IV THE CONSERVATION OF BLACK MANUSCRIPTS: AN OPEN QUESTION

CHRISTA HOFMANN AND TATIANA GERSTEN

In modern printed books and digital media, we are accustomed to encountering dark printed lines or coloured images against a light background. In Antiquity and the Middle Ages we also find a different concept: glittering metallic inks on purple or black parchment. Here the contrasts are reversed: the text and the illumination shine against a dark background. Many examples of these special effects have changed their appearance over time and are now difficult to read or appreciate.[1] Silver inks have corroded, or the support material has faded or suffered degradation through the chemical reaction of the dye. Such changes have not only an aesthetic dimension, but also a conservation aspect. The material testimony of a particular taste is vanishing, and requires solutions for its preservation. So-called black manuscripts from the fifteenth-century Burgundian Netherlands constitute a distinctive group of artefacts that pose great challenges to conservators and curators. Six manuscripts on black parchment and one on black paper are preserved worldwide.[2] Possibly all of them were created in the second half of the fifteenth century in the Southern Low Countries – modern day Belgium – which was ruled by the Valois Dukes of Burgundy from 1384 to 1477. Six of them are

1 Hofmann et al., "The Vienna Genesis".
2 Jenni and Thoss, *Das schwarze Gebetbuch*, 10–12.

prayer books, while one of them is a collection of *basses danses* (Brussels, KBR, Ms. 9085, henceforth "Br9085"). What do these artefacts have in common? Why are most of them in fragile condition and therefore hardly accessible? This chapter tries to shine some light on their origin, their material aspects and the question of their preservation. The description of the history and condition of this group focuses on two exemplary cases whose originals the authors have been able to study: Brussels, KBR, Ms. 9085, and Vienna, Austrian National Library (ÖNB) Cod. 1856, the so-called book of hours of Galeazzo Maria Sforza.

THE COLOUR BLACK IN BURGUNDY

Like antique codices on purple parchment, fifteenth-century black manuscripts were something exclusive, combining a certain understatement and an expression of luxury.[3] The Burgundian Dukes Philip the Good (1396–1467) and his son Charles the Bold (1433–77) showed a predilection for black both in their wardrobe and in their art collections.[4] A recent exhibition and a cross-disciplinary book project investigated the phenomenon of "Burgundian Black" in detail.[5] The meaning of the colour black changed in the fourteenth century. After the plague, black became a serious and virtuous colour worn by judges, masters of universities, members of religious orders, bankers, and merchants, signifying both humility and distinction.[6] Wearing bright colours was a privilege of noble people. Ordinary women and men wore undyed linen and woollen cloth. It was difficult to dye textiles uniformly black and specially to achieve deep saturated tones.[7] Fabrics were first dyed blue with woad and in a second step red with a plant dye such as madder. Dyeing black became a Flemish speciality, in which the bark of black alder was used with iron mordant.[8] Iron gall ink dyes were also applied on a woad blue ground.[9] As dyeing fibres and textiles black involved multiple steps and experience, textiles with saturated black colours were expensive. Wearing black clothing was a way for the rising middle class to display

3 Examples of antique purple manuscripts are the Vienna Genesis (Vienna, ÖNB, Cod. Theol. gr. 31), Codex Purpureus Rossanensis (Rossano, Museo Diocesano), Codex Sinopensis (Paris, BnF, Ms. Supplément grec 1286).
4 Jenni and Thoss, *Das schwarze Gebetbuch*, 22–29; Jolivet, "The Construction of an Image".
5 Boulboullé and Dupré (eds.), *Burgundian Black*.
6 Pastoureau, *Noir, histoire d'une couleur*, 93–130.
7 Ortega Saez and Cattersel, "Dyeing & Dress, Reworking Black Dye Technologies".
8 Schweppe, *Handbuch der Naturfarbstoffe*, 71.
9 Cardon, *Natural Dyes*, 417.

their wealth without breaking the strict social dress codes. Noblemen first began dressing in black in Northern Italy. Philip the Good, who promoted a stylish court, adopted this fashion. Pictures and miniatures always show him in black gowns, against which his diamonds, rubies and gold jewellery sparkled impressively.[10] The taste for the contrast of silver and gold on a dark background is also seen in Burgundian objects of applied art and in illuminated manuscripts. Philip the Good collected and commissioned many books. It is likely that his tastes in fashion, which were followed by his son Charles the Bold, influenced the creation of black manuscripts. Like jewels against a black dress, the silver and golden letters sparkle on the black parchment. Book of hours were made for personal prayer, a form of devotion that grew in the fifteenth century, under the influence of manuals such as *De imitatione Christi* by Thomas a Kempis, who guided the reader to a personal spiritual life. Precious illuminated books of hours were a sign of devotion as well as of wealth.

Charles the Bold continued the fashion for black at the court of Burgundy. Charles V (1480–1504), grandson of Mary of Burgundy and Maximilian I, demonstrated a strong preference for the colour black. The noble and exclusive connotation of black has been preserved until modern times.[11]

All seven known black manuscripts probably originate from the second half of the fifteenth century and the Southern Burgundian Netherlands. Their early provenance remains largely unknown. These manuscripts share several features, including the contrast of silver and gold on a black background and an unfortunately fragile condition. The seven black manuscripts are preserved in the following collections:

- Brussels, KBR, Ms. 9085 (basses danses)
- Vienna, Austrian National Library, Cod. 1856 (book of hours)
- Vatican City, Biblioteca Apostolica Vaticana, Ms. Vat. Lat. 9488 (book of hours)
- New York City, The Morgan Library & Museum, Ms. M. 493 (book of hours)
- New York City, Hispanic Society of America, Ms. B 251 (book of hours)

10 Boulboullé, "Illuminating Burgundian Black Splendours".
11 Pleij, *Colors Demonic & Divine*, 89–98.

- Rouen, Bibliothèque municipale, Collection Leber, Ms. 136 (book of hours, on black paper)
- Paris, Louvre, Cabinets des dessins, Inv. M. I. 1091; and Paris, Bibliothèque nationale de France, Ms. nouv. acq. Lat. 149 (two bifolios from a book of hours)

In addition, there exist manuscripts in which only text blocks or inscriptions are written on a black background, for example the Hours of Mary of Burgundy (ÖNB Cod. 1857, ▶ Fig. IV.1). These partially coloured manuscripts do not seem to have suffered from the same kind of degradation as the others.

▶ p. 233

▶ p. 234

The dance book of Margaret of Austria was part of her library (▶ Fig. IV.2): it is mentioned in the second inventory of the princess's books of 1523–24.[12] The only clear facts are that it was owned by Margaret of Austria during the time when she was Princess of Spain, and then later passed into the collection of Mary of Hungary, and thence into the *Bibliothèque de Bourgogne,* the collection that eventually became the Royal Library of Belgium (now the KBR). (For more details, see Chapters 2 and 3 in this volume).

Vienna, ÖNB Cod. 1856, known as the book of hours of Duke Galeazzo Maria Sforza of Milan, consists of 154 folios (252 mm × 178 mm) that were unbound and separated from the original binding in 1930. Golden initials and decorative borders with seventy-two medallions illuminate the text (▶ Fig. IV.3). In the calendar, twenty-four small miniatures depict seasonal activities and signs of the zodiac. Fifteen large miniatures illustrate the prayer offices (▶ Fig. IV.4). The miniaturist enhanced the illuminations with highlights of gold and silver as well as the main colours red, blue, white and green, contrasting with the dark background. The binding consists of a red velvet fabric glued over wooden covers decorated with little gilded silver flames and two ornate silver clasps. The circumstances surrounding the creation and the early movements of the Viennese black book of hours are unclear, and can only be reconstructed through inference. The style of the illuminations suggests strongly that it was written and illuminated in the Southern Low Countries.[13] It is possible that it was

▶ p. 235

▶ p. 236

12 For some reason the book was not included in the first inventory of Margaret's collections (1516), edited in Le Glay (ed.), *Correspondance de l'empereur Maximilien Ier et de Marguerite d'Autriche*, vol. 2, 468–77.

13 Thoss, *Flämische Buchmalerei*, 49–50; Smeyers and Müller-Haas, *Flämische Buchmalerei*, 369–71.

commissioned by Charles the Bold, or dedicated to him. Charles waged many wars, and used to travel with his splendid artefacts. When the Swiss defeated him at Grandson and Murten in 1476, they took rich spoils, perhaps including the black prayer book. The coat of arms of Galeazzo Maria Sforza, fifth Duke of Milan, are painted on fol. 1 of Cod. 1856, and the manuscript is thus known as the "book of hours of Galeazzo Maria Sforza". If the book originally belonged to Charles, and if it was taken by the Swiss as spoils of war, it is possible that they sold the book to Sforza, who was known, like Charles the Bold, for his luxurious taste.[14] The entry of Sforza's coat of arms in the manuscript must have occurred before he was murdered in December 1476. In the Visconti and Sforza libraries no record has yet been found of a direct commission or payment for a Flemish manuscript.[15] It was long believed that the daughter of Galeazzo Maria Sforza, Bianca Maria Sforza, second wife of Maximilian I, brought the manuscript to Austria as part of her dowry, but the book does not appear in the inventory of objects with which she arrived in Innsbruck. The manuscript was probably transferred from the private collection of the Habsburg family to the Court Library.[16] The manuscript was listed for the first time in the library catalogue of Michel Denis in 1795.

THE CONDITION OF THE BLACK MANUSCRIPTS

All seven manuscripts have a black carrier material: parchment, and in one case paper. We assume that two types of colourants were used to achieve the dark background: an iron gall ink system or carbon black.

- Iron gall ink is made of vitriol, iron sulphate, the extracts of gall nuts or other tannin rich substances, water or wine and a binder such as gum arabic.[17] Natural iron sulphate often contains copper as minor component. Iron and copper ions catalyse the oxidation of cellulose and collagen by Fenton reaction. The shortening of the chain length due to oxidation leads to the degradation of microfibrils and fibres which decreases the flexibility of both paper and parchment, a phenomenon known as ink corrosion.[18] Due to the alkaline production

14 Jucker, "Der Umgang der Eidgenossen mit der Burgunderbeute", 332.
15 Jenni and Thoss, *Das schwarze Gebetbuch*, 31.
16 Jenni and Thoss, *Das schwarze Gebetbuch*, 34.
17 The Iron Gall Ink Website, ed. Birgit Reissland and Frank Ligterink; https://irongallink.org/index.html, accessed 26 April 2022.
18 Neevel, "Phytate – a potential conservation agent"; Reissland, "Neue Restaurierungsmethoden".

of parchment and the alkaline reserve in the finished sheets, acid hydrolysis by high levels of sulphuric acid seems to play a minor role in the degradation of parchment by iron gall ink than of paper.[19]

- Carbon black, an inert organic substance, can be made of soot, charcoal or other materials rich in carbon. Birgit Reissland recently investigated the great variety of blacks used in book illumination and the different sources for the generic name carbon black.[20]

The folios of Br9085 seem to have been dyed with an iron-gall ink system. Indeed, recent multispectral images of the leaves show that the black colour is transparent under infrared radiation, which is characteristic of iron gall inks (▶ Fig. IV.5a). In a FCIR (false colour infrared) image, iron gall ink appears red while carbon black appears black (▶ Fig. IV.5b).[21] Analyses carried out at the Royal Institute for Cultural Heritage (KIK-IRPA, Brussels) in 1984 showed the presence of iron and calcium, and traces of aluminium, sulphur and potassium in the parchment.[22] Even if these results could not be interpreted validly at the time, the presence of those chemicals is quite compatible with our hypothesis. The presence of calcium could be explained by the use of lime (calcium hydroxide) during the manufacture of parchment. The presence of iron, sulphur, potassium and aluminium indicates the use of an iron-gall ink. By contrast, the paper margins of a nineteenth-century treatment seem to be coloured with carbon black, which appears dark in infrared light. In transmitted light, the appearance of the colour to the parchment (except for the modern retouching) is quite even. Some of the leaves show occasional irregularities, but these are probably related to the characteristics of the skin. The texture and the appearance of the dye could suggest that a pre-prepared iron gall ink was applied with a pad. Alternatively, it is possible that the colour was produced in a two-step application, first the tannin solution, then the iron sulphate solution, so that the reaction took place directly in the parchment. Attempts

▶ p. 237
▶ p. 237

19 Možir et al., "Material properties of historic parchment".
20 Reissland, "Black Colour Technologies".
21 FCIR is a colour-rendering technique used to display images in colour which are recorded in the non-visible and visible parts of light. The image is here composed of the three different wavelength IR, red and green instead of the red, green and blue of a true colour image (normal picture).
22 Unpublished analysis report n° DI 84/2948 – 21/32. – A 1176, KIK-IRPA, Brussels 1984; reported in Lemaire, "Les Basses Danses", 21.

to investigate the application of the colour further (with experiments in replication) could be a fruitful avenue for future research.

Investigations by Banik et al. in 1982 identified the presence of iron and copper in the parchment of ÖNB Cod. 1856.[23] These findings were recently confirmed by preliminary first X-ray fluorescence (XRF) and Scanning electron microscopy (SEM) with Energy dispersive X-ray analysis (EDX) measurements on a fragment of Cod. 1856.[24] We therefore assume that the parchment was coloured with an iron-gall ink system. By contrast with Br9085, brush strokes, visible in transmitted light, indicate that the colour was applied to the parchment of ÖNB Cod. 1856 with a brush. The parchment is extremely brittle. Iron and copper ions seem to have caused degradation of collagen fibres.

In Vatican Library, Ms. Vat. Lat. 9488, another black book of hours, the parchment is in similarly fragile condition, if not even worse.[25] Tears and lacunae testify of the deterioration process, probably caused by transition metal ions.

The book of hours preserved in Bibliothèque municipale de Rouen, Ms. 136, is executed on paper. According to the images provided by the library in Rouen, the degradation patterns suggests the use of an iron gall ink colorant.

The two books of hours in New York City, in the Morgan Library & Museum and at the Hispanic Society of America, were recently investigated by the Metropolitan Museum of Art.[26] A carbon black was identified as the main colourant of the black parchment. According to the conservator Frank Trujillo at the Morgan Library and the conservator Monica Katz at the Hispanic Society, the parchment sheets of both manuscripts are in fairly good condition.

Both books of hours in New York City are preserved in bindings from the nineteenth century. The folios of ÖNB Cod. 1856 and of Ms. Vat. Lat. 9488 were both unbound in the early twentieth century due to the bad condition of the parchment, and are today stored between polyacrylate sheets (▶ Fig. IV.3). The bifolium of a book of hours at the Bibliothèque nationale de France is stored between glass plates. The book of hours in

▶ p. 235

23 Jenni and Thoss, *Das schwarze Gebetbuch*; Banik and Stachelberger, "Phänomene und Ursachen", 207–10

24 XRF measurement with portable instrument by Jembrih-Simbürger, INKT, Academy of Fine Arts Vienna, SEM/EDX measurements on a micro-sample of a fragment by Bernardi, USTEM, Technical University Vienna.

25 Montuschi, "La rara eleganza della pergamena nera".

26 Internal Report, Metropolitan Museum of Art, New York City, 2020.

Rouen is bound but not accessible to the public, due to its very fragile state of preservation. The manuscript Br9085 is preserved in its original textile binding. Although the binding has been extensively restored with new sewing and a new red leather spine, it appears that the boards and the silk satin cover could be original. They correspond in any case to the description of the manuscript in the inventory of the library of Margaret of Austria in 1523–24: "… petit [livre] couvers de satin cramoisy …" ("a small book covered with carmine satin").[27] Due to its precarious condition, the manuscript is not available for consultation or display. We assume that the differences in the black colourant used in each case are responsible for the differences in the books' condition.

A project currently being planned at the Austrian National Library aims to investigate the black colourants of ÖNB Cod. 1856 and the related black manuscripts in detail to find a solution for the conservation of Cod. 1856.[28] Brush strokes are visible in transmitted light. We assume that the colourant was brushed onto the parchment from both sides. Fragments of fol. 22 show under the microscope (scale 0.5 mm) that the core of the parchment is not penetrated by the ink (▶ Fig. IV.6 ▶ p. 238 and the detail from Br9085 in ▶ Fig. IV.9 ▶ p. 241). Thus, iron and copper were spread over the whole surface, recto and verso, causing a much more extreme example of ink corrosion than would be produced simply by writing in iron gall ink on parchment. The primary concern of conservation is the stabilisation of iron and copper ions in the parchment to prevent further degradation.

All the black manuscripts were written and decorated with gold and silver inks. The analysis of Br9085 in 1984 and the first XRF measurements of Cod. 1856 indicate that the illuminators used pure gold for the gold ink (▶ Fig. IV.7 ▶ p. 239).[29] The silver of the decoration of a loose fragment from Cod. 1856 contains traces of chlorine.[30] The silver ink of the text is well preserved, showing few signs of corrosion, similar to Br9085. In contrast, in the sixth-century Vienna Genesis, the silver ink has turned

27 Debae, *La bibliothèque de Marguerite d'Autriche*, 457.

28 Hofmann, "The Black Prayer Book, Austrian National Library Codex 1856", unpublished project proposal submitted to the Austrian Science Fund (FWF), 2022.

29 Lemaire, "Les Basses Danses", 20–21. In ÖNB Cod. 1856 the scribe and the illuminator used powdered gold and leaf gold for certain initials. The IRPA report on Br9085 mentioned "little flakes" of both gold and silver, so the inks could be powder gold and silver with a binder. However, the composition of the inks is one aspect that requires further research.

30 The silver is probably powdered, though the team at the ÖNB analysed only one spot. It is possible that the silver used for writing and that used for drawing were of a different composition. But again, this is an aspect that requires further research.

black and has severely damaged the parchment.[31] Pictures from the manuscript in Rouen do not show corrosion of silver ink. According to Frank Trujillo, the silver ink in Morgan Library Ms. M. 493 shows corrosion which varies from folio to folio. We are planning to investigate in detail the composition of gold and silver inks and to compare the seven manuscripts.

The manuscript Br9085 was created without miniatures, such as the manuscripts in Rouen and the Hispanic Society in New York City. Miniatures are preserved in ÖNB Cod. 1856, in Morgan Library Ms. M. 493, and in the two bifolios in Paris. In Vatican Library, Ms. Vat. Lat. 9488, the folios with miniatures are missing. The text block is surrounded with decorated margins. The white, red, green and blue pigments of the illuminations of ÖNB Cod. 1856 appear less prominent on the dark background than the design in gold and silver (▶ Fig. IV.8). Areas painted with the presumed pigments lead white and azurite show losses in the paint layer. A black pigment applied to the black coloured parchment is flaking off (▶ Figs. IV.4 and IV.8). Blue was used as background for the margin decoration in Morgan Library Ms. M. 493. In some areas the blue colour azurite has flaked off the smooth layer of carbon black.[32] As carbon black does not penetrate the parchment, it can be abraded from the surface, and is a less solid black support for additional paint layers than iron gall ink.

▶ p. 240

p. 236, ▶ p. 240

EARLIER TREATMENTS

Due to their gradual deterioration, all the black manuscripts have been subject to more or less successful attempts of conservation-restoration.

The black parchment of Br9085 is very fragile and brittle, as already mentioned by Baron de Reiffenberg in his 1829 catalogue: "... very ragged condition, no doubt due to the frequent use that has been made of [the manuscript]".[33] Thus, during the nineteenth century, the manuscript was the object of invasive restoration treatments to consolidate the edges of the very degraded leaves. Large strips of paper were glued on the four edges of the parchment folios, recto and verso (▶ Figs. IV.2, IV.10, and IV.11). This paper was dyed black with a paint of a slightly

p. 234, ▶ p. 242, p. 243

31 Hofmann (ed.), *The Vienna Genesis*.
32 Information by Frank Trujillo, the Morgan Library.
33 Reiffenberg, *Notices et extraits des manuscrits*, 1.

lighter hue than the parchment. In addition, the edges of the parchment itself, where they meet the paper frames, have also been repainted. The contrast between these restorations and the original parchment on the multispectral images in infrared light indicates that carbon-based black paints were used to colour the paper frames and retouch the parchment (▶ Figs. IV.5a, IV.11). At this stage, however, it is difficult to establish a precise chronology for these two interventions.

▶ p. 237, p. 243

The laid paper reinforcements are much thicker and stiffer than the parchment. Thus, if the edges are too well consolidated, significant stresses are exerted on the original parchment. The difference in strength between stout paper and brittle parchment has caused tensions and further mechanical damage: tears, cracks, deformation and gaps (▶ Fig. IV.10). Moreover, on some folios, other local reinforcements were glued to the parchment and the paper borders, probably where the parchment had broken just at the edge of the first reinforcement. At some stage, small tabs were applied to prevent further cracking of the parchment (▶ Fig. IV.12). The manuscript had to be unbound for the reinforcement treatment of the leaves. It was then sewn back into its original binding, but the order of the leaves was disturbed in the process. The spine of the binding was also restored in red morocco leather with gold tooling.

▶ p. 242

▶ p. 244

In the early twentieth century, probably in 1928, the folios of ÖNB Cod. 1856 were separated from the original red velvet binding with its silver decoration. The illuminated folios were mounted between glass plates and the text folios were stored in paper folders. We assume that the book conservator Alois Liska stabilised tears and large lacunae with black dyed silk gauze before the first facsimile was made in 1930. The use of silk gauze was developed in the conservation department of Biblioteca Apostolica Vaticana and promoted by the prefect Franz Ehrle in the early twentieth century. [34] Alois Liska used silk gauze in the conservation of manuscripts at the Austrian National Library in the first half of the twentieth century.[35] In 1975, the conservator Hilde Kuhn deacidified all folios with ammonia vapours. Attempts to consolidate the parchment with parchment glue remained unsuccessful.[36] Tears were mended with bridges of pressure sensitive tape, presumably Filmoplast®. Hilde Kuhn

34 Austrian National Library archive, record 443/1914.
35 Burkheiser, "Ein Beitrag zur Geschichte der Buchrestaurierung".
36 Irblich, "Die Konservierung von Handschriften".

mounted all 154 folios between two sheets of polyacrylate (▶ Fig. IV.3). One sheet was drilled with holes to allow some air exchange. The mounted folios were stored vertically in compartmentalised wooden boxes.

▶ p. 235

In 1898, Franz Ehrle, prefect and founder of the conservation department of Biblioteca Apostolica Vaticana, took folios of Ms. Vat. Lat. 9488 to a conference in St. Gallen, where international experts discussed the preservation of manuscripts.[37] Ms. Vat. Lat. 9488 was separated from the original binding in 1904 or 1910. Vittorio Allamprese treated the folios in the 1930s at the conservation department of Biblioteca Apostolica Vaticana. He flattened the parchment and joined bifolios. The bifolios were mounted between glass plates. In 1963 the glass was replaced by polyacrylate sheets.[38]

Ms. M. 493 at the Morgan Library was bound by Trautz-Bauzonnet in a brown leather binding with blind lines for the former owner Nicholas Yemeniz in 1867. Pierpont Morgan acquired the manuscript in 1912.

Ms. B 251 at the Hispanic Society of America is preserved in a binding from the nineteenth century. A conservation treatment is planned for the near future.

The bifolio Ms. Lat. nouv. Acq. 149 at Bibliothèque nationale de France is mounted between glass plates.

Ms. Leber 136 at Bibliothèque municipale Rouen is preserved in its original leather binding, with blind lines and a metal clasp with a depiction of the Virgin and Child.

PERSPECTIVES FOR STUDY AND CONSERVATION

The precarious condition of five of the black manuscripts demands study and solutions for long-term preservation. There is a need to investigate the different materials in more detail and to compare the results. How were the parchment hides produced, and how were they coloured uniformly black? Does the use of particular colourants, inks and pigments reveal connections and a possible origin in the same workshop? The creation of this specific group of books remains largely unknown. A deeper understanding of the process of manufacture is a prerequisite for finding a conservation strategy. The extreme brittleness of the parchment

37 Protokoll der internationalen Conferenz zur Erhaltung und Aussbesserung alter Handschriften 1898; Montuschi, "La rara eleganza della pergamena nera".

38 Montuschi, "La rara eleganza della pergamena nera".

requires physical support. Japanese tissue papers are used in conservation to reinforce tears and cracks. Degraded parchment does not tolerate high levels of humidity. As parchment is very reactive to humidity, any movement of a brittle parchment sheet causes damage. Using remoistenable tissue papers with an adhesive layer that can be reactivated limits the impact of humidity.[39] On a micro-level, degraded collagen fibres can break down and gelatinize.[40]

The aim of a conservation treatment is to stabilise the current condition and to prevent further deterioration and losses. New materials such as nano-cellulose or nano-collagen could offer options for a semi-translucent support.[41] Any support material has to be dyed to visually integrate with the black background. Furthermore, the support material should not cause additional tension which would result in dimensional deformation of the fragile parchment. The dyed support material has to be stable in the long term and emission-free. All these demands are a challenge for conservation that need to be investigated before a treatment can be applied.

To stop further deterioration caused by iron and copper ions, antioxidants offer possibilities of interaction with radicals. Complexing agents and antioxidants showed a stabilising effect on iron gall inks on paper in previous investigations.[42] An illuminated manuscript on parchment needs non-invasive and non-aqueous methods. An earlier attempt to conserve Cod. 1856 showed the dangers of treatments with aqueous protein adhesives as well as solvents. Any kind of treatment has to be based on conservation research, including ageing studies.

As storage conditions, especially fluctuating temperature and relative humidity, influence the ageing behaviour of artefacts, we have to find conditions that are as stable as possible. The enclosure of folios between polyacrylate sheets does not seem to be the best answer. For that reason, we are striving to establish a cross-disciplinary research project that connects the collections of the black manuscripts in an effort

39 Pataki, "Remoistenable tissue preparation"; Pataki-Hundt and Walter, "Comparison of lightweight Japanese tissues"; Hofmann et al., "Studies on the conservation of Verdigris on paper"; Hofmann et al., "Stabilization of Verdigris".

40 Mühlen Axelsson et al., "Establishing the relation between degradation mechanisms and fibre morphology".

41 Dreyfuss-Deseigne, "Nanocellulose Films in Art Conservation", 22; Völkel et al., "Combining phytate treatment and nanocellulose stabilization", 3–15; Bicchieri et al., "The solution to an unresolved problem", 1–9.

42 Neevel, "Phytate – a potential conservation agent"; Reissland, "Neue Restaurierungsmethoden"; Malešič et al., "Evaluation of a method".

to save this precious and unique heritage. The new facsimile edition of Br9085 is an excellent opportunity to raise awareness for this special group of books.