine cloth. The less valuable coarse "ultramarine ash" stays in the cloth

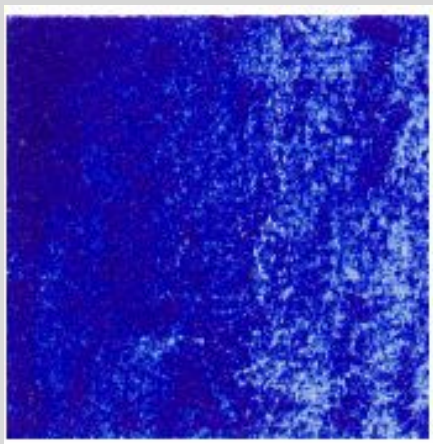
The finest pigment particles pass through the cloth and constitute the highest quality ultramarine

https://www.webexhibits.org/pigments/indiv/recipe/ultramarine.html

Smalt

- Ground potassium glass, (K, Al, Co silicate)
- A coarsely ground blue potassium glass containing small amounts of cobalt oxide, which provides the source of the blue color.
  - (CAMEO, http://cameo.mfa.org/wiki/Smalt)

- Pieter Bruegel's *Adoration of the Kings* (1564)
  - Spring, M., Higgitt, C., Saunders, D. 'Investigation of Pigment-Medium Interaction Processes in Oil Paint containing Degraded Smalt.' *National Gallery Technical Bulletin* Vol 26, pp 56–70, http://www.nationalgallery.org.uk/technical-bulletin/spring_higgitt_saunders2005.

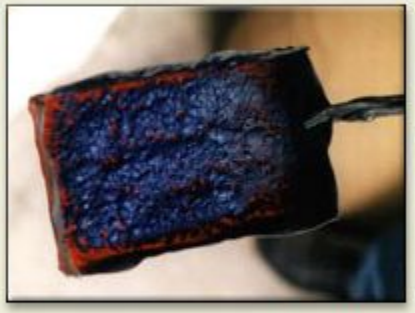


Smalt (cobalt blue glass)

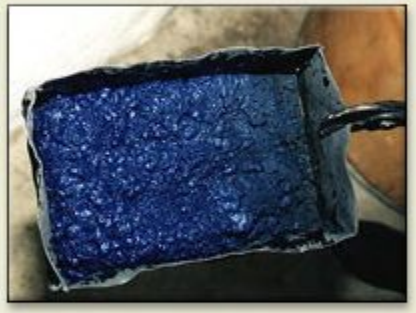
Illustration of the process:

Making smalt at Kremer Pigments

Heating the mixture of sand, potassium carbonate and cobalt oxide



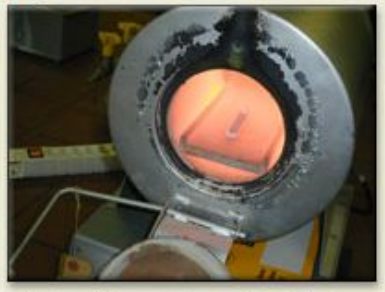
While in the oven, the color changes from red to blue



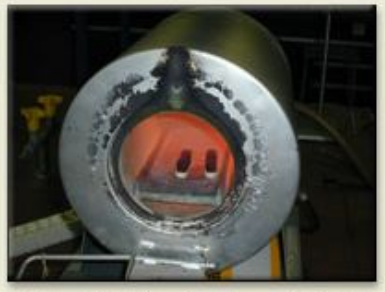
The blue colored finished product prior to grinding

Making smalt in the student laboratory

The mixture of sand, potassium carbonate and cobalt (II,III) oxide is homogenized



The mixture is transfered into a preheated oven



After 30 minutes at ca. 1100°C

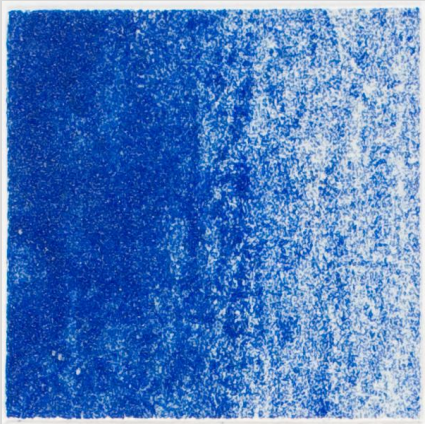
The still hot glassy product is being pulverised by immersion into cold water

Filtration of the finished product

https://www.webexhibits.org/pigments/indiv/recipe/smalt.html

Azurite

- natural basic copper carbonate, 2CuCO3-Cu(OH)2
- Coarsely ground azurite gives a deep blue color while finely ground particles give a lighter more transparent tone.
- Naturally found adjacent to the green copper carbonate mineral called **malachite**.
  - (CAMEO, http://cameo.mfa.org/wiki/Azurite)
- *The Virgin and Child with Saint John* (~1480), Filippino Lippi
  - The National Gallery
  - Dunkerton, *The Materials of a Group of Late Fifteenth-century Florentine Panel Paintings*



Azurite in Illuminated Manuscripts

C

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E

Marissa Bartz, Gabriela Rosas, Jerome Paquet, and Grace McLean, *Non-invasive Technical Analysis of Illuminated Manuscript Leaves from the W.D. Jordan Rare Book and Special Collections, Queen's University: A Collaborative Project*, https://www.culturalheritage.org/docs/default-source/publications/annualmeeting/2022-posters/32-non-invasive-technical-analysis-of-illuminated-manuscript-leaves-from-the-w.d.-jordan-rare-book-and-special-collections-queen's-university-a-collaborative-project---bartz.pdf?sfvrsn=e1af1720_3

Très Riches Heures du duc de Berry Folio 44 verso: The Nativity

Très Riches Heures du duc de Berry Folio 2, verso: February

Très Riches Heures du duc de Berry Folio 6, verso: June

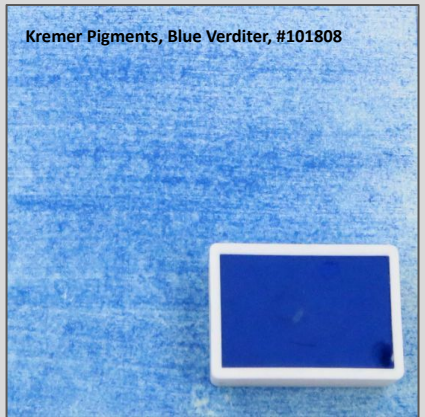
Blue in Books of Hours:
Très Riches Heures du duc de Berry (1412–1416)

Synthetic Azurite: Blue Verditer & Bice

- Synthetic blue copper carbonate, 2CuCO3-Cu(OH)2
  - (CAMEO, http://cameo.mfa.org/wiki/Verditer; https://cameo.mfa.org/wiki/Bice)

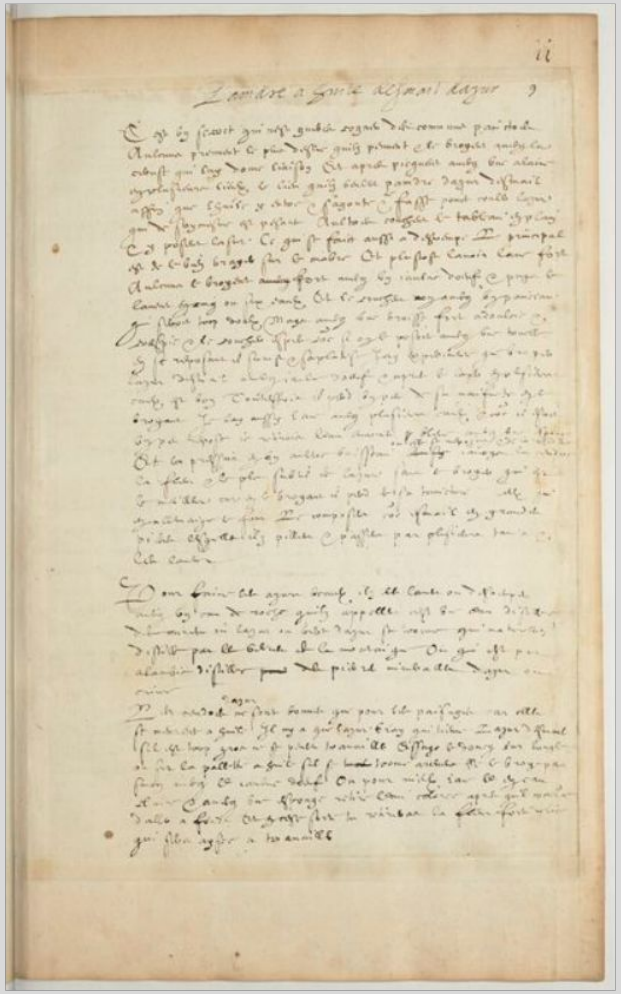
- Verditer and bice are non-standard names for manufactured copper carbonate (as opposed to naturally-occurring ore), created as a replacement for the more expensive azurite. In its early history of manufacture, it was made by pouring copper nitrate on calcium carbonate (whiting), followed by washing and drying.

- *Festoon of Fruit and Flowers* (1660-70), Jan Davidsz. de Heem
  - De Keyser, *de Heem 1606-1684 - a technical examination of fruit and flower still lifes combining MA-XRF scanning, cross-section analysis and technical historical sources*



Blues in BnF Ms. Fr. 640

Painting esmail d'azur in oil (fol. 11r)



This is a secret that is hardly known to common painters. Some take the most delicate they can & grind it with ceruse, which binds it, and next prick with an awl in several places the area they want to paint with *azur d'esmail*, in order that the oil enters & leaks in, & does not cause the azure, which in itself is heavy, to run. Others lay the panel flat & put down the azure on it, which is also done in distemper. The main thing is to grind it well on marble, and before that, to have washed it thoroughly. Some grind it ~~with~~ thoroughly with an egg yolk & then wash it in five or six waters and lay it on not with a paintbrush, which would be too soft, but with a brush thoroughly softened & crimped, & layering it thickly as if one were putting it down with a trowel; settling down it evens out and flattens. I have experienced that grinding *azur d'esmail* with egg yolk & next washing it in several waters is good. However, it loses a little of its vividness in the grinding of it. I have also washed it in several waters &, when it had settled a little, I removed the water, still ~~q~~ blue, with a sponge and squeezed it into another vessel ~~thus~~ where it settled, & from the residue I had the ash, flower, and subtlest part of the azure without grinding it, which is the best, for in the grinding of it, it loses some of its tint. Those who make it in Germany compound it like enamel, in large pieces which they pestle, & pass through several sieves & wash.

To make azures beautiful, they wash or soak them in a rock water, as they call it; it is a water distilled from mines where azure or *vert d'azur* is found, which distills naturally through the veins of the mountain or is distilled through an alembic ~~*par*~~ from mineral stones of azure or copper.

Azure ashes are only good for landscapes because they die in oil. Only true azure holds on. *Azur d'esmail* cannot be worked if it is too coarse. Try it, therefore, on the fingernail or the oil palette. If it ~~*[illegible]*~~ happens to be sandy, do not grind it except with the egg yolk or, better yet, wash it in clear water & with a sponge remove the colored water after it starts to go to the bottom, and in this manner you will extract the very delicate flower, which will be easy to work with.

https://edition640.makingandknowing.org/#/folios/11r/f/11r/tl

Read out loud together

Preparing and Using Azurite

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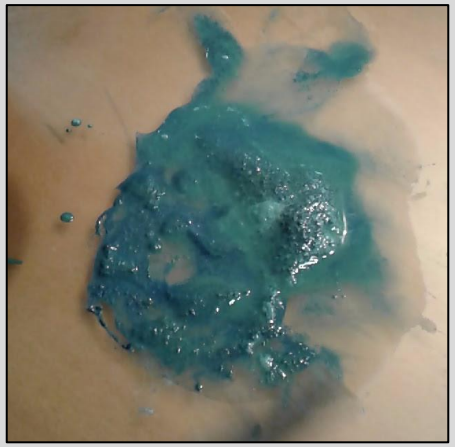

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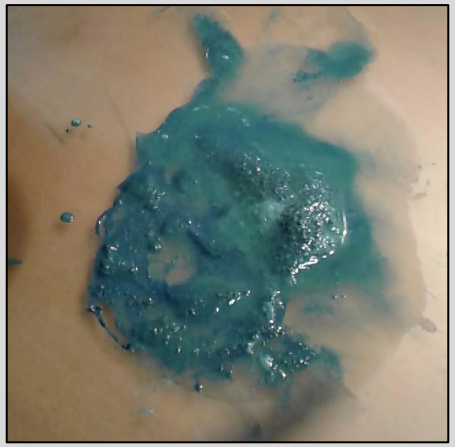


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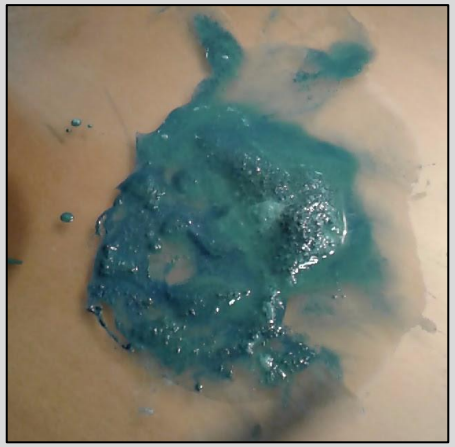


Painting esmail d'azur in oil (fol. 11r)

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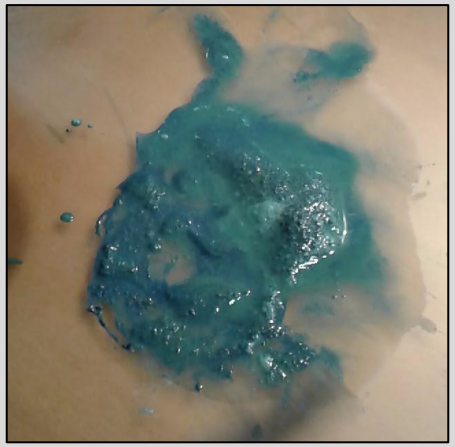



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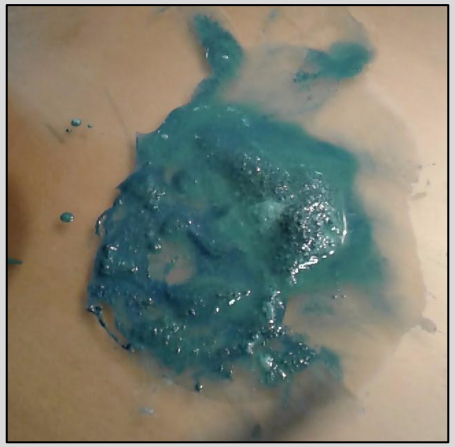




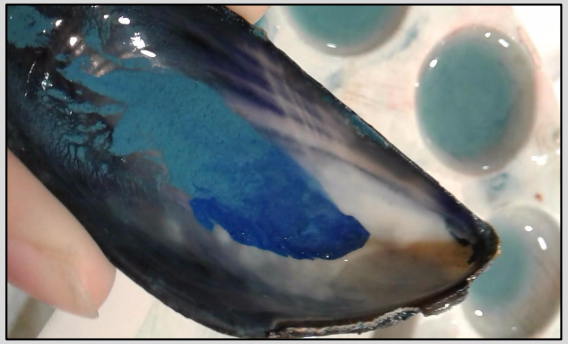

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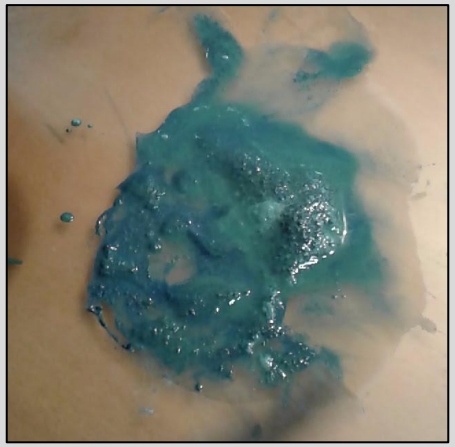




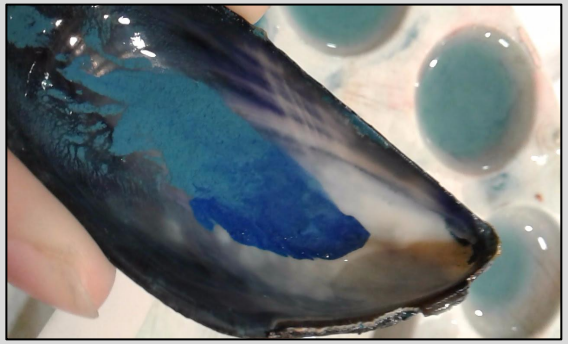
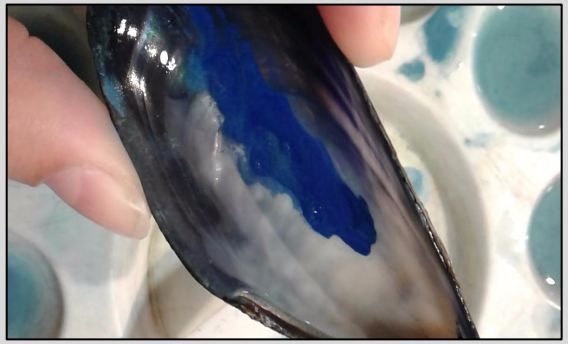

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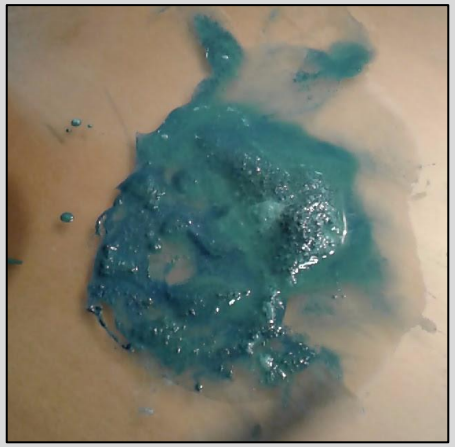




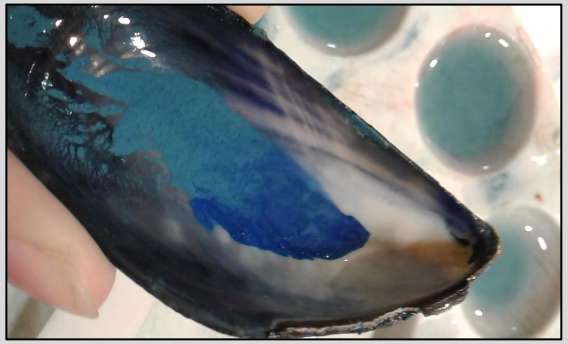
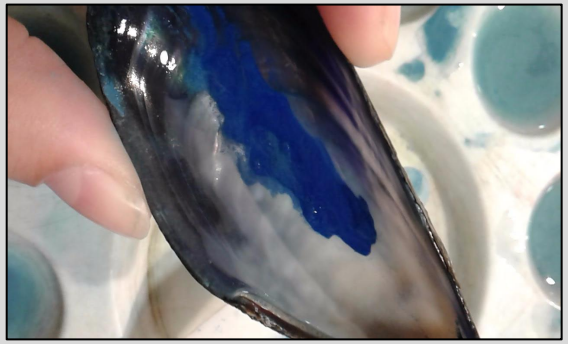
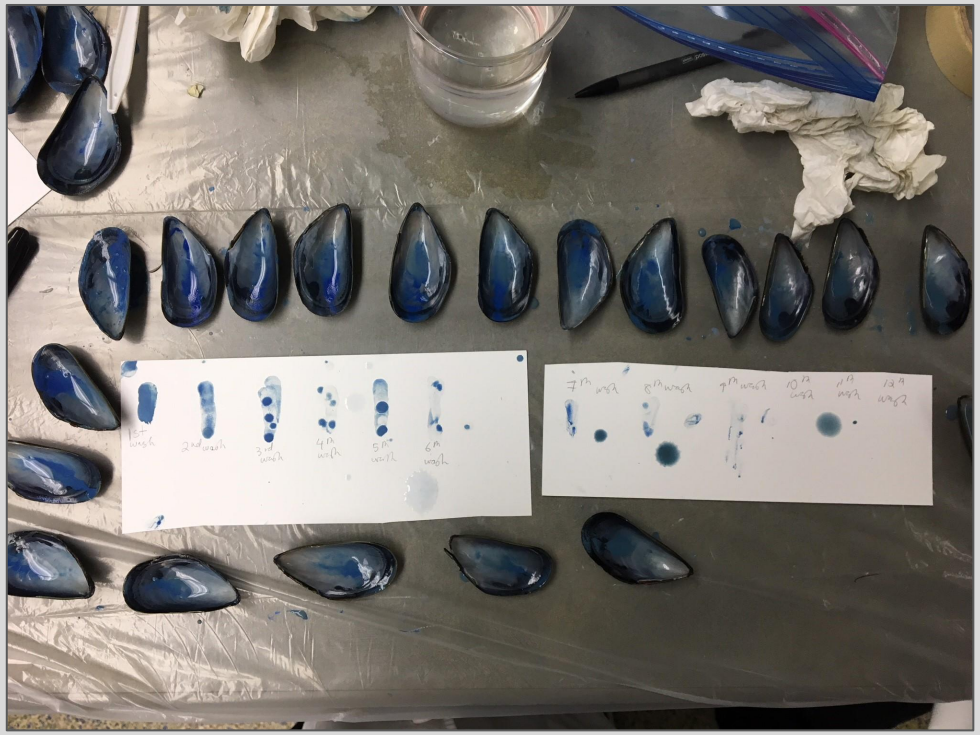

Other Recipes for Comparison

Cennini — Preparation & Application

Cennino Cennini, *The Craftsman's Handbook: The Italian "Il Libro Dell'arte"*, ed. Daniel V. Thompson (New York: Dover Publications, 2018).

- Azzurro della Magna, translated as “azurite” rather than former “German blue”
- “the azurite stone, which looks very lovely to the eye, and resembles an enamel.” (37)
- ”When you have to lay it in, **you must work up some of this blue with water, very moderately and lightly**, because it is very scornful of the stone. If you want it for working on draperies, or for making greens with it as I have told you above, it ought to be worked up more. This is good on the wall in secco, and on panel. It is compatible with a tempera of egg yolk, and of size, and of whatever you wish.” (35-36)
- For painting the blue drapery of the Virgin: Lay down a coat of sinoper and black in a fresco. “Then, in secco, **take some azurite, well washed either with lye or with clear water, and worked over a little bit on the grinding slab.** Then, if the blue is good and deep in color, put into it a little size, tempered neither too strong nor too weak. Likewise, put an egg yolk into the blue; and if the blue is pale, the yolk should come from one of these country eggs, for they are quite red. Mix it up well. Apply three or four coats to the drapery with a soft bristle brush.” (54-55).

Merrifield — Preparation & Application

Jean Le Begue, “Experimenta de Coloribus (1431),” and The Bolognese Manuscript (15th century), in *Medieval and Renaissance Treatises on the Arts of Painting: Original Texts with English Translations*, ed. Mary P. Merrifield (New York: Dover, 2003)

- “How azure is prepared and purified. —But I shall not conceal how I purify it when it comes to my hands. **I first pour it into a bason, and put a little water along with it**, and rub it with my finger until it is thoroughly moistened, and **then I pour in more water and stir it well, and let it rest**. **When it has settled, I pour off the water**, turbid from the impurities, into another vase, keeping the precious colour which remains at the bottom of the vase, for its nature is such that the finer and purer the colour is the heavier it is, and therefore the sooner it reaches the bottom; and **the impurities**, or the whitish or yellowish parts, which are lighter, **float or remain above it in the water**. And, if necessary, **I repeat this process several times, pouring water out and in until it is purified**” (Manuscript of Jehan Le Begue, 134)
- “Take the azure, and put it into a glazed pan; then add some very clean honey and incorporate them well together then grind the honey with the blue upon marble or porphyry until it becomes an almost impalpable powder. **When it is ground fine put it back into the pan and wash it several times with warm water**, and when it is well washed with warm water, wash it with cold water, and **after each time let the azure sink to the bottom**. Continue this until it is well washed, cleaned, and purified ; then take the azure and put it to soften in clear and clean ley in a glass vase, such as a tumbler, and let it stand for the space of seven days; change the ley every two or three days, and then wash it well with fresh and clear water, and let it dry in the shade in a place where no dust will get to it” (Bolognese Manuscript, 408)

Hands-on Reconstruction

Questions for consideration

- **Observation:**
  - What does the stone look and feel like?
  - Other than the blue parts of the stone, what other inclusions (different types of stone) can you see?
  - When the stone is ground, what does the powder look like?
  - How does it behave in water?
  - What do the particles look like?
- **Embodied experience:**
  - What kind of movements do you use in each step of the process (grinding, adding water, pouring, painting out)?
  - How does it feel to grind the azurite stone?
  - How does it change when you add water?
  - Can you manipulate the separation of the particles? How? (time, amount, ratio of water, speed of pouring)
  - How many different “grades” can you get?
  - When painting the different grades out, is there a difference between the paler and darker colors?
  - Is there a difference in the way each paint wants to be handled or flows off the brush?
- **Artisanal knowledge:**
  - What kind of knowledge would you need in order to prepare, apply, handle, appreciate these materials?
  - How might you acquire that knowledge today and historically?
- **Asking new questions:**
  - What new questions does this experience cause you to ask about paintings or other works of art in general?

Materials

- plastic table cloth
- nametags & pens
- azurite ore, e.g., Kremer #102005 “azurite stone”
- mortar and pestle
- glass plates & mullers
- on the side (optional): ceramic plates and plastic palettes
- pouring/separating: mussel shells and/or plastic containers
- large containers of water
- paper towels
- scoopulas
- concentrated gum arabic solution (1g gum arabic in 5ml water), e.g., Kremer #63330
- paintbrushes
- mixed media paper

Resources

- The Making and Knowing Project, https://www.makingandknowing.org/
- *Secrets of Craft and Nature in Renaissance France. A Digital Critical Edition and English Translation of BnF Ms. Fr. 640*, https://edition640.makingandknowing.org
  - Making and Knowing Project, Pamela H. Smith, Naomi Rosenkranz, Tianna Helena Uchacz, Tillmann Taape, Clément Godbarge, Sophie Pitman, Jenny Boulboullé, Joel Klein, Donna Bilak, Marc Smith, and Terry Catapano, eds. (New York: Making and Knowing Project, 2020)
- Other recipe books:
  - Cennino Cennini, *The Craftsman's Handbook: The Italian "Il Libro Dell'arte"*, ed. Daniel V. Thompson (New York: Dover Publications, 2018)
  - Mary P. Merrifield, *Medieval and Renaissance Treatises on the Arts of Painting: Original Texts with English Translations* (New York: Dover, 2003)
- "Azurite skillbuilding," https://cu-mkp.github.io/sandbox/docs/azurite-assignment.html
- "Introduction to Paints and Pigments," https://cu-mkp.github.io/sandbox/docs/introduction-paints-pigments_njr_2021.pdf
- "Experiments with Azurite on the History of Design MA Course," V&A/RCA History of Design MA
  - Part 1: https://www.vam.ac.uk/blog/news/experiments-with-azurite-on-the-history-of-design-ma-course
  - Part 2: https://www.vam.ac.uk/blog/projects/thinking-and-experiencing-techne-making-azurite-part-2
- Traveling Scriptorium: A Teaching Kit by the Yale University Library, https://travelingscriptorium.com/
  - https://travelingscriptorium.com/2012/03/20/an-online-version-of-the-ink-pigment-sampler-set/
- CAMEO Characteristics of Common Blue Pigments, http://cameo.mfa.org/images/e/ea/Download_file_506.pdf
  - Very helpful overview: Table with all blue pigments, their composition, usage, characteristics, etc.
  - http://cameo.mfa.org/wiki/Lapis_lazuli; http://cameo.mfa.org/wiki/Ultramarine_blue,_natural
  - http://cameo.mfa.org/wiki/Smalt
  - http://cameo.mfa.org/wiki/Azurite
  - http://cameo.mfa.org/wiki/Verditer; https://cameo.mfa.org/wiki/Bice
- Pigments Through the Ages, https://www.webexhibits.org/pigments/intro/blues.html
  - https://www.webexhibits.org/pigments/indiv/recipe/ultramarine.html
  - https://www.webexhibits.org/pigments/indiv/recipe/smalt.html
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