## Materials and Inks

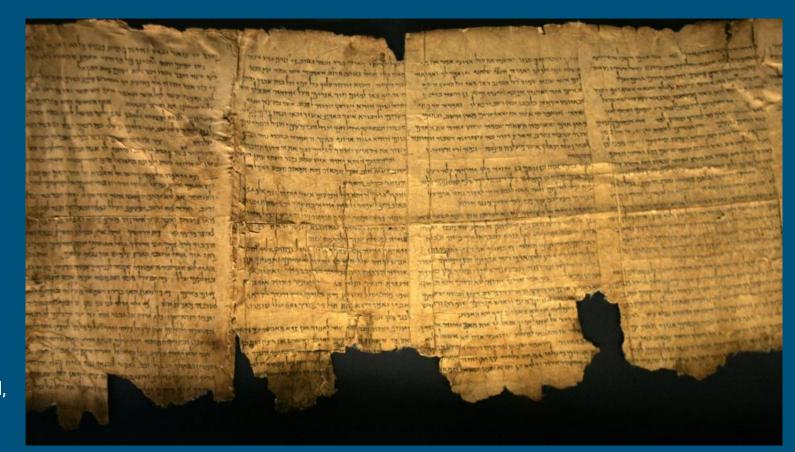
Helen R. Davies and Kyle Ann Huskin

### Book History

- We know many of you already understand the basics of book history, but we want to make sure we all share a common vocabulary.
- We want to think about these items as technological innovations.
- We want to think about how these different components will affect imaging of both traditional digitization and, more importantly for the sake of this workshop, multispectral imaging.

# Forms

### Scroll



Dead Sea Scroll, c. 400 BCE to 100 CE.

### Roll



Account rolls from St George's Chapel Archive in Windsor, SGC XV.34.4, 1366–67. Image credit: https://blog.nationalarchives.gov.uk/transforming-archives-st-georges-chapel-archives-windsor/

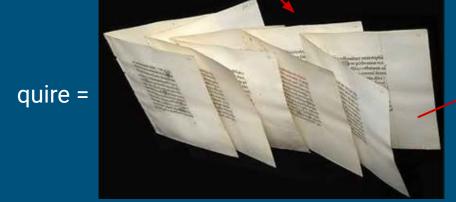
## Codex



St Chad Gospels (Lichfield Cathedral, MS Lich. 01), c. 730

#### codex





#### bifolium = folio + folio



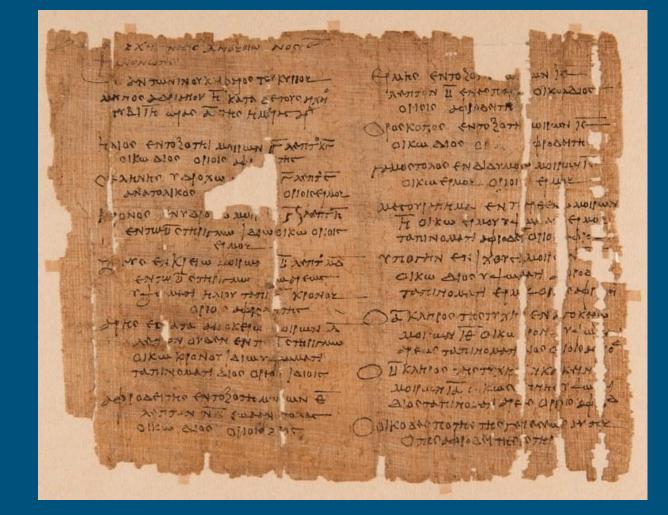
verso recto

# Substrates

# Clay



### Papyrus



### Papyrus

- 2550 BCE: oldest inscribed parchment found in Egypt
- All papal bulls were written on papyrus until 1022 CE
- Used in Egypt and around the Mediterranean
- Making papyrus:
  - Peeling the reed
  - 2. Cutting the reed into thin strips
  - Weaving the strips into a mat by layering strips horizontally and vertically
- Scrolls were made by gluing sheets together on their fringed edges



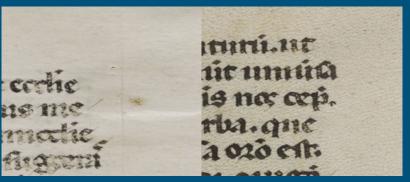
## Parchment



### Parchment

- Parchment = animal skin that has been prepared for writing or printing
  - Antiquity: leather or tanned parchment
  - Middle Ages: untanned parchment
- Animals most commonly used: goat, cow/calf, and sheep
  - DNA analysis suggests about 70% identification accuracy among experts
- More durable than papyrus or paper
- High cost of production

- Fluoresces under UV light
- Retains inks very well
- Flesh vs. Hair sides



University of Pennsylvania, MS LJS 184, fols. 4r (flesh) and 3v (hair), respectively.

### Paper

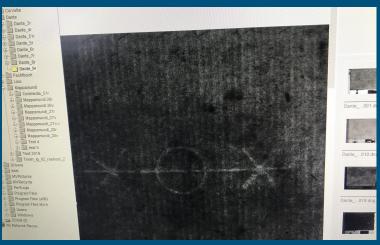
Rijksarchief te Gent K98, watermark dated to c. 1398. Image credit: http://sites.nd.edu/manuscript-studies /2017/02/10/what-lies-beneath-the-reli ability-of-watermarks-as-a-method-for-telling-time/



### Paper

- China, c.150 BCE → Middle East, 751
   CE → Europe, 1144 CE
- European paper mills use
  - Linen cloth/rags
  - Wiremolds and watermark designs
  - Gelatin as sizing agent
- Watermarks allow for high precision dating and provenance
- Cheaper but less durable than parchment

- Does not retain ink as well as parchment
- Transmissive light source reveals watermark



Watermark and chain/laid lines revealed clearly in transmissive band on a page of Dante's *Inferno* (Dresden, SLUB MS Ob.25).

# Inks and Pigments

## Inks and Pigments

- Ink = colored liquid made from dye solutions (e.g., tannins) or pigment dispersions (e.g., sepia, bistre)
- Pigment = dry coloring material mixed with a binding agent (e.g., gum arabic, egg tempera) to form an opaque paint
- Identification is possible using XRF, Raman and IR spectroscopy, and observation under UV, visible, and IR light



### Soluble Inks

- Commonly used materials derived from plants or insects
- Brown plant inks, traditionally made from the bark of the blackthorn/sloe tree and wine, was commonly used in monasteries in the early Middle Ages
- "Theophilus Ink"
  - Recipe from Theophilus Presbyter's De diversis artibus [On Various Arts] (c.1120)
     recommends adding small amounts of vitriol to the traditional bark-wine ink
  - Transitional between plant-based and iron-gall inks

### Carbon or Dispersion Inks

- Made by mixing soot with a binding agent (e.g., gum arabic, egg tempera/yolk, animal glue)
  - o Four recipes survive from medieval Europe, all using egg yolk as the binder
- Various additives can be detected (e.g., copper sulfate) because pure soot was difficult to produce in Antiquity
- Carbon inks were expensive to produce, and cheaper inks were necessary as documentary cultures increased

### Iron Gall Ink

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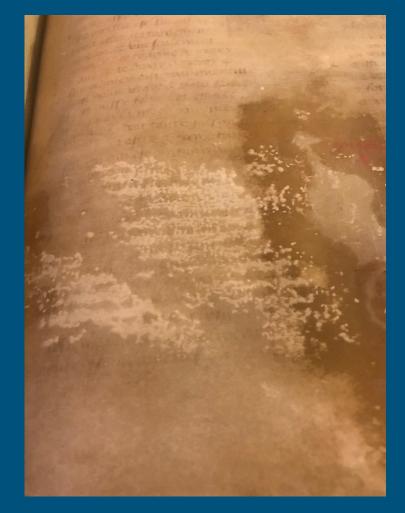
Image credit: https://sarahpeverley.com/2014/01/29/iron-gall-ink-a-medieval-recipe/

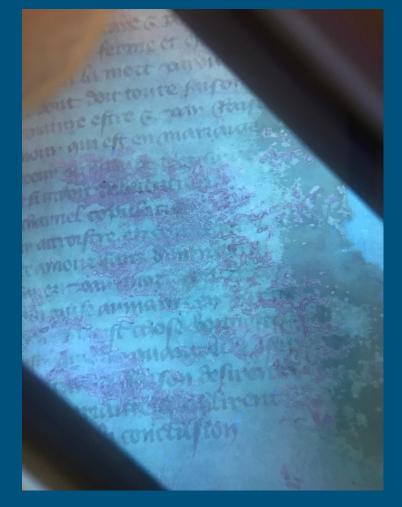
### Iron-Gall Inks

- Most common ink used in medieval Europe
- Made by distilling oak galls in an aqueous medium (e.g., wine, vinegar) and combining the distillate with vitriol (iron (II) sulfate) and gum arabic
- Combines properties of soluble and dispersion inks

#### Relevant properties for MSI:

- Soluble penetrates surface of substrate
- Corrosive causes parchment to thin over time
- Blocks fluorescence of parchment under UV light
- "Disappears" under IR light

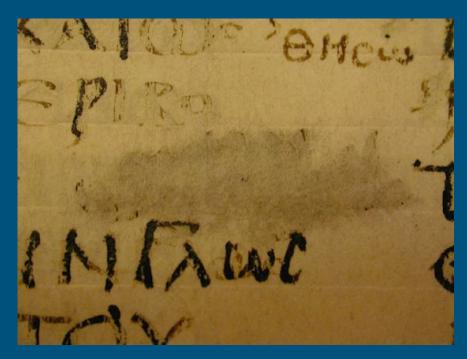




fol. 109r of Les Eschéz d'Amours (SLUB MS Oc. 66) under visible light (left) and under handheld UV light (right).

# Frequent Types of Damage

### Erasures and Corrections

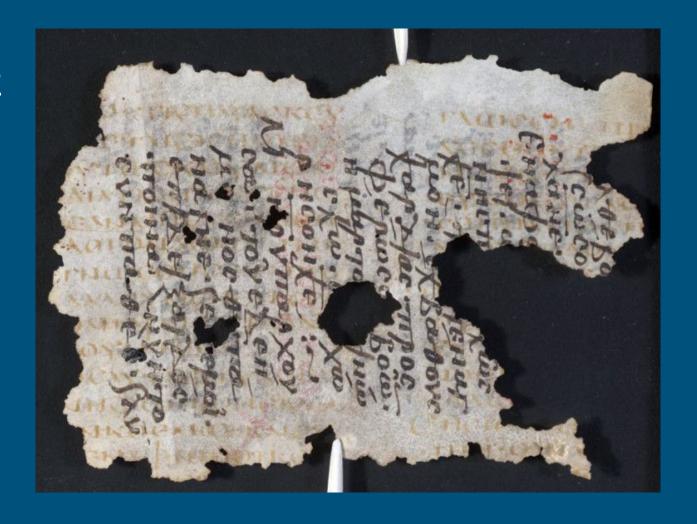




## Palimpsest

Palimpsested copy of 1 Corinthians under visible light.

Image credit: Sinai Palimpsests Project.



## Palimpsest

Palimpsested copy of 1 Corinthians after multispectral image processing. Image credit: Sinai Palimpsests Project.



### Water

un fix fieblece a pour fa bonte where bonne octonismic Go con punit sind to ten

much it en fur favour Coorne Wen Lun tru mut borguise il effice en fui we de ferne ne would anois ere Thefe wer bante ant ten of bien requires of an oner anony mal with descentioneral de bien ne de bestugneleonque out mature le munit outque Ine puff bien ancunement winer en la feme enfement estron es than a chi climaton Manage wind intenten in by deam of feminance b responsement a plus de confors en me was pour andtime miler de feno a de museno net amale entention ordunations fiver Some fewerff Empire dix comfo quilines and the mettre a eveninen to la fonte ne common fine in blue Soubte a arint a meffure de reformités et Gulemons our for feblece & pour fa bonte efonces onte encor to honon Come hav in he en mon compre urent funte evcellentement rust ment fe ne mue montrenot monan puff lome monnoit est cona auffr ben maneron del home blasmes an oult de femer ou ont en gold for don nature amer mulanic mal a cine Swort one fam fem to confens To be the teme mich more an an tant ten dist tant en fang Es ne mellotrata fu treffance and someon elle tehiste siene definer a confonde ET un trouma forte la mamere Some Sift on Resounton S & Course latines seremiere Schliebenese Emilion ome asime fir les mount विश्वास क्षेत्र के स्थापन a quel chose se on le monses A mothefle et de mar pur of mutoff toponderout t fe ce bu me te fouffit Com le Beffenderont e te sius zoin mentete im novemes Timientenous Liquon faroit opofes mounte one dour mile ofen Tomle Smile Same Commune House & femienin feve et in esterent & seno si wannes toute Bulleour eft annew de ta bel warler fi finestes confore et coute planance & Bonne vesonnance di tleme cantes et fore a man Son to feet Suize et auoit O in Senant lee more Formanne The wee force famous Dome feufent wellinge home t will ce du peuple de Como in colle Some amf p nommee naulo er femes tes homes e for true com blame Ist effort la pine Personmee o our requelle portoit comus ellemicellin our fort one pouter femenin orfacte Ere et moine limb trest inule anne go to Rementer vin furent fi funce in aufmer des chofes Proctes Teter Sona nom! Se prietes

Les Eschéz d'Amours (Dresden, SLUB MS Oc. 66), fol. 109v, before and after image processing

## Fire

Chartres Media
Library, L'Apostrophe
– Médiathèque de
Chartres, MSS
Fragments



### Workshop

- Pairs (if you are a science person, try to find a humanist, conservator, librarian, etc.)
- Work directly with one of the manuscripts to answer the following questions:

Many thanks to Dr. Anna Siebach-Larsen and UR's Department of Rare Books, Special Collections, and Preservation for supplying these wonderful objects!

- Identify the form of the object.
- Identify the substrate(s).
- Try to identify the type of ink used.
- Is it a palimpsest?
- What considerations would you have for imaging it?
  - What would you be trying to capture?
  - What would you be hoping to highlight with imaging?