The Difficulties of the Dead Sea Scrolls

Balancing Preservation and Exhibition
# Table of Contents

Introduction ....................................................................................................................................... 3  
Historical Method of Production ...................................................................................................... 4  
Degradation Processes ....................................................................................................................... 6  
  - Light ............................................................................................................................................... 7  
  - Temperature and Relative Humidity ............................................................................................... 7  
  - Pollution ......................................................................................................................................... 8  
  - Pests ............................................................................................................................................... 9  
Preventative Conservation ................................................................................................................ 9  
  - Light ............................................................................................................................................... 9  
  - Temperature and Relative Humidity ............................................................................................... 10  
  - Pollution ......................................................................................................................................... 10  
  - Pests ............................................................................................................................................... 10  
Conclusion .......................................................................................................................................... 11  
Appendix A ......................................................................................................................................... 13  
Bibliography ....................................................................................................................................... 14  
Research Proposal and Evaluation ................................................................................................... Attached
The Difficulties of the Dead Sea Scroll: Balancing Preservation and Exhibition

Introduction

Since their discovery in 1947 by a Bedouin herder in the region of Qumran, the Dead Sea Scrolls have captivated the imaginations of scholars, theologians and the public at large (see Figure 1\(^1\)). These ancient documents have provided insight into the theology of ancient Judaism and opened many scholastic avenues of investigation including linguistic development, ancient societal study, among others\(^2\). The cultural significance of these scrolls cannot be overstated. For those of Jewish faith and decent and those of Christian faith the scrolls have great religious value in that they are the oldest surviving copies of the Hebrew Bible (Old Testament). This status generates great interest in the scrolls around the world and demand for their exhibition is great\(^3\). These scrolls found at Qumran date from the Second Temple period ranging from approximately from the 2\(^{nd}\) century BC to 70 AD (the date given for the destruction of the Second Temple by the Romans). Due to their age, the scrolls present a difficult challenge to those tasked with their preservation at the Israeli Antiquities Authority, especially given their poor treatment in the years immediately following their discovery\(^4\). It will be the focus of this paper to examine the historical methods of production of these ancient scrolls, the degenerative processes, the methods to slow current degeneration and the difficult process of making these historic documents

---


\(^4\) Ibid, 102
available to the public through international exhibitions.

**Historical Method of Production**

The vast majority of the Dead Sea Scrolls (80%) are written on parchment derived from goat, sheep and calf skin. The rest are on papyrus and one is written on bronze. For the purposes of this research paper, the focus will be on those made of parchment. Parchment consists of collagen and is therefore a protein based material. The ink used on these scrolls was carbon inks based on either lampblack or soot.

The common animals used in the production of parchment in ancient times were goats, sheep and calves. Ronald Reed, in his book *The Nature of Parchment Making*, gives a detailed step by step account of the production of parchment in pre-modern times. The first step, after the animal was flayed, was soaking the skin in water to remove the residual organic matter that included dung and blood from the surface. The second step was the liquor bath of fermenting vegetables in either wooden or stone vats to soften the epidermal layers and follicle layers and therefore allow for easier removal. Next was the removal of the hair using metal or stone knives on a flat, hard surface followed by a second liquor bath. Reed states that the most vital stage of bath. If the skins retained these elements, the inks would not penetrate deeply into the parchment and therefore be useless for their intended purpose. The skin was then stretched and allowed to dry. This process allows for the fibre network (which, prior to this stage is meshed) to be aligned

---

8 Ibid, 80
9 Ibid, 80, 81
10 Ibid, 81
11 Ibid, 90
into layers parallel to the grain. The skin during this process was scraped with knives once again to produce an even thickness. This process of scraping under tension was vital to ensure that there were no deformities in the flesh (or writing) side. As the skin dried, the naturally occurring glue that held the skin together dried and created a firm, highly stressed sheet of parchment. This, however, was not the final product. In order for parchment to be used for writing, it must be treated to allow for the correct amount of ink to be absorbed into the fibre structure. This first of these treatments was called pouncing and it was done while the parchment was still on the drying rack. This process involves rubbing pumice stone powder into the fibre structure. This created a smooth, even surface that would not only allow the inks to adhere properly, but also added resilience to the writings. The parchment then went through the stanchgrain process which involved rubbing pastes made of egg white, milk and flour into the structure to whiten the parchment. This process is a factor in the parchment’s degeneration. Using foodstuffs to whiten the parchment increases its risk of attracting pests to the document.

The ink used in writing many of the Dead Sea Scrolls was analysed by Yoram Nir-El and Magen Broshi in their paper “The Black Ink of the Qumran Scrolls”. They were given access to many fragments of scrolls to determine the ink used. Their conclusion was that the ink was made from a carbonaceous based pigment such as soot or lampblack. They also discovered a number of other elements on the surface of the parchment including iron. It was originally believed that iron gall ink was the source but the authors discovered that the iron was in fact deposited on the

---

13 Ibid, 84
14 Ibid, 44
15 Ibid, 87
16 Ibid, 88
17 Ibid, 88
18 Ibid, 91
20 Ibid, 164
surface by the pouncing process of rubbing the surface with pumice stone powder\textsuperscript{21}. Where the ink penetrated the surface of the parchment, the iron deposits were pushed into the parchment surface causing the degeneration that appears on many of the older scrolls\textsuperscript{22}. The authors also discuss the fact that ancient binders that are present in the ink such as vegetable gum, animal size, oil and honey also have had a degenerative effect on the scrolls through their attraction of pests such as insects and rodents\textsuperscript{23}.

**Deterioration Processes**

The reason these scrolls survived so long is because the place where they were hidden was the perfect environment; low relative humidity, sealed in jars to prevent animal and insect consumption, and complete darkness\textsuperscript{24} (see Figure 2\textsuperscript{25}). When they were excavated, their condition rapidly degenerated due to the improper conditions and techniques used by early scholars\textsuperscript{26}. The scrolls were not kept in humidity controlled conditions.

\begin{figure}[h]
  \centering
  \includegraphics[width=0.4\textwidth]{Figure_2.jpg}
  \caption{Aerial View of Qumran: Note the dry arid landscape}
\end{figure}

\begin{figure}[h]
  \centering
  \includegraphics[width=0.4\textwidth]{Figure_3.jpg}
  \caption{Fragments of scrolls encased in glass}
\end{figure}

\begin{figure}[h]
  \centering
  \includegraphics[width=0.4\textwidth]{Figure_4.jpg}
  \caption{Note the tape used in early encasement}
\end{figure}

\textsuperscript{21} Yoram Nir-El, Magen Broshi. “The Black Ink of the Qumran Scrolls” *Dead Sea Discoveries* 3:2 (1996), 166
\textsuperscript{22} Ibid, 166
\textsuperscript{23} Ibid, 165
\textsuperscript{24} Ira Rabin, Oliver Hahn. “Dead Sea Scrolls Exhibitions around the World: Reasons for Concern” *Restaurator*, 33 (2012) 102
\textsuperscript{26} Ira Rabin, Oliver Hahn. “Dead Sea Scrolls Exhibitions around the World: Reasons for Concern” *Restaurator*, 33 (2012) 102
environments, adhesive tapes and glass plates were used to flatten and mount the scrolls, and castor oil and glycerol used in their treatment\textsuperscript{27} (see Figures 3 and 4\textsuperscript{28}). These factors rapidly increased the natural deterioration of the parchments which include the exposure to light, elevated temperatures, humidity, pollutants and microorganisms\textsuperscript{29}.

Light, especially UV light, has an incredibly degenerative effect on the Dead Sea Scrolls. In their article, Bella Dolgin, Valery Bulatov and Israel Scherchter discuss the effect that UV has on parchment samples\textsuperscript{30}. When exposed to UV light, the surface collagen becomes cleaved at random junctures and this causes a breakdown in the hierarchical fibrillar network\textsuperscript{31}. When the surface collagen is breeched, light photons can penetrate deeper into the molecular structure continuing the process of deterioration\textsuperscript{32}. Light damage is very insidious due to the fact that it is cumulative and irreversible and this is a problem when the scrolls go on display. Yellowing and darkening have been two consequences of excessive light exposure over the past 60 years\textsuperscript{33}. Amazingly, the ink on the Dead Sea Scrolls shows little evidence of fading\textsuperscript{34}.

Temperature and relative humidity play a major role in the breakdown of collagen. The process of producing parchment changes the make-up of the collagen fibres and this contributes to its degeneration. As stated above, the collagen fibres that make up the skin are messed and during the process of parchment making, they are stretched. This process aligns some of the

\textsuperscript{27} Ira Rabin, Oliver Hahn. “Dead Sea Scrolls Exhibitions around the World: Reasons for Concern” \textit{Restaurator}, 33 (2012), 102
\textsuperscript{29} Bella Dolgin, Valery Bulatov, Israel Schechter. “Non-Destructive Assessment of Parchment Deterioration by Optical Methods” \textit{Anal Bionanl Chem} 388 (2007) 1885
\textsuperscript{30} Ibid, 1890
\textsuperscript{31} Ibid, 1890
\textsuperscript{32} Ibid, 1890
\textsuperscript{34} Yoram Nir-El, Magen Broshi. “The Black Ink of the Qumran Scrolls” \textit{Dead Sea Discoveries} 3:2 (1996) 164
fibres but breaks many other. This creates shorter chains of collagen which allows for more water to be absorbed into the structure due to collagen’s hydroscopic nature. When the relative humidity fluctuates, the parchment absorbs and releases water. This has caused many of the scrolls to become deformed (cockled). Increased temperature and relative humidity will also cause the much more damaging process of gelatinization to occur. This is the process of molecular breakdown that unwinds the triple helix structure of the collagen molecule into a random mess resulting in the solid parchment degenerating into semi-solid gelatine (see Figure 5). When the RH and temperature are high, water in the air react with highly active hydrogen bonds on the collagen molecule. If these bonds are broken, the triple helix structure can no longer be held together and they form individual, less ordered structures.

Pollutants also can put the Dead Sea Scrolls at risk. Hydrolysis can occur when acids in the air such as sulfur dioxide combine with water to create sulphuric acid. This interaction causes cleaving within the main chain of collagen, leading to its eventual breakdown. This

---

36 Ibid, 218
37 Ira Rabin, Oliver Hahn. “Dead Sea Scrolls Exhibitions around the World: Reasons for Concern” Restaurator, 33 (2012) 103
39 Ibid, 219
40 Ira Rabin, Oliver Hahn. “Dead Sea Scrolls Exhibitions around the World: Reasons for Concern” Restaurator, 33 (2012), 104
41 Ibid, 219
42 Ibid, 219
becomes a very difficult issue when the scrolls are travelling abroad. Different countries have different levels of pollution in the air and it is very difficult to predict how the local environment will affect the scrolls.

Fungi are one of the most dangerous pest problems due to their ability to embed themselves deeply into the material structure of the artifact. Their hyphal networks penetrate deeply and can cause acid corrosion, enzymatic degradation and mechanical attack to the artifact. They are hard to control, given that they exist naturally within the environment. The collagen in parchment is high in nitrogen and is easily digested by microorganisms, making them a likely target.

Preventative Conservation Processes

The Israeli Antiquities Authority (IAA) is the organization in charge of the care of the majority of the Dead Sea Scrolls. Since 1991, they have been documenting and treating the thousands of scroll fragments in the collection of the Israel Museum. The IAA sets the standards of care for the scrolls and the requirements for exhibition when the scrolls go out on tour. They have designed special cases to house the larger scrolls both when they are in storage and when they go out on display (see Figure 6). These cases have UV filters over the polycarbonate plates, thereby protecting the scrolls from UV damage. However, visible light also can cause damage on a molecular level. The IAA has set very specific standards in the number of LUX they will allow the scrolls to be placed under during an exhibition. For an

44 Ibid, 559
exhibition that took place in 2006, they allowed only 35 LUX of illumination for the scrolls\textsuperscript{48} (See Appendix A for full condition report). After visiting CMC in 2004 to see the scrolls, I can personally attest to the very low light in the exhibition gallery. Though this makes it more difficult for the visitor to clearly view the scrolls, this lighting is necessary for the long term preservation of these priceless treasures. The IAA also states that if a scroll goes out on exhibition for three months, it must “rest” for one year before going out again in order to preserve the LUX hours of the scroll in question\textsuperscript{49}. Obviously objects cannot “rest” or recover as the statement implies. Whatever damage is inflicted on the scrolls while on display is cumulative however this policy will ensure that no single scroll is being over displayed to its detriment.

Environmental controls of temperature and relative humidity are absolutely vital to the long term preservation of these scrolls. When they are on display, the specialized cases designed by the IAA, contain blotting paper, linen, cardboard and filter paper to act as sinks to absorb water in the micro-environment\textsuperscript{50}. When they toured the US in 1993-1994, they also used silica gel inside the cases to absorb any excess moisture\textsuperscript{51}. This is vital to providing the scrolls with

\textbf{Figure 6: Storage Case for the Dead Sea Scrolls}

\textsuperscript{48} Ira Rabin, Oliver Hahn. “Dead Sea Scrolls Exhibitions around the World: Reasons for Concern” \textit{Restaurator}, 33 (2012) 110
\textsuperscript{51} Doris Hamburg. “Housing of Dead Sea Scroll Fragments for Exhibition Tour in the United
the optimum environment that mimics the cave conditions at Qumran. The scrolls travelled to many places during this tour, each with its own environmental relative humidity. Creating these micro-environments for the scrolls added a buffer to the changes that each location brought. For the elimination of pollutants, an activated charcoal was suggested as a method of absorbing dangerous air pollutants while the scrolls were on display during this tour. The cases are hermetically sealed to prevent any kind of pest (such as mould or insects) from gaining access to the scrolls. For the tour that took place in 2006, the IAA required that RH in the host institutions be kept at 50% and temperature be kept at 20ºC. However they continued to employ the micro-environments of the cases.

Conclusion

These scrolls are priceless ancient treasures and their long term preservation must be a priority. However, given the great public interest in these artifacts, they must also be made available to the public for exhibition. These two statements are contradictory given that the best way one can preserve delicate artifacts is to seal them in stable micro-environments and lock them away in complete darkness. The IAA must balance the preservation of the scrolls with the need and want of the public to see and experience the scrolls in an exhibition setting. As stated above, given the fragile nature of these scrolls, the visitor experience is diminished due to low light levels while the alternative is an escalating rate of deterioration for these ancient treasures. The IAA has set standards that are harsh, but necessary. Without these standards, there could be

---

complete loss of these two thousand year old scrolls within a relatively short period of time (based on their rapid deterioration after their discovery)\textsuperscript{55}. These cultural treasures cannot be preserved indefinitely; everything must go back to the earth from whence it came. In 2007, the IAA began a mass digitization project that will provide the highest resolution colour and infrared images of the thousands of scroll fragments, eventually uploading them to their online database allowing free access to all\textsuperscript{56}. This effort will ensure that even after the Dead Sea Scrolls are gone, their text and physical characteristics will be available for future generations to learn from and enjoy.


\textsuperscript{56} Ibid
## Appendix A Loan Condition Report

<table>
<thead>
<tr>
<th>Israel Antiquities Authority</th>
<th>The Israel Museum, Jerusalem</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exhibition Cradle of Christianity&lt;br&gt;Maltz Museum</td>
<td>Condition Report – Works of Art of Paper</td>
</tr>
<tr>
<td>Dates of Exhibit from 21/3/06 to 30/7/06</td>
<td>Registration no.:</td>
</tr>
<tr>
<td>List of Objects #</td>
<td>Old. reg. no.:</td>
</tr>
<tr>
<td>Temple Scroll Columns XIX – XXI</td>
<td>Department no.:</td>
</tr>
<tr>
<td>Object: Scroll (Temple scr. col. XIX-XXI)</td>
<td>Department: Shrine of the Book</td>
</tr>
<tr>
<td>Inventory number</td>
<td>Artist</td>
</tr>
<tr>
<td>Material: Leather</td>
<td>Dates of work: 1st century CE</td>
</tr>
<tr>
<td>Provenance: Qumran</td>
<td>Technique</td>
</tr>
<tr>
<td>Negative #:</td>
<td>Condition of paper/parchment:</td>
</tr>
<tr>
<td>Dimensions in cm: L_____ W_____ D_____</td>
<td>The fragment is in general stable condition, there are many cracks and tears with runs across &amp; long the fragments. Numerous holes and parchment lacks are all over, there are some darker areas mostly on the edges, please compare the photographs and the graphical schemes to the fragment. The text is in relative stable condition, though there are some areas mostly on upper parts were the text is less visible if at all. [sic]</td>
</tr>
<tr>
<td>Mount y/n</td>
<td>Condition of frame/mat: Good</td>
</tr>
<tr>
<td>Description and Condition:</td>
<td>RH% 47% Temp C 20°C Lux: 30Lux</td>
</tr>
<tr>
<td>Sewn between two sheets of Stabiltex net with Stabiltex thread.</td>
<td>Item no.: 337414</td>
</tr>
<tr>
<td>Illumination 35 lux RH 50% Temp 20°C</td>
<td>No change [x] Signature (Mus) Date: 10/6/09</td>
</tr>
<tr>
<td>Special Requirements for Mounting, Handling, Packing:</td>
<td>No change [ ] Signature (Ven) Date: 10/6/09</td>
</tr>
<tr>
<td>Do not place at an angle greater than 15°</td>
<td>No change [x] Signature (Ven) Date: 10/9/09</td>
</tr>
<tr>
<td>See attached to this report – photos, sketches</td>
<td>No change [ ] Signature (Mus) Date: 17/9/09</td>
</tr>
<tr>
<td>*** The I.A.A must be informed immediately if any change has occurred***</td>
<td></td>
</tr>
<tr>
<td><em><strong>No treatment may be undertaken without our approval</strong></em></td>
<td></td>
</tr>
<tr>
<td>(?) Incoming, Date: 27/12/05</td>
<td></td>
</tr>
<tr>
<td>Examined by: Name: Conservator (IAA)</td>
<td></td>
</tr>
<tr>
<td>Conservator (Mus)</td>
<td></td>
</tr>
<tr>
<td>Incoming Maltz Museum 21/3/06: no change</td>
<td></td>
</tr>
<tr>
<td>Examined by: Name: Conservator (Ven)</td>
<td></td>
</tr>
<tr>
<td>Outgoing Maltz Museum: 30/7/06</td>
<td></td>
</tr>
<tr>
<td>In general, no changes in the physical aspects of the scroll, except some colour changes (much darker) in column XIX. Strictly speaking at the G left side at the hole area. Note: Between June 20 through July 5 there were ups &amp; downs in the humidity from 51% to 45% RH.</td>
<td></td>
</tr>
<tr>
<td>Examined by: Name: Conservator (Ven)</td>
<td></td>
</tr>
<tr>
<td>Courier of the Shrine</td>
<td></td>
</tr>
<tr>
<td>(Incoming) Outgoing, Date: 8/8/06</td>
<td></td>
</tr>
<tr>
<td>Examined: by Name: Conservator Mus N.C. 14/8/06 Name: Conservator IAA</td>
<td></td>
</tr>
</tbody>
</table>

Table 1 Text part of the loan condition reports of the Temple scroll (11Q19), columns 19-21 for the exhibitions in the USA in 2006 (left column) and Hungary in 2009 (right column). 57

---

Bibliography


