TREATMENT OF INK CORROSION IN A BOUND BOOK

ARMENIAN MANUSCRIPTS OF THE MATENADARAN COLLECTION IN YEREVAN

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Abstract

Although some methods for treating ink corrosion on single sheets of paper have been suggested, treatment of bound books is still an open question for conservators. This contribution documents the combined use of a specially designed book wedge, which goes deeply into a book's structure, and the aqueous phytate treatment. The precious Armenian manuscripts in Yerevan are taken as an example, as they suffer badly from ink corrosion and need to have some urgent measures taken to be rescued. The method allows for a treatment of manuscripts without opening and destroying their historical bindings, and thus seems to offer a real solution to the problem.

Keywords

Armenian manuscripts, Yerevan, ink corrosion, paper conservation-restoration

Introduction

The Armenian binding technique is quite unique.[1] It has hardly ever been described and has been applied only to Armenian manuscripts. These bindings occur quite rarely and, due to their difference from 'normal' Western bindings, were often replaced by the latter in the

1 Merian, Sylvie Louise Alice. The structure of Armenian bookbinding and its relation to Near Eastern bookmaking traditions. Ph.D. Disertation. University of Columbia, 1993.; Szirmai, Janos Alexander. The archaeology of medieval bookbinding. Aldershot, Hants. ; Brookfield, Vt. : Ashgate, 1999. Pp. 87-89.; Engel, Patricia; Wolfgang Schwahn. Das Arme-

course of conservation treatment undertaken in the past. This is not only especially true for the collections in the diaspora, where the Armenian books had been sort of exotic, but also for the collections in the Armenian motherland. The approach to restoration has been changing lately and, therefore, the request for preserving manuscripts suffering from ink corrosion included the request for finding a solution that would not require destroying the historical bindings.

Previous work

The first step was the survey of the material in Matenadaran, which was performed by an international project funded by the Getty Foundation in 2006.[2] In the course of the survey, both paper[3] and inks were understood and the dimension of the damage could be described more precisely than ever before.

Methods to stop the degradation of paper by iron gall inks have been discussed for a long time, and more intense research has led to the recommendation of phytates. The method of complexing metal ions was applied in paper conservation as early as the 1980s – for example, in the case of copper pigments on maps of the National Library in Vienna (by one of the authors). However, at that time the methods were relatively rough. Due to the cooperation of chemists and conservators, the calcium phytate-calcium carbonate method was developed[4], and has since been applied successfully by conservators to single sheets.

nische Buch : Prototyp‘ HANDES AMSORYA. // Zeitschrift für Armenische Philologie, Heft 1-12Jan/Dez (2005), 449-455.; Kouymjian Haig, Dickran; Isabel Berberian. From manuscript to printed book : Armenian bookbinding from the sixteenth to the nineteenth century : paper presented at the 2nd International Symposium Printing and Publishing in the Languages and Countries of the Middle East, Paris, France, November 2-4, 2005 [cited 2012-5-20]. Available at: http://armenianstudies.csufresno.edu/faculty/kouymjian/articles/2008%20DK%20BnF%20Sympsoium%20Nov%202005%20PDF.pdf

2 Engel, Patricia; Gayane Eliazyan. Ink manufacturing methods used in ancient Armenia : revisiting the problem of iron gall ink corrosion in the light of some new materials on the ink composition. // Bulletin (2006), 94-112.

3 It should be noted here that Armenians used paper as early as the seventh century and, therefore, the project focused on the treatment of paper. Parchment, which was used very little, in comparison to Europe, is not addressed by this project.

4 Neevel, Han. Phytate : a natural antioxidant blocking ink corrosion : paper presented at the ICOM Committee for Conservation, 11th Triennial Meeting, Paris, France / Edinburgh, England, September 1-6, 1996 (Unpublished lecture).; Pedersoli, José Luiz Jr.; Birgit Reißland. Risk assessment : a tool to compare alternative courses of action for the conservation of objects containing iron-gall ink. // Restaurator 24(2003), 205-226. An overview is also given in: The iron gall ink meeting : 4th & 5th September 2000, the University of Northumbria, Newcastle upon Tyne : postprints / edited by A. Jean E. Brown. Newcastle upon Tyne : Conservation of Fine Art, University of Northumbria, 2001, and the *Restaurator* of the years 2008 and 2009.

Calcium phytate is capable of chelating iron(III)ions. The thus formed complex is oxidized to a more stable iron(III)phytate complex and blocks the determinal effect of the iron(II)ions in the paper. The calcium carbonate helps the paper react to the newly formed carboxyl and carbonyl groups, which occur due to natural aging.

The efficiency of the method was proved by a combination of gel permeation chromatography and multiple detection and X-ray absorption spectroscopy.[5] The hitherto unresolved problem was the application of the method to a bound book. To achieve this, the conservators required non-aqueous complexing agents. Research is going on to develop them further.[6]

New ideas

Seeing such a pressing need, the conservator is challenged to develop fantasy. Fortunately he has not got solely the material at hand, but also a large variety of techniques to apply the latter. Together with his skills and knowledge in handling the very material of the individual book, a new combination was developed for the precious Armenian manuscripts.

Description of the problem

The task was to find a solution which would allow applying aqueous solutions to corroded areas on the book pages without the water being allowed to spread in the paper horizontally by capillary forces and thereby, reaching the binding structure or the peculiar Armenian water-soluble marginal paintings. Furthermore, water tide lines had to be prevented for obvious reasons, and the tension difference between de-

5 Henniges, Ute; Antje Potthast. Phytate treatment of metallo-gallate inks : investigation of its effectiveness on model and historic paper samples. // Restaurator 29(2008), 219-234.; Hahn, Oliver; Max Wilke; Timo Wolff. Influence of aqueous calcium phytate/calcium hydrogen carbonate treatment on the chemical composition of iron gall inks. // Restaurator 29(2008), 235-250.; Havlínová, Bohuslava; Jarmila Mináriková; Jozef Hanus; Viera Jančovičová; Zuzana Szabóová. The conservation of historical documents carrying iron gall ink by antioxidants. // Restaurator 28(2007), 112-128. The latter article also includes another antioxidant, BHT (2,6-ditercbutyl-4-methylphenol) in the series of tests, which was found to have minor disadvantages in comparison to the calcium phytate; double folds, brightness and deacidification effect were compared.

6 Kolar, Jana; Alenka Možir; Aneta Balažic; Matija Strilič; Gabriele Ceres; Valeria Conte; Valentina Mirruzzo; Ted Steemers; Gerrit de Bruin. New antioxidants for transition metal containing inks and pigments. // Restaurator 29(2008), 184-198. And although the method is not without water, and copper is not the main component of iron gall inks, never the less also the development of modified Proteins looks very promising; see Meyer, Fabienne; Anke Neumann. Recombinant Proteins : a new material for the chemical stabilization of copper pigment corrosion on paper. // Restaurator 30(2009), 96-130.

graded areas and intact paper had to be decreased as much as possible. Another matter of concern was the surface appearance of the treated and untreated areas after the procedure.

The manuscript wedge

Suction devices have been used in paper conservation since the early 1980s and have since been brought onto market in a large variety of forms. For book conservation book wedges are currently available. The authors, however, constructed a simpler wedge, which was especially appropriate for the task at hand.

The wedge consists of a substructure of Ceran and an upper part of, a molten granulate. The Porex is white, which allows good visible control of the conservator's work - even if it is covered by further material, it is better to have a light support - and is screwed to the substructure. This allows for cleaning the interior of the device, if needed. The possibility to benefit from suction also in remote areas, such as deep in the fault's area was one of the challenges, which was addressed by the new construction in a simple and most effective way. However, there was also the request that it should not cut, scratch or damage the paper in any way (Figure 1).

While in action the air flow goes vertically through the ink, the paper, the protective material still to be described and the wedge. Horizontal spreading of water or other water-based solutions, due to capillary forces in the paper is minimized to an acceptable extent (Figure 2).

The wedge can be connected to any commercially available vacuum cleaner. The air flow can be regulated in the usual way, by opening a window in the course of the tube between the wedge and the vacuum cleaner.

Figure 1.
Drawing of the manuscript suction wedge, schematic cross-section

Figure 2.
Point of the manuscript suction wedge

The wedge has quite a narrow angle, but even more important to fulfil the described aims is, that the Porex foremost edge is not supported by the ceran sub-construction. The narrow angle helps to slip the wedge quite deeply into the binding without stressing it. The tip being of pure Porex guarantees that suction is performed as close to the edge as possible.

The setup is such that the treated side of the book lays flat (Figure 3). The other side can be upright or at any angle from 90° to 180° depending on the book. The closer towards 90° the stronger any support construction must be made. Sandbags are of sufficient help. The height of the bookblock is compensated by small cardboard pieces inserted between the table and the wedges´ underside. Only one page is treated at the time.

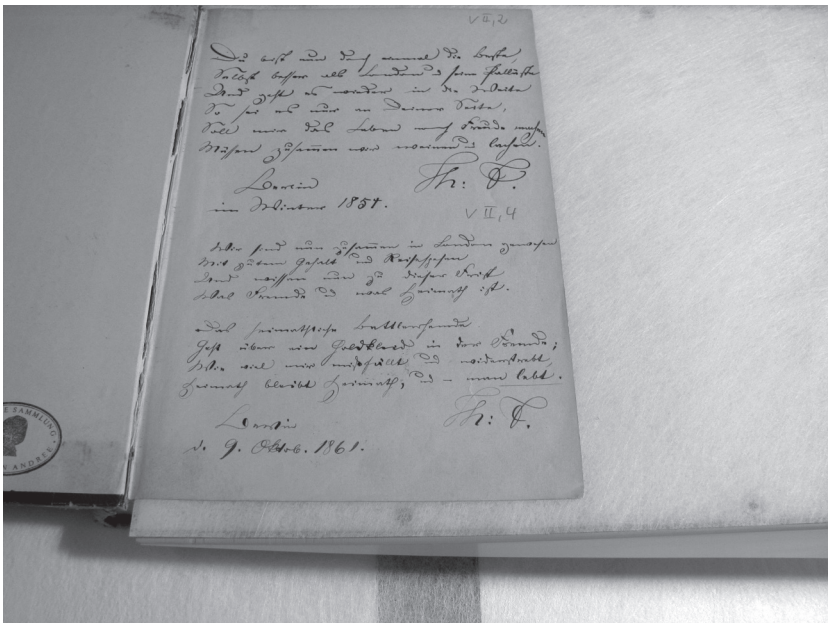

Figure 3.
Book on the wedge

First application of the wedge

During the conservation treatment of manuscripts by Theodor Fontane[7] in the Fontane Archives in Potsdam[8], Germany, the wedge was applied for the first time. While the working of the wedge was studied, the already well-known step by step procedure of the calcium phytate – calcium carbonate application[9] was performed.

The wedge was adjusted in the bookblock directly under the page to be treated. To secure the page on which the wedge rested, a PE felt was laid down onto the page and a cotton cloth came onto the PE felt i.e. the wedge actually rested on this cloth during treatment. As soon as the wedge was inserted, its upper surface, the Porex, was isolated with

7 Theodor Fontane (1819-1898), German poetic realist.

8 The authors would like to thank Dr. Hanna Delf von Wolzogen, head of the Fontane Archives, for her kind permission to publish the material about the conservation work performed in the collection as well as the pictures taken then.

9 Hofmann, Christa. Österreichisches Tintenfraß-Projekt (Teil 1). // PapierRestaurierung 5(2004), 29-39.

a layer of PE felt onto which a piece of finely woven cotton cloth came, which, from the author's experience, works better than blotting paper (apart from its cheap price and wide accessibility in any dimensions, it does not tear even in a wet condition and can be washed and reused easily). The PE felt should make the open Porex surface a bit more even and help avoid destructions of the paper while wet and under suction. The book page in question was accommodated on the cloth. The not to be treated second half of the book, was covered with another piece of PE felt and a piece of water-tight plastic.

Before all this the detection of iron (II) ions with Bathophenanthroline had been executed.[10] As the indicator showed free Iron ions present, the test for free copper ions [11]did not seem necessary any more for practical conservation and the calcium-phytate solution[12] was applied locally onto the ink with a soft brush and in a quite shallow angle, while the rest of the page was slightly moistened by spraying water. This was done to help even out the tension in the paper and avoid water tide lines. As the second half of the book was covered while spraying and the airflow was vertical, no water reached the binding area. After that, calcium carbonate was applied again with a brush and, finally, a gelatine[13] solution. During the procedure the treated areas became wetter than those that were only sprayed. This did not cause any problem of tension, as spraying could be varied according to the needs. The paper took water more readily where it was has been an observed fact for a long time and earlier was used to keep applied solutions to a restricted area when e.g. bleaching foxing was still en vogue. The typical nineteenth-century machine-made paper used by Fontane in the particular book is slightly glossy[14], thus also providing a chance to check the final surface appearance of the treated paper. The author was able to establish that the appearance of the paper surface before and after treatment

10 Preservation Equipment Ltd, info@preservationequipment.com. The procedure of testing is described for example in: Neevel, Johann G. Application issues if the bathophenantrhroline test for iron(II) Ions. // Restaurator 30(2009), 3-15.

11 This could have been done with a paper strip impregnated with 2-(5-nitro-2-pyridylazo)-1naphtol. See also: Hanus, Jozef; Alena Maková; Michal Čeppan; Jarmila Mináriková; Emília Hanusová; Bohuslava Havlínová. Survey of historical manuscripts written with iron gall inks in the Slovak Republic. // Restaurator 30(2009), 165-180.

12 1.44 g 40% Phytin acid, 0.22 g Calciumcarbonate-Pouder, 500 ml dest./dem.water, pH Value 5,0- 5,5.

13 Gelatine Typ B, Bloom 285, Viskosity 6,99.

14 Fontane used different kinds of paper for his work manuscripts and his letters. Both are in general machine-made paper without water marks, sometimes heavily filled with chalk and with smooth surface.

was the same. The examination was made in raking light with the eyes. Furthermore, after the application of the gelatine the water absorption ability of the paper was reduced again and was similar to that of the paper before treatment.[15] Finally the presence of iron (II) ions and iron (III) ions was tested by Bathophenanthrolin and ascorbic acid.[16] The result was deemed to be sufficient.

Overall, the conservation treatment of the Fontane manuscript gave satisfactory results.

We must note, however, that the ink corrosion of the Fontane manuscripts is, on the whole, relatively little compared to what can be witnessed in Armenian manuscripts. The inks are more uniform,[17] they were applied relatively recently[18] and, thus, their 'damaging history' is shorter. The paper – typical nineteenth-century paper – is more or less consistent throughout the piles. In Matenadaran, on the other hand, we face a large variety of inks, dyes, and what we would like to call 'Oriental' and 'Occidental' paper.[19] The history of the books is dramatic; all this together results in heavily damaged material. Therefore, identifying any further factors that would support the conservators' work of application of aqueous phytates and the wedge was very important.

Application in Armenia

In September 2009 another scientific cooperation between members of the 2006 team and the Matenadaran was agreed on. On the basis of the material collected then, several books were again surveyed; this time more closely, and one of them was selected for treatment.

15 The speed of water absorption could be witnessed while the final test for iron ions was executed. It was similar to the speed during initial testing.

16 Instead of ascorbic acid also sodium hydrosulphite can be used to reduce the iron ions.

17 Fontane was a trained pharmacist, so he might have actually known something about the ink composition and the problems it causes in terms of the future survival of the manuscripts.

18 The concrete page contains 2 inscriptions, both dated by Fontane. The dates are "Winter 1854" and "9 October 1861".

19 'The term "Oriental paper" stands for a thick type of paper which was usually produced on a grass mould, with pulp containing long fibres, inclusions of bark, starch and chalk fillers and the sheets carrying a reasonable amount of surface coating which was then polished. "European" paper is mainly homogeneous thin paper produced historically on a wire mould, without fillers and with animal glue surface sizing' according to Eliazyan, Gayane. Ink corrosion in Armenian manuscripts. // Research in book and paper conservation in Europe : a state of the art / edited by Patricia Engel. Horn; Vienna : Berger, 2009. Pp. 137-170, esp. p. 147, footnote 10.

The manuscript 10998

For treatment, the Manuscript Mat 10998 was chosen (Figure 4). It is a 'Textbook of knowledge', deriving from New Gulfa (Tshotsh). The client is an Azarian church clerk, as are the scribe and the illustrator. The catalogue in Matenadaran, from where all the data given here are taken, furthermore notes that the book was transferred to Darashamba church later, that the colophone has not yet been studied in detail and the date, which was 1691.

Figure 4.
Manuscript 10998 cover and one of the pages in 2006

In Figure 5,[20] a plotting of material and damage of the manuscript shows that

- paper and ink throughout this manuscript are uniform while
- the damage increases significantly in the centre of the book block, a phenomenon, which can be found quite often in Matenadaran manuscripts and which so far has not been explained. It might be due to the 'incapsulation' of acidic fumes in the block. This is the reason why air washing the entire library had been recommended as one of the results of the project in summer 2006.
- Furthermore, the book is made of so called "Oriental" paper, whose reaction to the new method was less known at the time.
- The inks were a mixed sort, typical for Armenian manuscripts, a mixture of soot and iron gall ink.
- There were all sorts of lines, rubrication and margin decoration.
- The binding was classified contemporary to the book block by Armenian conservators

The damage state 5[21] (y axis gives degree of damage), which was reached between pager 105 and 209 (x axis gives page numbers) is fatal, which means the pages break and large pieces are lost.

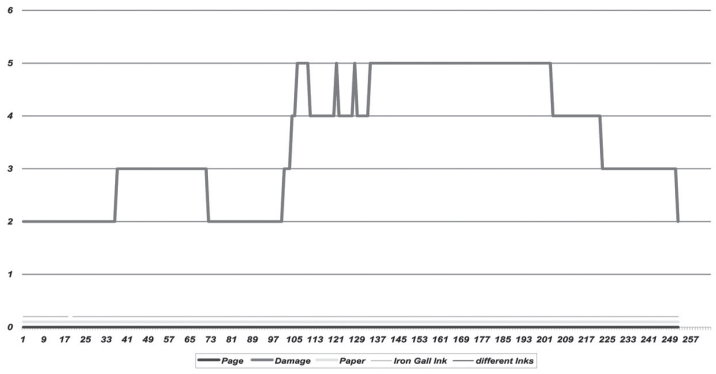

Figure 5.
Ms 10998 Matenadaran: Material and damage plotted on a chart. - X-Axis = pages from first to last, Y Axis degree of damage 2 = little, 5 = fatal

20 The charts of the surveyed books showing material and damage state of the single books were results of the Getty survey project. The charts were gained by transferring the handwritten data, collected from the manuscripts by hand into an excel file and then using the "chart-function" of this programme. Details of the procedure are described in Eliazyan, G. Op. cit., pp. 137-170.

21 Damage categories after Eliazyan; see Ibid.

The book was treated between 2006 and 2009. The restoration included reapplying all particles which in 2006 had been between the pages as single fragments back to their original place, fixed by the use of methylcellulose and Japanese tissue, establishing the pH value at 4 by the application of Bariumcarbonate and some fixing on the cover (Figure 6).

However the iron ion test executed then[22] was positive, both for iron II and III ions. The manuscript thus provided a worth trying example. Furthermore the other parameters were limited, as there was only one paper and one ink to be expected during treatment. That the ink represented the usual Armenian mixture contributed even more to the given aims.

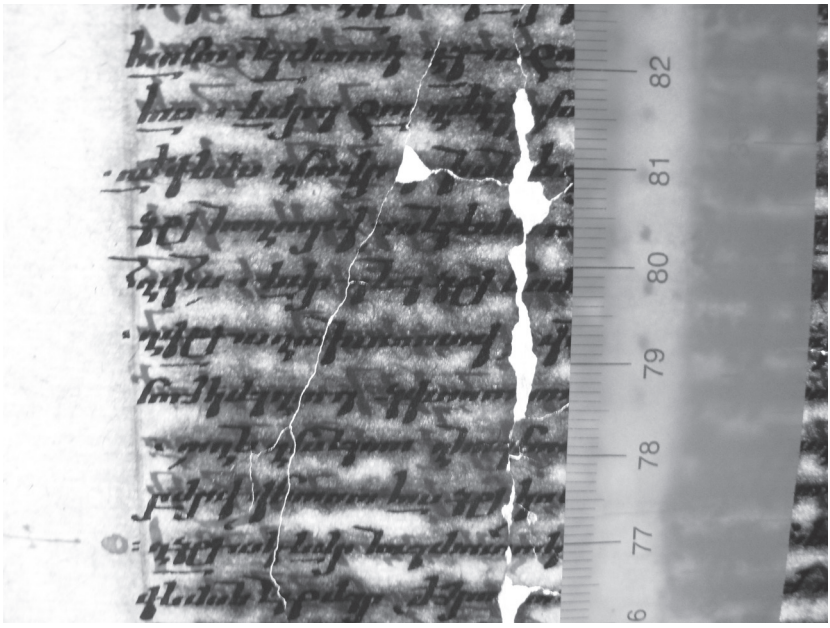

Figure 6.
Ms 10998 example of the state after the restoration, page 193 in transmitted light

22 Measured with indicator paper "Iron Gall Ink Test Paper" and ascorbic acid.

Observations while treatment

The ink, in contrast to expectations, was rather stable in water. This spot observation on one manuscript was confirmed to be a general behaviour of Armenian inks by the colleagues in Matenadaran and to a certain extent surprising. Earlier research had indicated that mixed inks contain soot and gums, which were estimated to dissolve and flow off when water would touch them. Smearing, which can be found in many Armenian manuscripts, was taken to be the result of touching with wet hands.

The amount of applied solution must be sufficient, which means the page becomes quite wet. It was tried to reduce the amount of solution throughout the treatments, however one sufficient treatment where ions are complexed in one single go seemed to be less stress for the paper than several less wet treatments. Furthermore sufficient amount of solution leads to a kind of washing through. The residues on the cloth contained detectable iron II and iron III ions, which had not been complexed by the Phytate solution.

The paper, which was, in the case of these manuscripts, very much decayed in the entire area of script and only intact on the margins around, absorbed the water readily. However, with the usual spraying as to prevent water margins, no water stains occurred. The use of a template has not yet been tried, but suggested.

The pages are utmost fragile and cannot be turned during treatment. If there is a need to apply Japanese tissue together with the complexing treatment, work should be started and complexing solution should be applied from the verso right from the beginning. If the procedure is made fast enough, water soluble ink compounds do not seem to have enough time to dissolve and no checking of the side, which lies on the sucking wedge, is needed. Drying should be allowed in the treating position, which is on the wedge. The suction can be turned off while drying, but the paper should not be moved until it is dry.

Verso of paragraphs written in red dyes or pigments[23] must be left untreated. However in these areas the ink can only damage the paper from one side and it can be expected therefore to be less damaging than in the other areas where both sides of the page are carrying iron gal ink writing.

23 According to observations under magnification both is possible.

The marginal paintings, characteristic for Armenian manuscripts, can be left untouched by the application of the wedge. This was proven by the treatment described here. At first a page only carrying ink-text, then one with margin painting was treated. The red lines on both sides of the text columns, also found in nearly every Armenian manuscript, seem to be water stable enough for the treatment too. No special care was taken to prevent them from becoming wet and they did not bleed (Figure 7). The pH value was 7 after the treatment.[24]

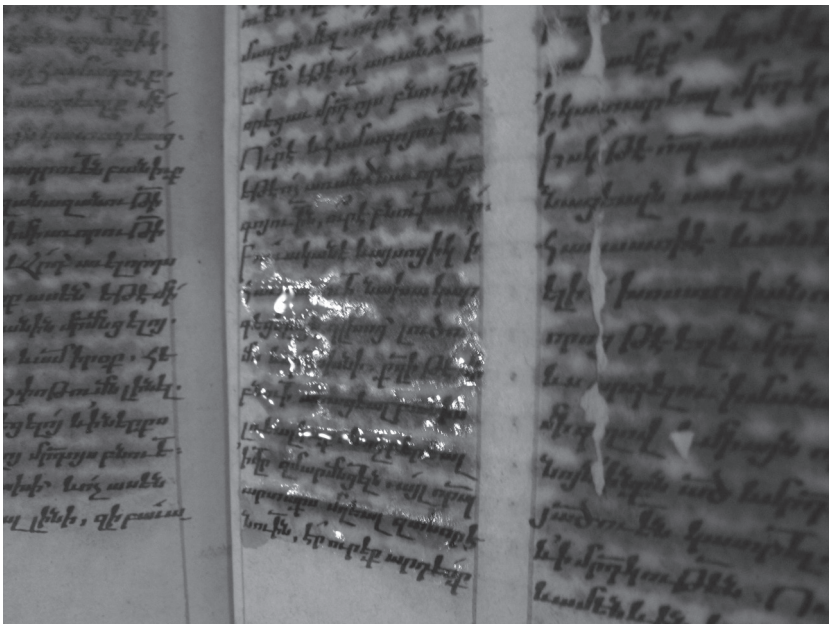

Figure 7.
Page 186 during treatment

Forecast

The shape of the wedge was good for the Fontane manuscript but should be modified for the Armenian bindings. Especially the part which goes into the fault should be a bit flexible. If there were a possibility to make the angle even less wide, it would also contribute to better work. A set-up to be able to control the side of the page lying to the wedge would be

24 pH Value was measured with a Merck indicator Nr. 1.09533.0001.

ideal. This could perhaps be performed by inserting a camera into the wedge possibly combined with a system of mirrors. The application of the solution as an aerosol was suggested and tested by the Armenians after the days of stay. It was reported to be impossible. The reasons are not yet clear.

Conclusion

Armenian manuscripts represent the earliest Christian manuscripts in the world and therefore are of unique and outstanding value. At the same time, their condition, due to the composition of material and their trying history is currently quite miserable. Before they were brought to modern storage areas of the major collections in Yerevan, Jerusalem, Vienna, Venice, Lwiv (only to name the largest), they often suffered from quite heavy environmental impact.

These books deserve to be treated in the best possible way. This was the reason why the team at the Matenadaran collection started a research project and asked for support from international colleagues.

The result of the cooperation was a suggestion of a simple, but effective treatment, including the employment of some of the latest findings in chemistry and new ideas from the conservation science. The application of the aqueous complexing agents in combination with a new wedge provides a possibility to stop ink corrosion on bound books not only of the Matenadaran collection. The book treated was chosen in such a way that the results can be seen as characteristic for many other Armenian manuscripts not only in the Armenian motherland, but also in Diaspora throughout Europe (Figure 8). This, however, does not mean that the attempts to find non-aqueous complexing agents, or ink corrosion treatments should be dropped. If found they might open wider and greater opportunities in dealing with the problem. The nano technologies promise completely new approaches.[25]

For the time being, however, the method described above might provide a kind of 'first aid' relief.

25 Stefanis, Emmanuel; Costas Panayiotou. Deacidification of documents containing iron gall ink with dispersiony of $Ca(OH)_2$ and $Mg(OH)_2$ nanoparticles. // Restaurator 31(2010), 19-40.

Figure 8.
Page 187 verso before and after treatment

Appendix

Materials used

Gelatine Typ B, Bloom 285, Viskosity 6,99:
Gelita Deutschland GmbH
Postfach 1253
69402 Eberbach
Germany

Gabi Kleindorfer
Aster Straße 9
84186 Vilsheim
Germany

Calciumcarbonat, Phytin acid, Ammonia, pH Indicator and ascorbin acid:
Th. Geyer Berlin GmbH
Dillenburger Str. 53
14199 Berlin

Indicator for Iron ions "Iron Gall Ink Test Paper":
Pel
Preservation Equipment Ltd.
Vincens Road
Diss Norfolk
England IP22 4HQ

Bottle:
Neunteufel
Untere Landstraße
3500 Krems
Austria

Recent suppliers for Suction devices:
Preservation Equipment Ltd, Vinces Road, Diss, Norfolk, IP22 4HQ, England Tel: +44 (0)1379 647400 Fax: +44 (0) 1379 650582, Email: info@preservationequipment.com or MUSEUM SERVICES CORPORATION, 385 Bridgepoint Drive, South Saint Paul, Minnesota 55075, USA, Phone: (651)450-8954, Fax: (651)554-9217, E-Mail: info@museumservicescorporation.com or in Germany BELO Restaurierungsgeräte GmbH, Wiesenstraße 14, 9585 Steinen, Germany, Geschäftsführer: Dipl.rest. Karl-Friedrich Bergmeier, Handelsregister: Amtsgericht Lörrach HRB 1963, E-Mail: belogmbh@aol.com, Telefon: (0049) (0)7627-1703, Telefax : (0049) (0)7627-972 08

The wedge used produced by

Thurm Labortechnik GmbH, Loebeckstr. 36, 10969 Berlin, Germany, Tel. +49 (0)30 616992 – 0 Fax: +49 (0)30 616992 – 40 E-Mail: info@thurm-labortechnik.de at the price of EURO 201.94.

Molten granulate material was "Porex":

Porex Technologies GmbH, Strangenhaeuschen 30, 52070 Aachen, Germany, Tel. +49 (0)241 910525-0 Fax: +49 (0) 241 910525-16, www.porex.com (The material used was 6 mm thick and had an average width between the granulate pieces of 250 μm; the colour was white.)

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Biographical sketch

Dr. Gayane Eliazyan graduated from Yerevan State University, Faculty of Chemistry with an M.A. Diploma with Honors in 1966 and from National Academy of Sciences Republic of Armenia with a PhD Diploma in Chemistry and a Red Diploma, granted by Yerevan State University in 1976. She had a training in the National Library, Berlin 2002 (6 weeks) and 2003 (2 weeks) and contributed to numerous conferences

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Dr. Patricia Engel holds a diploma in conservation from the University of Fine Arts, Vienna and a PhD in conservation from the University of Fine Arts, Warsaw. After employment at the National Libraries in Vienna and Berlin, she worked as a freelance conservator. In 2000, she began setting up a Book and Paper Conservation Chair at the University for Applied Sciences and Arts in Hildesheim, Germany and subsequently headed it until 2008. She lectures on conservation in Antwerp, Ascona, Warsaw, Novosibirsk, Colombo and Malta and published papers on globe- and, manuscript conservation and conservation theory. She has led conservation projects in leather wall hangings and Armenian manuscripts. Currently she is scientific head of the European Research Centre for Book and Paper Conservation-Restoration, Horn, Austria.

TRETIRANJE UVEZANE KNJIGE OŠTEĆENE KOROZIJOM TINTE
ARMENSKI RUKOPISI U ZBIRCI MATENADARAN U EREVANU

Sažetak

Iako postoje prijedlozi nekih tretmana oštećenja nastalih korozijom tinte na pojedinačnim listovima papira, tretiranje uvezanih knjiga ostaje otvoreno pitanje za konzervatore. Ovaj prilog prikazuje kombiniranu upotrebu posebno dizajniranog klina za knjigu koji ulazi duboko u strukturu knjige i tretmana pomoću vodene otopine fitata. Dragocjeni armenski rukopisi u Erevanu navode se kao primjer jer su znatno oštećeni uslijed korozije tinte i hitno treba poduzeti mjere za njihovo spašavanje. Metoda omogućava tretiranje rukopisa bez otvaranja i uništavanja starih uveza i tako nudi pravo rješenje problema.

Ključne riječi: armenski rukopisi, Erevan, korozija tinte, čuvanje i restauracija papira