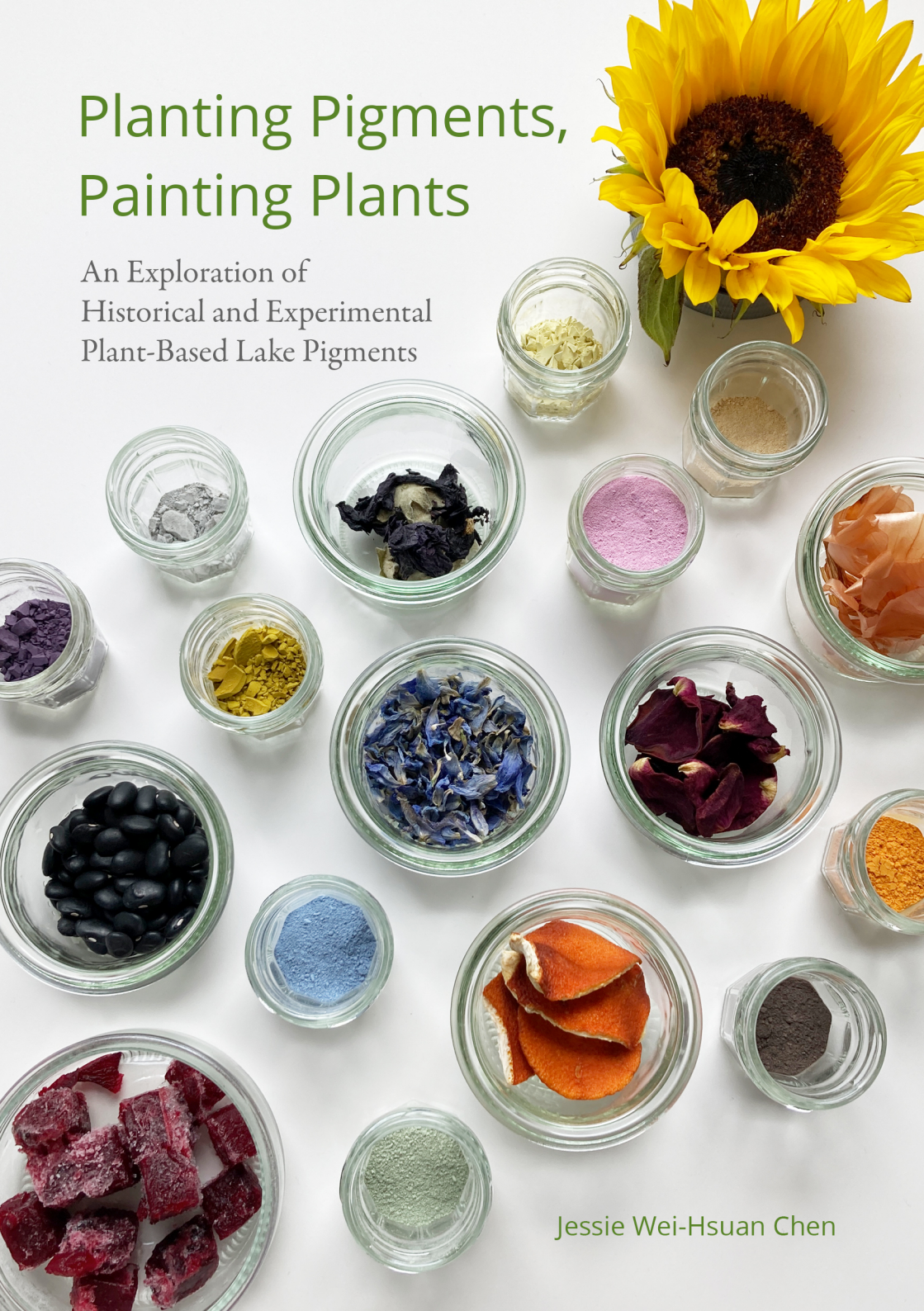
Planting Pigments, Painting Plants

An Exploration of
Historical and Experimental
Plant-Based Lake Pigments



Jessie Wei-Hsuan Chen

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Contents

Prologue

This booklet is a small book with a big identity crisis. It is not a master class on the theory and practice of painting materials and techniques. It is not an exhibition catalog that thematically introduces and describes artworks. It is not a piece of gallery work displaying the art and craft of painting plants. It is not a how-to manual to show the step-by-step process of extracting plant-based dyes and making pigments from them. And it is not a sample book because the pigments in this booklet are not intended to be purchased nor further disseminated. Debatably, some might not even consider it a "real" book, for it is digital-born and not intended to be printed and bound. Nevertheless, this booklet took inspiration from all the above-mentioned categories. What it can be best described as is a series of end results, but not conclusions, of experimenting with turning plants into pigments, into paints, and into paintings. Moreover, the colorful swatches of pigments and paints in this booklet are abstract visual representations of the conversations, discussions, and many more questions that arose from the making process.

This project stems from my PhD research, part of which delves into the practical making of botanical watercolors from the early modern period, which roughly refers to the period from the late fifteenth to the late eighteenth centuries. It tries to understand how image-makers in early modern Europe worked with the "color technology" of their time to visualize the plant world. Applying the performative research method that can be best described as historical reworking/remaking, I spent a lot of time at the university Kunstlab (Artlab) to work with historically-oriented art materials and techniques.[1] This particularly enabled me to safely handle toxic colors, such as lead white, that were essential in the past. The Covid-19 pandemic disrupted this lab access, and some aspects of the research have been halted, but being forced to experiment from

[1] For more on this research in progress, see the Making Colors series (https://jessieweihsuanchen.com/tag/making-colors-series/). On performative methods, see especially Hendriksen, "Rethinking Performative Methods in the History of Science" and other articles in the same journal issue; Dupré et al., eds., *Reconstruction, Replication and Re-enactment in the Humanities and Social Sciences*.

a simple home lab brought into play different perspectives on a maker's relationship with various working environments.

Concurrently, two things came to the foreground while working from home. First, the interest in hand-making things grew throughout many places in the world during the pandemic lockdowns. Making lake pigments from dyes gained traction, particularly among communities of natural dyers, a practice that has deep historical roots.[2] Albeit constantly changing their forms and shapes, many arts and crafts share experiences and qualities that transcend time and place. Second, the longstanding habit of sending bouquets or potted plants to express appreciation of a person's effort, to celebrate their accomplishment, to console them in sorrow, or simply to brighten their day became even more common. The question of what colors can be extracted as a visual reminder of the memories these plants commemorate grew in the back of my mind.

Plant-based lake-pigment making became a suitable means to bring historical and present-day experimental colors together. This booklet shows three different (sets of) watercolors done with paints made from plant-based lake pigments. The first single sheet watercolor concerns itself with early modern materials and techniques, with the goal of achieving a specific artistic style through the maker's control of the paints. The second set of twelve small paintings took the opposite approach. Instead of manipulating the paints to create what I envisioned, the final style was a response to how the paints behaved in the moment of painting. The final watercolor is a combination of having and losing control. Through making lake pigments and painting flowers with them, this booklet offers a possibility of what can happen when plants, colors, and makings intersect.

[2] Three online resources that were particularly useful in introducing me to many present-day practitioners are World Pigment Day by Ruth Siddall and Jo Volley (https://www.instagram.com/worldpigmentday), Wild Pigment Project (https://wildpigmentproject.org/), and the blog of Botanical Colors (https://botanicalcolors.com/category/blog/).

(Re)Painting Colorful Flowers

The road to find one's own artistic expression often starts with imitating the works one likes. The path for me to better understand the application of historical color technology took me to copy a seventeenth-century painted parchment (Fig. 1). The reproduction and the original painted folio (Fig. 2) show a snowdrop, two winter aconites, two hellebores, some hepaticas, and some crocuses.[3] This folio is one of the 100 paintings in the manuscript that is titled *Jardin de rares et curieux fleurs* and attributed to the Leeuwarden-based Dutch painter, Franciscus de Geest (after 1626 and before 1638/39–c. 1699).[4] Today, these recognizable plants are common garden flowers in the Netherlands and many European countries. Procuring them requires only a simple trip to a local florist or supermarket. As its title suggests, however, the depicted flowering plants in the manuscript were considered rare and curious in early modern Europe.

De Geest's book of flowers can be broadly categorized as a *florilegium* (plural *florilegia)*. While it is not a strict label and the content of each book can vary, the *florilegium* is a genre of book featuring a collection or a selection of flower images. Literally meaning "a gathering of flowers," the term *florilegium* first described a collection of excerpts from other bodies of text in the Middle Ages, but gained an association with a "flower book" in the early modern period. *Florilegia* were essentially picture books. Copperplate engraving (sometimes hand-colored) and hand-painted watercolor/bodycolor were two major ways to create the images in a *florilegium*. Text often only appeared in the introductory section(s) to state the owner's possession of the plants and again in the

[3] The album is preserved at the Oak Spring Garden Foundation in Upperville, Virginia. See catalog entry in Tongiorgi Tomasi, *An Oak Spring Flora*, 84–87. There is another album by De Geest with very similar content and many flowers in same compositions that is preserved at the National Central Library of Rome (Biblioteca nazionale centrale di Roma) and is digitized for public access (http://digitale.bnc.roma.sbn.it/tecadigitale/manoscrittoantico/BNCR_Ms_VARIA_0291/BNCR_Ms_VARIA_0291/1). The 2012 printed facsimile of the Rome volume includes updated studies of De Gesst and his works, see Menghini, ed., *Hortus Amoenissimus*.

[4] Huisman, "Franciscus de Geest and His 'Delightful Gardens'," 24–29.

Fig. 1. Reproduction of watercolor by Franciscus de Geest.

Fig. 2. Original watercolor by Franciscus de Geest.
(Image credit: Oak Spring Garden Foundation, Upperville, Virginia)

captions for the illustrations. *Florilegia* of the seventeenth century focused on the plants' decorative quality, as opposed to their medicinal or utilitarian functions, which were the focus in early modern herbals.[5] Early modern *florilegia* also often had close connections to specific gardens that once existed and showcased the several color variations of the same flower and the most valued cultivars of the garden owners.[6]

Regardless of whether it was in the form of a printed book or painted manuscript, *florilegia* were markedly expensive. The cost in producing and reproducing a volume full of folio-size-or-larger engravings was (and still is) much higher than printing a book without pictures.[7] Additionally, the emphasis on the wide range of colors of the depicted flowering plants meant that (professional) colorists had to be brought in, as hand-coloring was the common method to add colors to black-and-white prints in the early modern period.[8] The cost of the many people and artist's materials involved in its making process gave a printed *florilegium*, particularly a hand-colored one, a high price tag. Similarly, manuscript *florilegia* were often commissioned over a long period of time, from several years to more than a decade. Although each folio may not have been exorbitantly expensive, the accumulated cost of more than 100 folios, which is typical for surviving *florilegia* that have not been dismantled, means that only people with certain financial means and privileges were able to afford such an item.[9] *Florilegia* were not the most democratizing objects, but the early modern fascination with flowers which they embody and visually represent led to many gardening and technological developments (such as the greenhouse) that eventually

[5] For more information on the genre of *florilegium*, see Nissen, *Die botanische Buchillustration* 66–80; Chapter 2: Florilegia and Pattern Books in Saunders, *Picturing Plants*, 41–64; Blunt and Stearn, *The Art of Botanical Illustration*, 13–14.

[6] See, for example, Sikkens-De Zwaan, "Magdalena Poulle (1632-99)"; Lauterbach, "Commerce and Erudition."

[7] A famously expensive *florilegium* is the *Hortus Eystettensis* (1613). See short introduction by the British Library (https://www.bl.uk/collection-items/hortus-eystettensis); Barker, *Hortus Eystettensis*.

[8] See Dackerman, ed., *Painted Prints*; Goedings, *Afsetters en meester-afsetters*.

[9] Two exhibition catalogs feature several essays that discuss the people who commissioned a few seventeenth-century *florilegia* that are most well-known to us today, see De la Fuente Pedersen and Kolind Poulsen, eds., *Flowers and World Views*; Bushart et al., eds., *Maria Sibylla Merian und die Tradition des Blumenbildes von der Renaissance bis zur Romantik*.

made the garden flowers so easily available and commonly enjoyed today.[10]

To pictorially capture the colorful flowers in *florilegia,* the medium of watercolor is important for the making of both hand-colored printed and manuscript volumes. However, the term "watercolor" may be somewhat misleading for present-day readers. Today, watercolor is often treated as a synonym for transparent watercolor, painted using a technique of thin and translucent washes and with a luminescent effect. The opaque paints De Geest used to depict the flowers are usually described by the term bodycolor, or alternatively gouache, instead.[11] However, this rigid separation of watercolor and bodycolor is not necessarily productive when discussing the majority of works from the past, since both translucent and opaque paints were often used together in a single painting.[12]

In a more general sense, watercolor is a water-based painting medium, consisting of pigments mixed with a binder; a pigment is a powder of insoluble colored particles, and a binder holds the particles together. Gum arabic (Fig. 3) is the most used binder for watercolor throughout the ages, and the only kind I used for this project. By adjusting the ratio of pigment and the gum arabic dissolved in water, the paint can become more translucent or opaque. [13] There is one major complication, however. Some of the translucent paints in early modern works that have a closer effect to transparent watercolor are more in line with the general definition of inks for writing and drawing (but not for printing). Instead of a pigment, an ink is usually made from soluble dye with a binder, which in most cases was also gum arabic. Sometimes there was even no mention of adding the gum, and only the dye was used for hand-coloring or painting as a glazing color.[14] Within this booklet, "painting

[10] A useful starting point is Lee and Helphand, eds., *Technology and the Garden.*
[11] See Cohn, *Wash and Gouache,* for an introduction on the materials and techniques of watercolor and bodycolor/gouache that is close to the present-day understanding of the terms from a conservation perspective.
[12] Creators of the recent exhibition Renaissance Watercolours at the Victoria and Albert Museum (https://www.vam.ac.uk/exhibitions/renaissance-watercolours) share the same view. See particularly, Evans, *Renaissance Watercolours*, 8; 14–15.
[13] Tallian, "John White's Materials and Techniques," 72.
[14] For instance, in an important seventeenth-century treatise on the art of illumination and watercolor, *Verlichterie-kunde, of recht gebruyck der water-verwen* (1670), the recipe of

with watercolor" includes using all three kinds of colorants: pigment-based paints, inks, and dyes (indicated as "clothlet" instead of "pigment" on the color charts).

Fig. 3. Gum arabic.

Determining what colors to use for painting the reproduction required educated guesswork. Early modern artists' manuals on illumination and watercolor provide useful information on the color materials that were obtainable and commonly used during the period.[15] With non-invasive analytical methods, including infrared reflectography and macro-XRF scanning, conservators can identify the specific pigments (and, using other methods, binders) that went into a painting.[16] De Geest's piece has not been analyzed, so such identification is not yet available. However, several contemporaneous pieces depicting flora and fauna that have been analyzed offer useful insight into the common color

"Bresilie Verwe" (a color made of redwood/Brazilwood) describes the steps of making a red ink and the recipe for saffron states that the yellow extracted from the plant can be used without gum. See Goeree, *Verlichterie-kunde, of recht gebruyck der water-verwen,* 14; 24–25.

[15] A few largely quoted ones include Boltz, *Illuminierbuch,* Goeree, *Verlichterie-kunde, of recht gebruyck der water-verwen*, and Norgate, *Miniatura.*

[16] The ILLUMINATED project at The Fitzwilliam Museum offers a helpful introduction (https://www.fitzmuseum.cam.ac.uk/illuminated/lab/lab/analytical-methods) to different analytical methods suitable for examining illuminated manuscripts and similar types of paintings.

materials found in watercolors of natural history more widely.[17] By comparing the colors listed in historical manuals, the pigments identified by recent analyses in similar works, and the visual properties of the colors in De Geest' original folio, I selected the ten historically-oriented colors listed in the charts of the next pages to paint the reproduction. The flowers were painted with freshly made paints and the mixing of the selected colors reproduced the range of variations observed in the original folio.[18]

For watercolor paints to become a watercolor painting, the paints need to be applied onto a support. The manuscript folios by De Geest are painted on parchment, which is one of the two most common supports—another one being rag-based papers—for historical watercolors.[19] Parchment is a durable writing and painting material, made from the prepared skin of an animal (Fig. 4). Typical species for parchment-making include goats, sheep, and calves, with the last one offering the highest quality working surface and often reserved for important or luxurious items.[20] Most manuscript *florilegia* have calfskin parchment as the support for the painted folios, including the volume by De Geest.[21] With a piece of calfskin parchment and the selected colors, I made the fresh paints and reproduced De Geest's colorful flowers (Fig. 1) over the span of three eight-hour workdays.[22] It is true that the pigments and inks used in the reproduction most likely differ from the original, and many of the tools (such as brushes) are from present-day manufacturers, but that is not a problem because replicating

[17] Including Montalbano et al., Painting on Parchment Besides Miniatures," Ambers et al., "John White's Watercolours," and Turner and Trentelman, "Exquisite Views of Nature in a 16th-Century Book."

[18] Color mixing has now been shown as a common practice for illumination, even though the extent of mixing is comparatively minimum to present-day practice, see Panayotova, "Colour in Illuminated Manuscripts," 17.

[19] The Rome volume of De Geest's *florilegia* is painted on paper.

[20] Cheese, "From Pelt to Painted Page," 75–78. The project Pergamenum21 (https://www.pergamenum21.eu/) has a helpful video showing a general parchment making process and what can be learned from this process from a transdisciplinary collaboration, see Parchment Making (https://youtu.be/_TmyEiVUTlg).

[21] Borring et al., "The Gottorfer Codex," 171–172; Tongiorgi Tomasi, *An Oak Spring Flora*, 84.

[22] The piece of calf parchment on which I painted was made by Sara Charles, see the making process on her website Teaching Manuscripts (https://www.teachingmanuscripts.com/blank-page-6).

the past to the very last detail is not the goal here. Rather, copying and re-painting De Geest' original is a way to closely examine and question the working processes of historical watercolors on a broad level through active bodily engagements.

Fig. 4. Parchments being stretched on frame.
(Image credit: Sara Charles, Teaching Manuscripts)

H – Historical Colors
F – Floral Colors
E – Experimental Colors

– Each color includes a photo of the pigment material/dyestuff, pigment/clothlet sample, and watercolor paint swatch.

– Champagne chalk, the substrate for making most of the lake pigments for this collection is shown below.

– All colors starting with letter F are made by Jessie Wei-Hsuan Chen and with the petals of the flowers in the photos.

picture of pigment material/dyestuff
(not always the actual material used for making the samples)

Collection Inventory Number

Pigment Material/Dydstuff

Botanical Name of Plant-based Dyestuff

(Maker/Manufacturer)

pigment/clothlet sample

watercolor paint swatch

Snowdrop

Lead White (H1)
Sap Green (H5)
Red Ochre (H6)
Cochineal (H8)
Indigo (H10)

Winter Aconites

Lead White (H1)
Orpiment (H2)
Verdigris (H4)
Sap Green (H5)
Red Ochre (H6)
Indigo (H10)

Hellebores

Lead White (H1)
Weld (H3)
Sap Green (H5)
Red Ochre (H6)
Cochineal (H8)
Smalt (H9)
Indigo (H10)

Hepaticas

Lead White (H1)
Weld (H3)
Verdigris (H4)
Sap Green (H5)
Red Ochre (H6)
Madder Root (H7)
Cochineal (H8)
Smalt (H9)
Indigo (H10)

Crocuses

Lead White (H1)
Orpiment (H2)
Weld (H3)
Verdigris (H4)
Sap Green (H5)
Red Ochre (H6)
Madder Root (H7)
Cochineal (H8)
Smalt (H9)
Indigo (H10)

Hepaticas

Lead White (H1)
Sap Green (H5)
Madder Root (H7)
Cochineal (H8)
Smalt (H9)
Indigo (H10)

H1

Lead White

(Kremer Pigmente, 46000)

H2

Orpiment

(Kremer Pigmente, 10700)

H3

Weld Yellow Lake

Reseda luteola

(Jessie Wei-Hsuan Chen)

H1 pigment

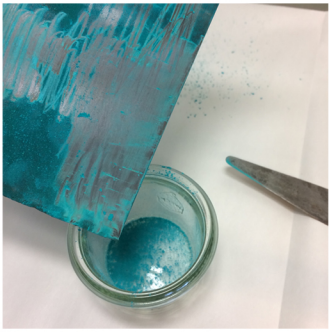
swatch

H2 pigment

swatch

H3 pigment

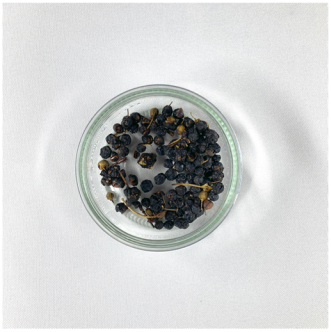
swatch



H4

Verdigris

(Verfmolen De Kat, 6046-93-1)

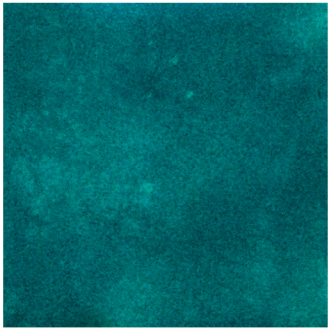


H5

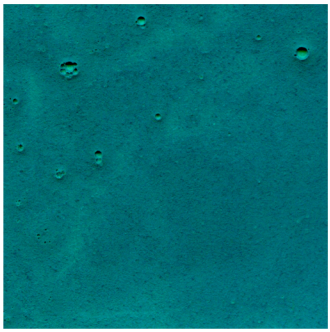
Sap Green
(made with ripe buckthorn berry)

Rhamnus sp.

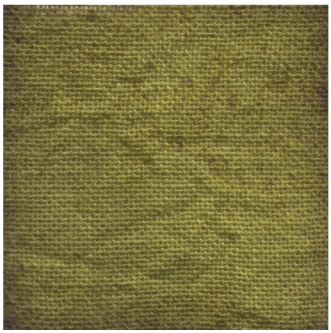
(Jessie Wei-Hsuan Chen)



H4 pigment

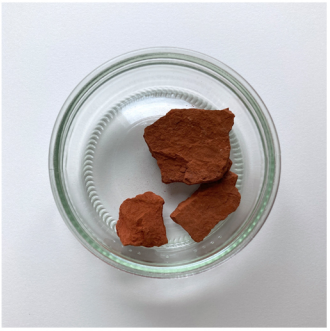


swatch



H5 clothlet

swatch



H6

Red Ochre

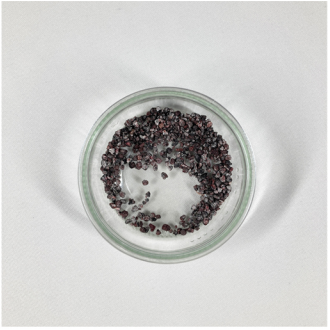
(Kremer Pigmente, 11584)

H7

Madder Root Red Lake

Rubia tinctoria

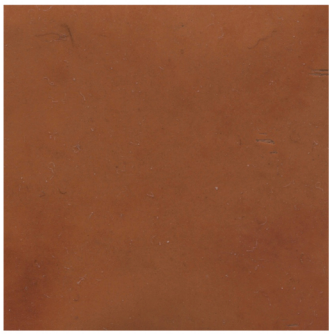
(Jessie Wei-Hsuan Chen)



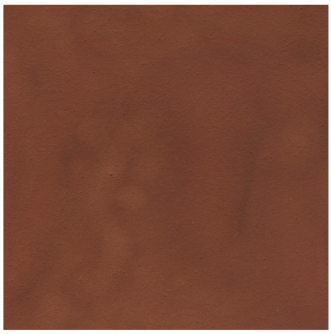
H8

Cochineal Red Lake

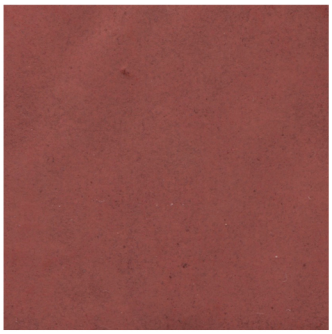
(Jessie Wei-Hsuan Chen)



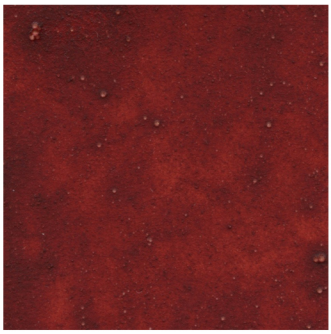
H6 pigment



swatch



H7 pigment



swatch

H8 pigment

swatch

H9

Smalt

(Kremer Pigmente, 10000)

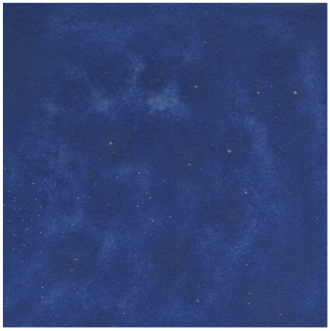
H10

Indigo

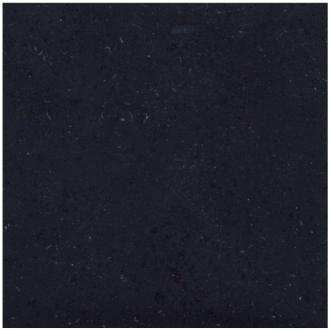
Indigofera tinctoria

(Kremer Pigmente, 36002)

H9 pigment



swatch



H10 pigment

swatch

Keeping Plant Colors

The ten selected colors for painting the reproduction present a range of inorganic and organic colorants.[23] Overall, inorganic colors include earth, mineral, and metal-based pigments, and they tend to be stable and lightfast.[24] Red ochre is an earth pigment that is among the oldest colors that continues to be used today. Other common earth pigments include yellow ochre, green earth, (burnt) sienna, and (burnt) umber. Orpiment (yellow) is a mineral pigment, and azurite (blue), malachite (green), and authentic ultramarine made of lapis lazuli all belong to this group as well. Lead white and verdigris are metal-based colors. Both are loose terms: lead white generally refers to pigments consist of basic lead carbonate and verdigris to copper acetate. Metal-based colors, which also include massicot, minium, and artificial vermilion, for example, tend to give vivid colors. As their vibrancy is hard to match by natural pigments made of other materials, these colors were regularly used throughout many historical time periods, in spite of being (highly) toxic. Not belonging to any of the three groups, smalt is a blue artificial pigment obtained by grinding cobalt glass into powder. Indigo, sap green, and the lake pigments with weld, madder root, and cochineal are organic colors made by processing plants and insects through various methods. Organic colors are comparatively fugitive and light sensitive.

Lake pigment, simply put, is a dyed substrate. The dyestuff provides the color, and the substrate gives the soluble dye some substance so that the colorant can be used as a pigment to be ground and mulled with the desired binder, such as linseed oil for oil painting, egg yolk for tempera, and gum arabic for watercolor.[25] The yellow and red lakes for painting the reproduction were made with the dyes extracted from weld, madder root, and cochineal precipitated onto potash alum (potassium aluminium sulfate, $KAl(SO_4)_2 \cdot 12\ H_2O$). Hydrated alumina is one of the

[23] A highly useful encyclopedic source on pigments is Eastaugh et al., *Pigment Compendium*. The *Artists' Pigments* series has many in-depth scientific studies of individual pigments and their use throughout history, see Feller, ed., Artists*' Pigments*, vol. 1; Roy, ed., *Artists' Pigments,* vol. 2; FitzHugh, ed., *Artists' Pigments,* vol. 3.

[24] The grouping of pigments can vary depending on the sources. For instance, some sources do not separate early and mineral pigments and place earth in the same category as mineral pigments.

[25] Kirby et al., *Natural Colorants for Dyeing and Lake Pigments*, 69.

most common substrates in early modern Europe, and traditionally lake pigment refers more specifically to pigments with dye precipitated onto this group of chemical compounds. As the substrate usually determines the property of the pigment, (red) lake pigments are mostly used as a glazing color because alum is translucent and hence has a low covering power. The broader definition of lake pigment encompasses a wider variety of substrates that were or can be used for color-making, both historically and at present. Dyed powdered chalk, ground eggshells, marble dust, and lead white can all fall into the lake pigment category.[26] Compared to alum, these substrates are more opaque and produce paler pigments (Fig. 5).

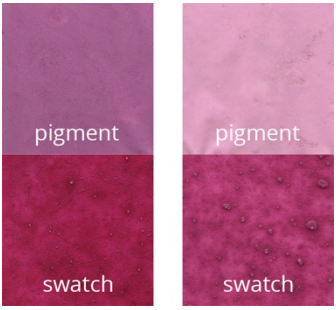


Fig. 5. Left column: potash alum as substrate;
Right column: Champagne chalk as substrate.

The sap green used for the reproduction is not a lake pigment, but simply a dye. This green came from adding a little potash alum to the dye extracted from dried ripe buckthorn berries. Alum functioned as a modifier here to change the brown buckthorn-berry dye into green, but the quantity was not enough to form pigment particles.[27] Because it is an organic solution, its shelf life can be short when simply left in a jar. Historically, sap green was usually made by reducing the juice of fresh ripe berries, mixed with alum, to a thick syrup consistency and stored in pig bladders, which gave sap green its alternative name of "bladder

[26] Kirby et al., *Natural Colorants for Dyeing and Lake Pigments*, 76–77.
[27] I followed the recipe from the Mayerne manuscript at the British Library (Sloane MS 2052, fol. 22r) (http://www.bl.uk/manuscripts/Viewer.aspx?ref=sloane_ms_2052_f022r), translated in Fels, ed., *Lost secrets of Flemish Painting.*

green."[28] Pig bladders prolonged the time one could paint with sap green, especially when the berries were out of season for making fresh colors.[29] Because only dried berries were available to me, the sap green made for painting the reproduction is a thin liquid. Although it has different properties from historical sap green, it offered an opportunity to explore the clothlet as another historical method for storing the color for future use. The basic concept of preparing a clothlet is to saturate a small piece of cloth with a dye. Because the cloth is not mordanted, the dye is not fixed onto the fiber. Clothlets can easily be stored in the dark once dried, and soaking clippings of the clothlet in a binder releases the color (Fig. 6), turning the mixture into an ink for painting in thin washes.[30]

Fig. 6. Inks made from soaking clippings of clothlets in gum arabic to release the dyes.

Lake pigments and clothlets are simple but effective methods for keeping dyes useful for a longer period, and the first step of making both

[28] Eastaugh et al., *Pigment Compendium,* 338–339; Thompson, *The Materials of Medieval Painting,* 169–171.
[29] On the relation between color-making and seasonality, see Boulboullé, "Seasonality and the (Re)creation of Early Modern Color Worlds."
[30] For examples of making and using clothlets, see recipes 28 and 38 in Neven, *The Strasbourg Manuscript*, 96–97; 108–109.

involves extracting the dye from the dyestuff. Oftentimes, this step is essentially the same as the basic process of preparing a dyebath for textile dyeing. Generally speaking, a common way to extract the colorant is to immerse a dyestuff in water, sometimes with an assist added to turn the water acid or alkaline. Often the mixture is soaked before standing on heat for some time.[31] There are several factors that can affect the color of the dye. The needed temperature and length for extracting color vary for each dyestuff, but in general overheating tends to brown the dye. Different batches of the same dyestuff may contain various levels of colorant. It is common that using the same quantity of a dyestuff and following the same recipe may still result in different shades every time (Fig. 7). Moreover, adding a modifier, such as metal salts, can often change the color of a dye by altering its pH level.[32] For example, adding alum turned the brown dyes extracted from the dried ripe buckthorn berries into sap green and yellow onion skin into a yellow that is similar to light yellow-ochre (Fig. 8).

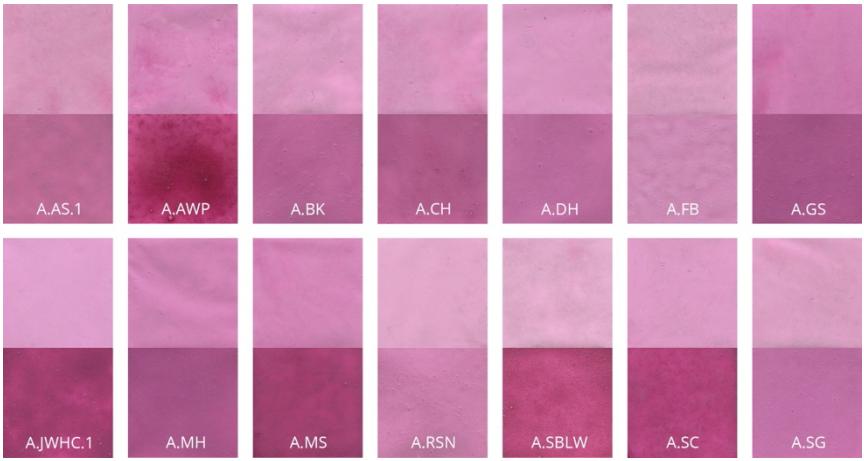


Fig. 7. Different shades of red lake pigments made of redwood/Brazilwood following the same procedures and with the same amount of ingredients.

[31] Indigo, however, works in the opposite way that dyers need to reverse the indigotin, which can be used directly as a pigment, into a dye. For a clear and simple explanation from an artist and expert practitioner, see Stopka, "Indigo as Pigment."
[32] For example, see Medlej, *Wild Inks and Paints,* in which the artist and expert practitioner shows the range of colors one can get from a selection of plants.

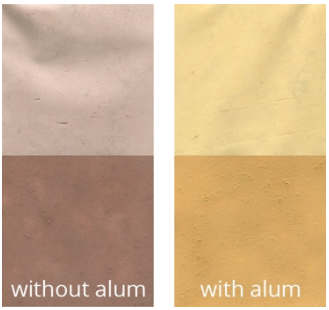


Fig. 8. Yellow onion skin lake pigments without and with potash alum.

Naturally, the quality of the resulting dye distinguished certain plants as serviceable and reasonably durable dyestuff. Without concern over quality in color and durability, however, one can extract color from several parts of most plants. What happens when, instead of using only the common dyeing plants, I extract the colors from garden flowers that regularly appeared in early modern *florilegia*? This idea is not entirely divergent from historical practices. Many clothlets of the late medieval period were made of flower petals, only, rather than extracting the dyes through heating, the maker crushed the petals into a mush and filtered it before saturating a clothlet with the juice.[33] Combining the ideas of extracting colors from garden flower petals and playing with the two color-keeping methods, the series of twelve small paintings (Fig. 9) came into being. The style of the watercolors was a result of spontaneously reacting to the behaviors of these inks and paints to see where a playful process can lead.

I painted each watercolor with the colors made from the depicted flower, after each flower was made into both clothlets and lake pigments. The selection of flowers is solely based on what my local vendors could provide, and the order of the watercolors on the next pages are arranged chronologically according to when they were painted. All the colors were made with a standardized procedure. The clothlets were saturated with the juice of crushed flower petals, infused with a little water and alum.

[33] For instance, recipe 28 in the Strasbourg Manuscript lists the juice of red poppies as the main ingredient, see Neven, *The Strasbourg Manuscript*, 98–99.

Fig. 9. Twelve small watercolors painted with inks and paints made of the petals of the depicted flowers.

For making the lake pigments, the petals were simmered for 20 to 30 minutes in water. The dyebath was filtered and reheated with a little alum before being precipitated onto Champagne chalk. Both clothlets and lake pigments were left to dry and sit for a week or two. Afterwards, I reactivated the clothlets by soaking some clippings in gum arabic and used the inks to tint the backgrounds. The flat layer of paints on the flowers are made by tempering the lake pigments with gum arabic with a small mortar and pestle. To finish the watercolors, I added outlines and details to the flowers with graphite or white colored pencil.

Tulip

Tulipa sp.

F1 clothlet

swatch

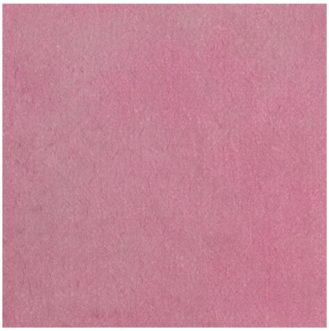
F2 pigment

swatch

Cyclamen

Cyclamen sp.

F3 clothlet



swatch

F4 pigment

swatch

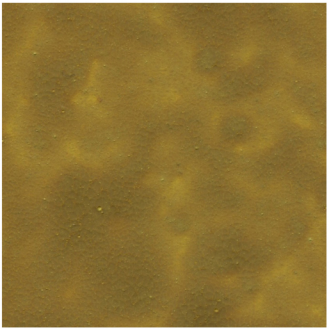
Poppy Anemone

Anemone coronaria

F5 clothlet

swatch

F6 pigment



swatch

Persian Buttercup

Ranunculus asiaticus

F7 clothlet

swatch

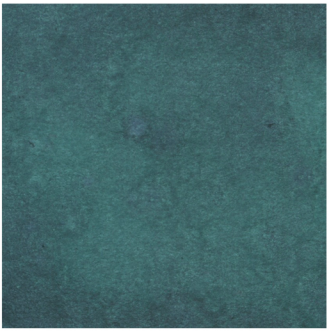
F8 pigment

swatch

Carnation

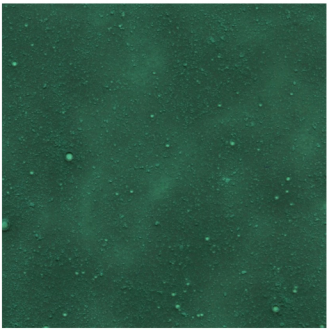
Dianthus caryophyllus

F9 clothlet



swatch

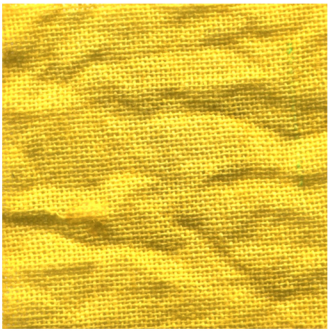
F10 pigment



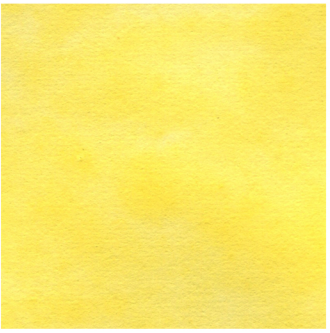
swatch

Narcissus

Narcissus sp.



F11 clothlet



swatch

F12 pigment

swatch

Hyacinth

Hyacinthus sp.

F13 clothlet

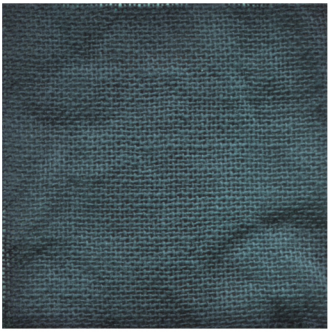
swatch

F14 pigment

swatch

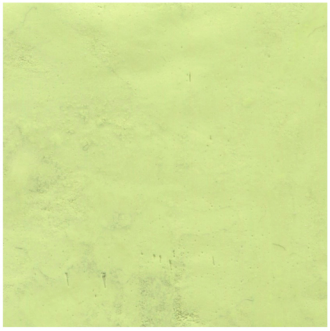
Pansy

Viola sp.

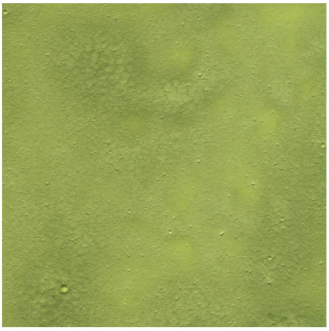


F15 clothlet

swatch



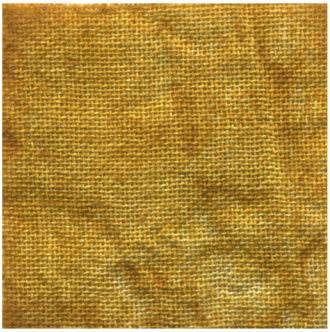
F16 pigment



swatch

Sunflower

Helianthus annuus



F17 clothlet

swatch

F18 pigment

swatch

Lily

Lilium sp.

F19 clothlet

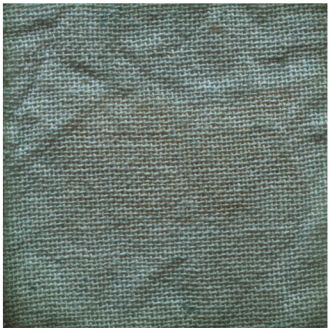
swatch

F20 pigment

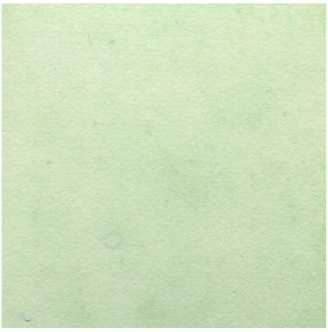
swatch

Larkspur

Delphinium sp.



F21 clothlet



swatch

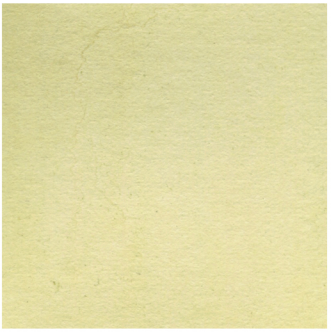
F22 pigment

swatch

Hellebore

Helleborus sp.

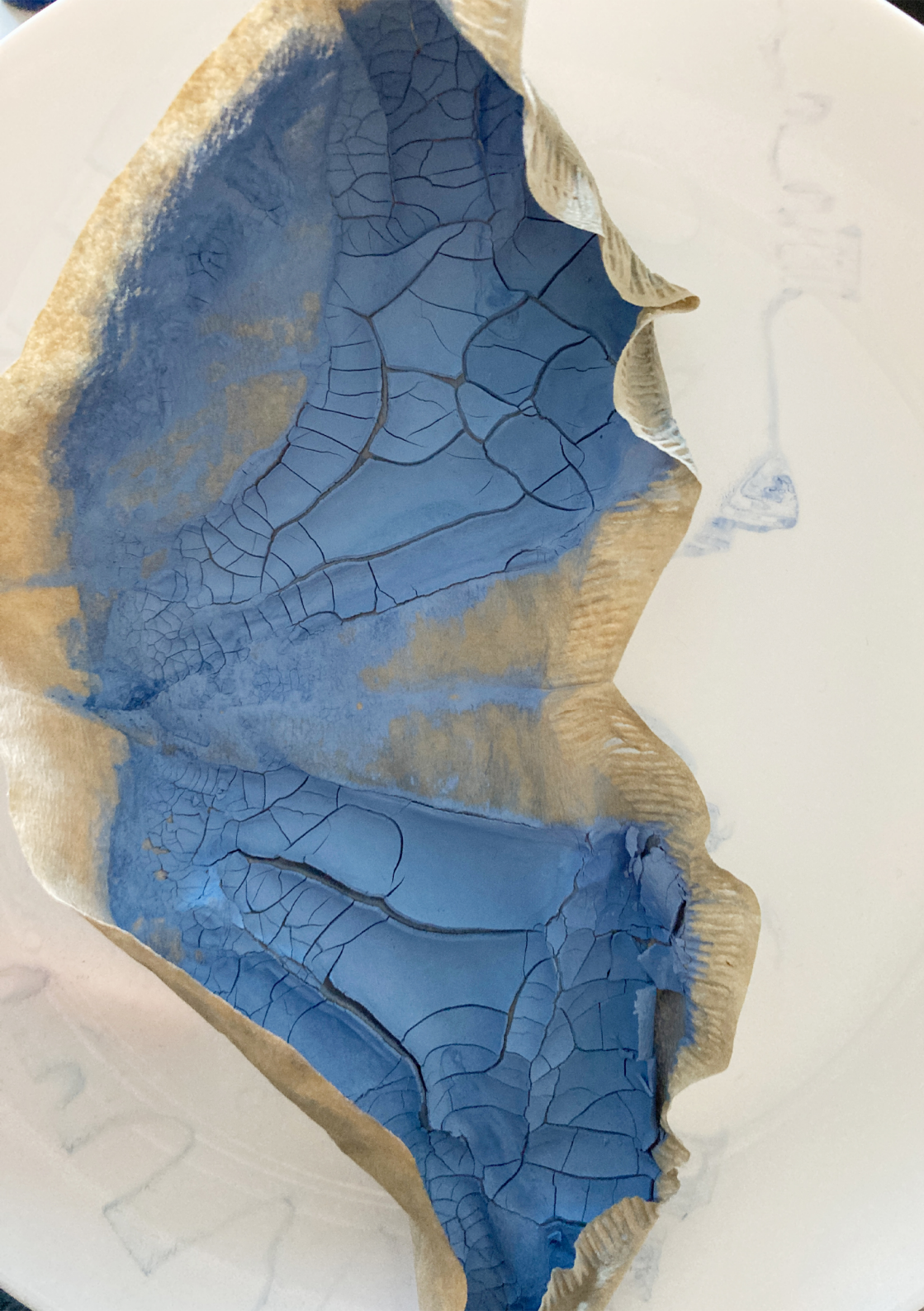
F23 clothlet



swatch

F24 pigment

swatch



Finding Colors, Fading Colors

Makers who are attentive to the materials they use might be uneasy when reading that I applied a relatively standardized process to produce the inks and pigments for the small watercolors. Every material has its own properties. Thus, each requires different handling to bring out its ideal qualities, and it usually entails many trials and errors to find how to best do so. If, as mentioned earlier, each plant needs different heating time (and temperature) to extract dye, the logical conclusion is that a standardized making process would inevitably produce bad color from most plants. However, from my experimentations at the early stage of this project, although the colors obtained from this process are not optimal, they provide enough information of the color a plant yields. For example, simmering an avocado pit for half an hour is too short to get a proper deep and rich pink dye, but it still produced a pink, albeit paler than the ideal. This mediocre color might be a low-grade art material, but the standardized process offered feasibility in exploring more plant colors within a limited timeframe. It reduced the need for multiple tries and made planning workdays easier because it took more-or-less the same time to make a lake pigment out of each plant-based dyestuff.

Similarly, testing different modifiers, such as vinegar, baking soda, iron, and copper, to change the colors of a dyebath is not part of this project. Present-day expert dyers and other practitioners working with plant-based colors have done a lot of experimentation on this front, and a quick search on the Internet shows many examples.[34] Aside from serving as a substrate, potash alum can function as a modifier, as well as a mordant to better bind a color to a surface and improve its permanency (to a degree), depending on how, how much, and when in the making process it is used.[35] For this project, alum worked as the only modifier (and possibly a mordant on a lower level), and Champagne chalk served

[34] Medlej, *Wild Inks and Paints*. See also the Resources tab on the website of the Slow Lane Studio (https://www.slowlanestudio.co.uk/resources).

[35] Most sources that are written for specific groups of readers (dyers, conservators, etc.) usually mention the use of potash alum for only one or a couple purposes. For simple descriptions on the various functions of this metal salt, see Medlej, *Wild Inks and Paints,* 22.

as the substrate for the lake pigments with inventory numbers starting with F and E.[36]

Applying the standardized process and using the same ingredients for making every lake pigment created close conditions—a similar "environment"—for the colors in this project. This not only shows the major color one can extract from each of the tested plant, as alum is one of the most ubiquitous materials used in color-making, it also exhibits how this environment affects the colors. Some dyes bind better with chalk and thrive better on this substrate than others. Having this overview of their conditions, one can always return to a specific plant and further experiment with it by adding different modifiers or precipitating onto other substrates.

For this project, the standardized process offered an additional opportunity to engage with people with various hands-on skill levels. Between February and March 2021, my collaborator, Anna Svensson, and I organized four online workshop sessions to virtually make lake pigments together in real time. The workshops aimed to explore conducting hands-on experimentations and engaging with performative methods in an online environment. The participants came from several fields, including history and its sub-fields, archeobotany, contemporary art, (painting) conservation, and museum curation. While everyone is an expert in their field, many participants had never extracted colors and/or made lake pigments before. The written-down steps of the standardized process became a recipe, from which everyone made a magenta lake out of redwood/Brazilwood (Fig. 7) during the first half of the workshop.[37] The participants selected one or two plants they found interesting and extracted the dyes to make more lake pigments in the second half, and some of them contributed their results to the project, displayed on the following pages.

[36] Lake pigments with inventory numbers starting with H used alum as the substrate.
[37] The redwood/Brazilwood for the workshop were shavings of *Haematoxylum brasiletto* (also known as Mexican logwood) according to the supplier Kremer Pigmente (under Product Information, https://www.kremer-pigmente.com/en/shop/dyes-vegetable-color-paints/natural-organic-dyes-vegetable-color-paints/36150-brazilwood-shavings.html).

Collectively, the contributors and I tested around fifty plants and produced sixty colors. We found colors in plants that are both mundane and rare in Europe or North America.[38] We found colors in plants that are common (historical) dyestuffs and plants that may be rather creative for this purpose. There were also several pigments made with assorted plants. This collection of experimental colors is of a decent size, but they represent only the smallest fraction of the vast plant world, even though produced with a standardized process and a group of makers. 60 colors provided a rich palette, and I used nineteen of them to paint the colorful bouquet of tulips (Fig.10). Similar to the early modern painting technique for reproducing Franciscus De Geest's watercolor, I started with a flat layer of mid-tone for local colors, and then brushed on shadows and highlights. Because there were plenty of hues and degrees of saturation from which to choose, I layered and blended with only pure colors and did not mix the paints.

Fig. 10. Watercolor of a tulip bouquet painted with experimental plant-based lake pigments.

[38] While online workshop has many advantages, it creates other challenges. We could only accommodate participants from Europe and North America due to practicalities of shipping supplies for the experiments.

More valuable perhaps than the produced color samples and watercolors, however, were the observations, discussions, and questions from the workshops. In the process of finding colors in these plants, we traversed the many layers of where and how plants have been used, both in our own lives and through the ages. For example, many colors from the collection are made of plants we consume through various means, as food, as spices, and/or as drinks. Most of these edible plants have a long local or global history that are often, but not always, connected to migration and trade.[39] The chemistry and technologies behind (historical) color-making was another topic that was interesting for many. What kinds of issues did makers have to anticipate and work with when pure chemicals were not available? How was temperature regulated and measured before the common use of a thermometer? As making the lake pigments required the engagement with almost all senses, the taste and smell of plants also became part of the inquiries. With a perfumer in the virtual room, we learned about the very different processes and devices for extracting plant colors and scents.[40]

A recurring topic throughout the four workshop sessions was the fugitive nature of organic colors. Because many of the pigment samples and paint swatches easily fade when exposed to light, keeping them in closed pages usually helps with the preservation of the colors (Fig. 11), sometimes for many centuries, as it did for historical watercolors in manuscripts and albums. However, darkness does not prevent many colors in this project, especially those made with non-traditional dyestuffs, from deteriorating. Aside from light, oxidization and humidity can also change the color, often to a less desirable shade or hue. The small watercolor painted with the ink and pigment made of cyclamen petals has already become muted within a few months (Fig. 12). It is inevitable that the painting of the tulip bouquet will lose its vibrancy at some point.

[39] See particularly current and new research and projects from workshop participants Sasha Gora (http://www.lsashagora.com/), Merit Honderlink (https://www.rug.nl/staff/m.m.a.hondelink/), and Suzanne Bernhardt (http://suzannebernhardt.info/).
[40] See the work of Liza Witte (http://www.lizawitte.com/).

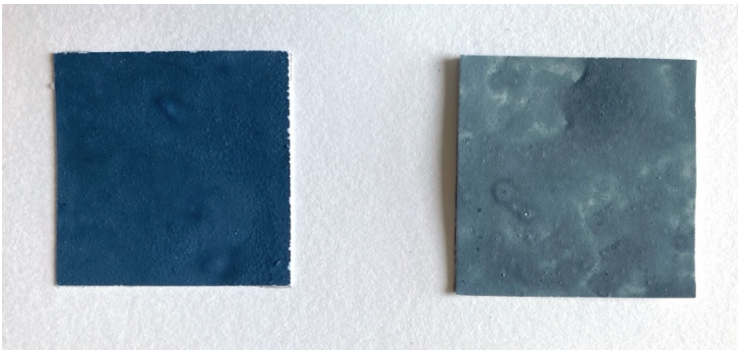


Fig. 11. Swatches of red cabbage lake pigment painted on the same day
and stored in different ways for five months.
Left: kept in the dark; Right: exposed in daylight (but not direct sunlight).

Fig. 12. Left: watercolor of cyclamen scanned a week after it was painted;
Right: watercolor of cyclamen scanned about four-and-a-half months after it was painted.

The paintings and the color collection in its physical form are living pieces. They will be ever-changing until all the colors turn into, one can speculate, browns and grays. How does one conserve something like this project that is, by nature, not conservable? Does one invest in a lot of resources to prevent it from changing? Or does one embrace its ephemerality, but document how it changes every so often? [41] Conversely, how about digital preservation?[42] The scanned and color-corrected samples and swatches in this booklet will remain somewhat permanent to show how the colors looked when they were first made. However, the booklet can easily become obsolete when no digital program recognizes the PDF format anymore. Unlike De Geest's *florilegia,* maybe with the exception of the reproduction, this project—both its material and digital form—presumably will not survive 400 years and will be gone without a trace.

[41] These are, of course, not new questions, but those that have been and continue to be largely discussed and debated by (object) conservators. One article that provided much food for thought for this project is Henderson, "Beyond Lifetimes."

[42] Digital preservation aims to ensure that digital materials can continually be accessible in the future. For an example of the ways to do so, see "History: the KB and digital preservation," National Library of the Netherlands (https://www.kb.nl/en/organisation/research-expertise/long-term-usability-of-digital-resources/history-the-kb-and-digital-preservation).

Colors Used

Saffron (E1)
Thai Tea (E8)
Alder Cone (E9)
Black Walnut Husk (E10)
Lupine (E23)
Assorted Petals (E24)
Wisteria (E25)
Bouquet (E26)
Artichoke (E27)
Spinach (E31)
Blood Orange Peel (Fresh) (E36)
Blood Orange Peel (Dried) (E39)
Buckthorn Berry (Unripe) (E40)
Bermuda Buttercup (E44)
Redwood/Brazilwood (E48)
Blackberry (E50)
Logwood (E51)
Red Cabbage (E54)
Black Turtle Bean (E56)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E60

E1

Saffron (Dried)

Crocus sativus

(Jessie Wei-Hsuan Chen)

E2

Cape Gooseberry (Fresh)

Physalis peruviana

(Ruth Sargent Noyes)

E3

Red Sandalwood (Powdered)

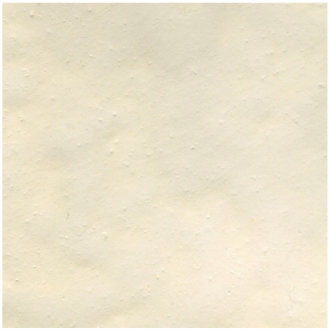
Pterocarpus santanin

(Jessie Wei-Hsuan Chen)

E1 pigment

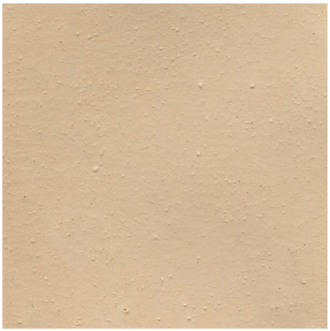
swatch

E2 pigment



swatch

E3 pigment



swatch

E4

Birch Bark (Fresh)

Betula sp.

(Brandy Kraft)

E5

Avocado Pit (Dried)

Persea americana

(Jessie Wei-Hsuan Chen)

E6

Beetroot (Fresh)

Beta vulgaris

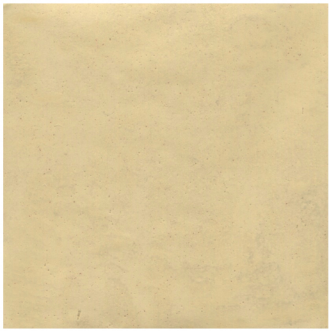
(Dominik Huenniger)

E4 pigment

swatch

E5 pigment

swatch



E6 pigment

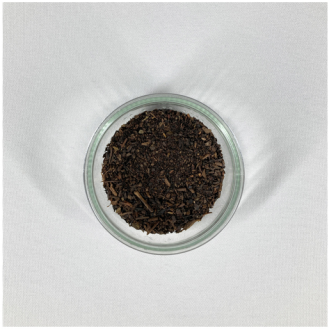
swatch

E7

Black Oak (Powdered)

Quercus velutina

(Jessie Wei-Hsuan Chen)



E8

Thai Tea (Dried)

Camellia sinensis

(Jessie Wei-Hsuan Chen)

E9

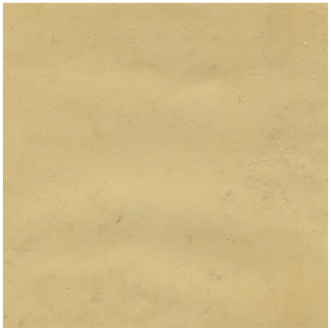
Alder Cone (Dried)

Alnus sp.

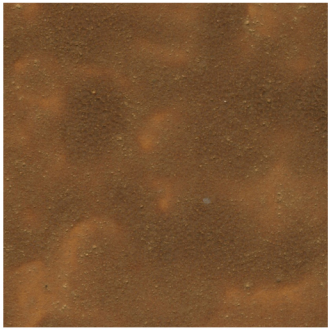
(Anna Svensson)

E7 pigment

swatch



E8 pigment



swatch

E9 pigment

swatch

E10

Black Walnut Husk (Dried)

Juglans nigra

(Sara Charles)

E11

Mimosa (Dried)

Acacia dealbata

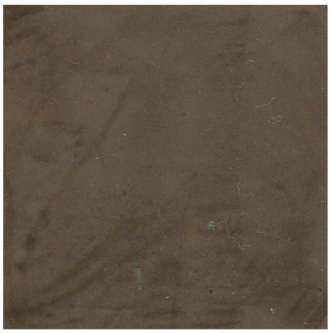
(Suzanne Bernhardt and Liza Witte)

E12

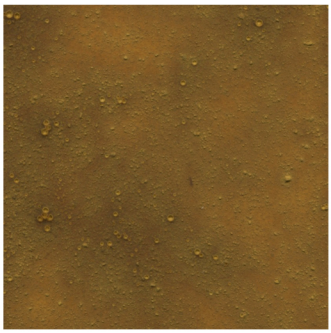
Buckthorn Berry (Ripe, Dried)

Rhamnus sp.

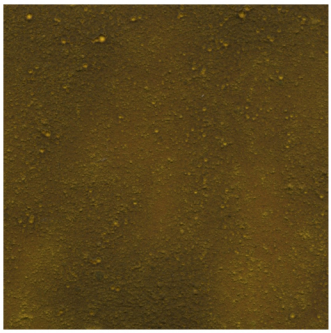
(Jessie Wei-Hsuan Chen)



E10 pigment swatch



E11 pigment swatch



E12 pigment swatch

E13

Pomegranate Peel (Fresh)

Punica granatum

(Jessie Wei-Hsuan Chen)

E14

Turmeric (Powdered)

Curcuma longa

(Jessie Wei-Hsuan Chen)

E15

Mahonia Bark (Fresh)

Mahonia sp.

(Anna Svensson)

E13 pigment

swatch

E14 pigment

swatch

E15 pigment

swatch

E16

Grape Tomato (Fresh)

Solanum lycopersicum

(Jessie Wei-Hsuan Chen)

E17

Coffee (Powdered)

Coffea sp.

(Jessie Wei-Hsuan Chen)

E18

Velvet Roll-Rim (Fresh)

Tapinella atrotomentosa

(Anna Svensson)

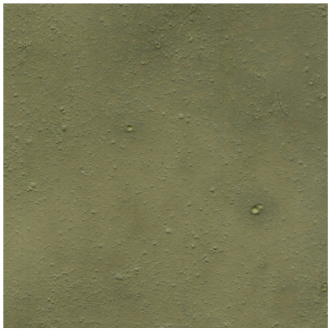
E16 pigment

swatch

E17 pigment

swatch

E18 pigment



swatch

E19

Vanda Orchid (Fresh)

Vanda sp.

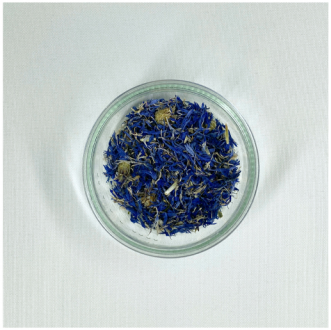
(Brandy Kraft)

E20

Cranberry (Fresh)

Vaccinium macrocarpon

(Charlotte Hoitsma)



E21

Cornflower (Dried)

Centaurea cyanus

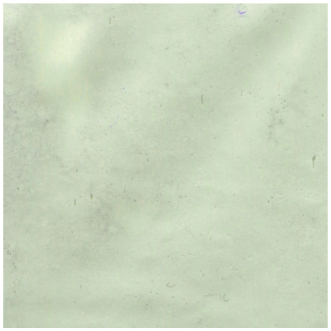
(Jessie Wei-Hsuan Chen)

E19 pigment

swatch

E20 pigment

swatch



E21 pigment

swatch

E22

Assorted Carnations (Fresh)

Dianthus caryophyllus

(Jessie Wei-Hsuan Chen)

E23

Lupine (Fresh)

Lupinus sp.

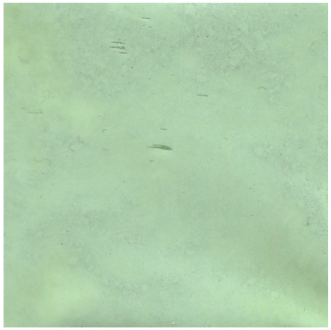
(Eva-Maria Spampinato)

*precipitated onto pure calcium carbonate

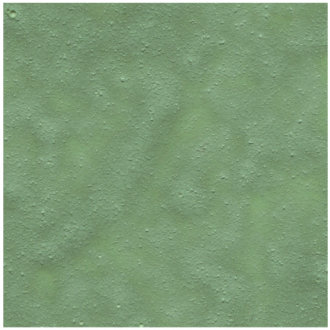
E24

Assorted Petals (Dried)

(Jessie Wei-Hsuan Chen)



E22 pigment



swatch

E23 pigment

swatch

E24 pigment

swatch

E25

Wisteria (Fresh)

Wisteria sp.

(Eva-Maria Spampinato)

*precipitated onto pure calcium carbonate

E26

Bouquet (Fresh)
(Tulip + Wild Blueberry)

Tulipa sp. + *Vaccinium myrtillus*

(Jessie Wei-Hsuan Chen)

E27

Artichoke (Fresh)

Cynara cardunculus

(Sasha Gora)

E25 pigment swatch

E26 pigment swatch

E27 pigment swatch

E28

Cape Gooseberry Husk (Fresh)

Physalis peruviana

(Ruth Sargent Noyes)

E29

Mallow (Dried)

Malva sylvestris

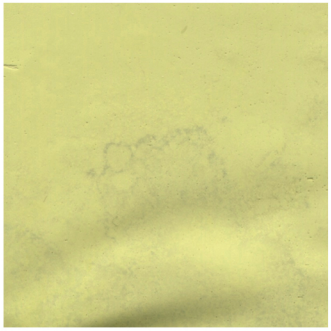
(Anna Svensson)

E30

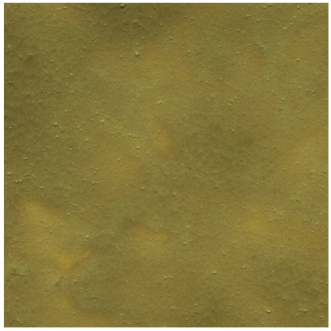
Carrot Leaf (Fresh)

Daucus carota

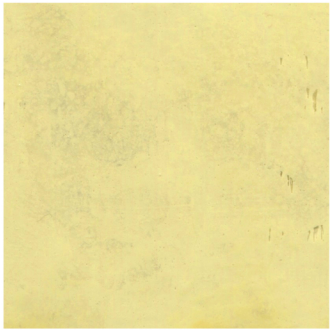
(Merit Honderlink)



E28 pigment



swatch



E29 pigment

swatch

E30 pigment

swatch

E31

Spinach (Fresh)

Spinacia oleracea

(Jessie Wei-Hsuan Chen)

E32

Lisianthus (Fresh)

Eustoma russellianum

(Jessie Wei-Hsuan Chen)

E33

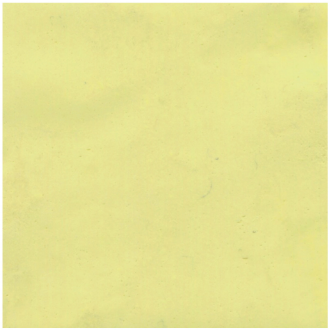
Ivy Leaf (Fresh)

Hedera sp.

(Suzanne Bernhardt and Liza Witte)

E31 pigment

swatch



E32 pigment

swatch

E33 pigment

swatch

E34

Safflower (Dried)

Carthamus tinctorius

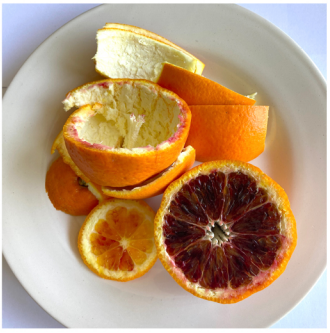
(Jessie Wei-Hsuan Chen)

E35

Parsley (Fresh)

Petroselinum crispum

(Dominik Huenniger)



E36

Blood Orange Peel (Fresh)

Citrus sinensis

(Giulia Simonini)

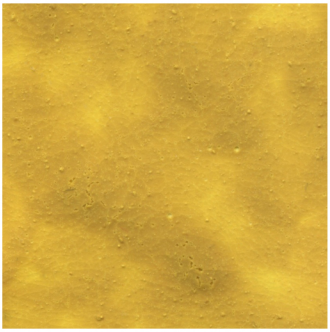
E34 pigment

swatch

E35 pigment

swatch

E36 pigment



swatch

E37

Rosehip (Dried)

Rosa sp.

(Suzanne Bernhardt and Liza Witte)

E38

Yellow Onion Skin (Dried)

Allium cepa

(Jessie Wei-Hsuan Chen)

E39

Blood Orange Peel (Dried)

Citrus sinensis

(Giulia Simonini)

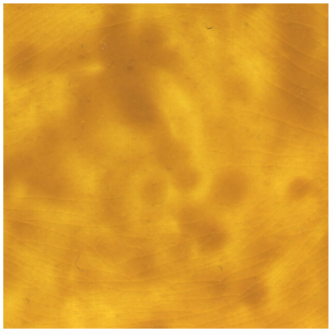
E37 pigment

swatch

E38 pigment

swatch

E39 pigment



swatch

E40

Buckthorn Berry (Unripe, Dried)

Rhamnus sp.

(Jessie Wei-Hsuan Chen)

E41

Annatto (Dried)

Bixa orellana

(Suzanne Bernhardt and Liza Witte)

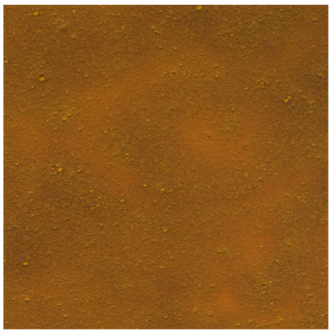
E42

Papaya Peel (Fresh)

Carica papaya

(Francesca Bewer)

E40 pigment



swatch

E41 pigment

swatch

E42 pigment

swatch

E43

Bougainvillea (Fresh)

Bougainvillea sp.

(Eva-Maria Spampinato)

*precipitated onto pure calcium carbonate

E44

Bermuda Buttercup (Fresh)

Oxalis pes-caprae

(Eva-Maria Spampinato)

*precipitated onto pure calcium carbonate

E45

Chinese Money Plant (Fresh)

Pilea peperomioides

(Marleen Schans)

E43 pigment

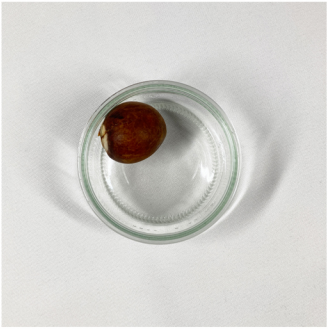
swatch

E44 pigment

swatch

E45 pigment

swatch



E46

Avocado Pit (Fresh)

Persea americana

(Jessie Wei-Hsuan Chen)

E47

Folium (Clothlet Dyed with Turnsole)

Chrozophora tinctoria

(Sara Charles)

E48

Redwood/Brazilwood (Dried)

Haematoxylum brasiletto

(Jessie Wei-Hsuan Chen)

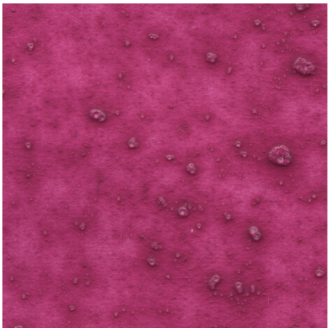
E46 pigment

swatch

E47 pigment

swatch

E48 pigment



swatch

E49

Assorted Plants 1 (Fresh)
(Magnolia Petal + Raspberry)

Magnolia × soulangeana + *Rubus idaeus*

(Kristan Hanson)

E50

Blackberry (Frozen)

Rubus fruticosus

(Merit Honderlink)

E51

Logwood (Dried)

Haematoxylum campechianum

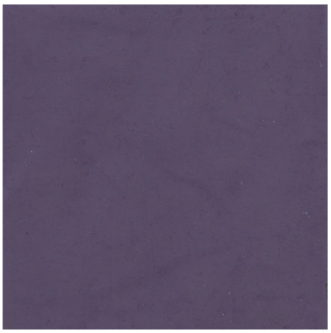
(Jessie Wei-Hsuan Chen)

E49 pigment

swatch

E50 pigment

swatch



E51 pigment

swatch

E52

Raspberry (Fresh)

Rubus idaeus

(Jessie Wei-Hsuan Chen)

E53

Pomegranate Seed (Fresh)

Punica granatum

(Jessie Wei-Hsuan Chen)

E54

Red Cabbage (Fresh)

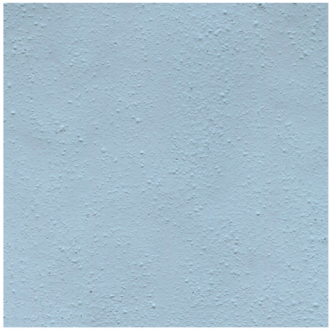
Brassica oleracea convar. capitata var. rubra

(Annemarie Kok)

E52 pigment

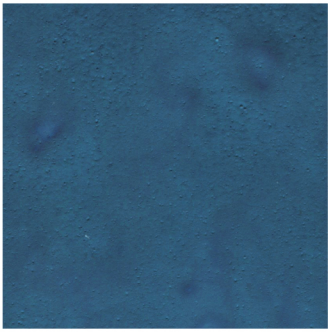
swatch

E53 pigment



swatch

E54 pigment



swatch

E55

Assorted Roses (Fresh)
(Red Naomi + Unknown Varieties)

Rosa sp.

(Annika Windahl-Pontén)

E56

Black Turtle Bean (Dried)

Phaseolus vulgaris

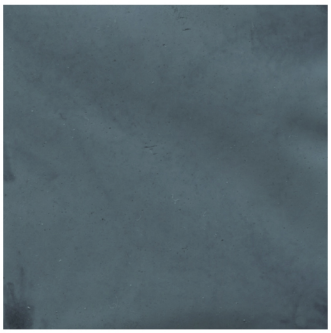
(Jessie Wei-Hsuan Chen)

E57

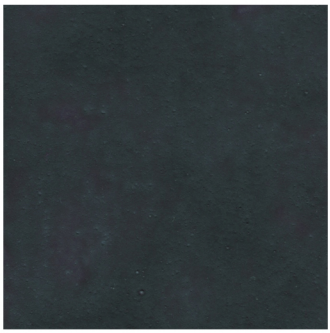
Peruvian Lily (Fresh)

Alstroemeria sp.

(Dominik Huenniger)

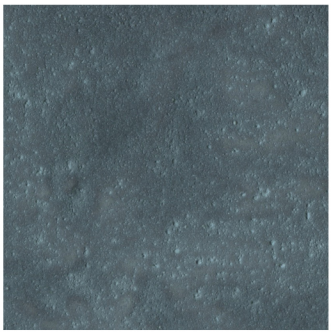


E55 pigment

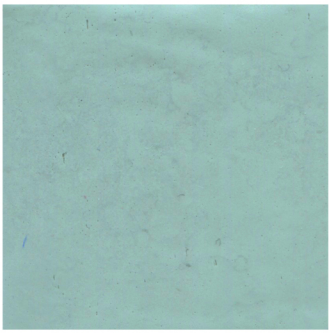


swatch

E56 pigment



swatch



E57 pigment

swatch

E58

Assorted Plants 2 (Frozen)
(Red Cabbage + Beetroot)

Brassica oleracea convar. capitata var. rubra + *Beta vulagris*

(Jessie Wei-Hsuan Chen)

E59

Red Grape Peel (Fresh)

Vitis vinifera

(Jessie Wei-Hsuan Chen)

E60

Hibiscus (Dried)

Hibiscus sp.

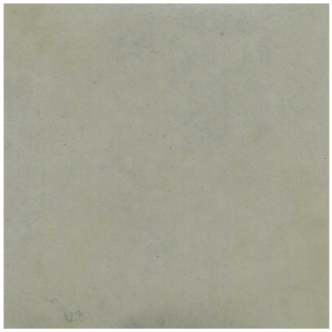
(Francesca Bewer)

E58 pigment

swatch

E59 pigment

swatch



E60 pigment

swatch


Smalt
Kremer (10000)
Indigo
Kremer (36002)
Lead White
Kremer (46000)
Orpiment
Kremer (10700)
Sap Green
(Buckthorn Berry Recipe)
Juice with Alum

Epilogue

Looking back at the making of this digital booklet and its material counterparts (Fig. 13), the process was unintentionally transhistorical. Being confronted with the fading and ever-changing colors of this project reminds one that most of what we see today from the past depends heavily on chance and other inconsistent aspects of survival, despite the great efforts archivists, curators, and keepers of collections have put in to preserve as much as possible. High material quality and suitable environment mark two factors that improve the chance for something to last centuries and longer, but they can also skew the types of evidence that were preserved. More often than not, records of all kinds are lost along the way, and reconstructing the past can never give a definitive picture and interpreting historical evidence needs to be done with care and nuance, which requires a lot of training. What is more important is to continue to ask big-and-small questions, carefully (re)assess our current understandings, and renew information where needed.

By delving into the technical making of the pictorial genre of *florilegium*, it has been shown that there is a whole world of materials behind the painted layers that transcends the specific time and place of the seventeenth-century Dutch Republic. The flowers Franciscus de Geest depicted are more widely available to the masses today, and there is still a sizeable group of artists and practitioners that use art materials, such as natural pigments, similar to the early modern painter. Furthermore, our connections and relationships with the plant world and nature continue to be a prominent theme for people from many professions dealing with the past, present, and future to explore, understand, and conserve.

The making process of this project also highlighted the importance of exchange and collaboration. The many conversations I had with conservators and historians working on adjacent topics shaped most of my decision-making when sourcing and selecting historical materials and techniques to reproduce De Geest's watercolor. Social media posts from present-day dyers and practitioners working with plants in various capacities offered a lot of insight and tips on the material properties and

qualities of several plant-based dyestuffs. The questions raised during the workshop sessions, as shown in the previous section, and many more that remain on the back burner, are useful starting points for drafting potential projects in the future. Whether an expert or novice on a subject, everyone has something to contribute; revisiting basic information by explaining it to beginners can often lead to seeing something familiar under a new light. Similarly, while a concept or topic may have been thoroughly investigated or over-saturated in one field, it may be unexplored or inspirational in another. However, collaboration takes effort to communicate because oftentimes every group has its own "language." How historians view certain materials, concepts, and words can be drastically different from how artists and scientists (all in the broadest sense) do. But with respect and open-mindedness, cross-fertilization can collectively expand our knowledge on many fronts.

Even though this booklet is at its end, the cross-fertilization does not have to be. For the workshop sessions, the #plantingpigments hashtag was created for the participants to follow the project and share their own process on social media. The hashtag will remain a virtual venue for sharing process, exchange ideas, and/or finding inspirations for anyone who is interested in engaging. When reflecting upon the main components of this project, it boiled down to three keywords: *plants*, *colors*, and *makings*. As stated in the prologue, through plant-based lake pigments, this booklet shows nothing more than one possibility to bring plants, colors, and makings together. There are easily hundreds of possibilities to combine two of the keywords, let alone all three. If this booklet has offered some inspiration or motivation for (re)visiting old and new ideas, it would be terrific to see your (process of) academic, scientific, professional, creative, or recreational endeavors with plants, colors, and/or makings through the #plantingpigments hashtag!

Fig. 13. The physical paintings and color samples of the Planting Pigments project.

Acknowledgement

This was a project that carried me through some difficult times while dealing with several crises in the past year. I want to thank Anna Svensson for inviting and collaborating with me on "A Green Turn?" panel series for STREAMS 2020/2021 (international conference for the Environmental Humanities). The invitation kickstarted the early version of this booklet and this current state debuted at the 2021 conference after the year-long postponement due to the Covid-19 pandemic. I am grateful to Sven Dupré and Florike Egmond for their (administrative) support in pursuing this project. Many thanks to the pigment contributors and workshop participants: their engagement added greatly to the development and enjoyment of making this booklet. Three of the workshop sessions were made possible by the Dutch Research Council (NWO) from the allotment of my PhD grant (Promoties in de Geesteswetenschappen, Project Number PGW.18.016). The Plant Humanities Initiative at the Dumbarton Oaks Research Library and Collection supported the last session. The Oak Spring Garden Foundation provided photos of Franciscus de Geest's watercolors for my research, including the one for me to reproduce and show in this booklet. Last but not the least, a warmest thank you to Sara Charles for supplying the parchment, Merit Hondelink for verifying the botanical names of the dyestuffs, Tamar Hestrin-Grader for copyediting the booklet, and Rhiannon Estwick for proofreading and helping with the text for the temporary project website.

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