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IFLA Journal is an international journal publishing peer reviewed articles on library and information services and the social, political and economic issues that impact access to information through libraries. The Journal publishes research, case studies and essays that reflect the broad spectrum of the profession internationally. To submit an article to IFLA Journal please visit: [journals.sagepub.com/home/ifl](http://journals.sagepub.com/home/ifl)

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# Preservation storage and curation strategies: Introduction

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All collecting institutions reckon with the fundamental question of how to store collections. The answer to this question often begins and ends with pragmatic decisions: collections are stored wherever staff can find room. Storage is an operational necessity but it also needs attention at a strategic level. Storage serves as a fundamental and functional piece of the institution's plan for access to and preservation of its collections: storage at its best becomes proactive curation of the collection and requires a good knowledge of the condition and quality of the collection. In this special issue of *IFLA Journal*, we have attempted to bring together articles depicting a variety of approaches to storage for physical and digital collections that are adapted to the particular constraints and opportunities of different types of libraries. We hope that this collection will show how storage choices affect the goals of libraries across the spectrum, from preservation to access.

As we brought together these articles, we found that there is a history of library science that deserves to be told from the viewpoint of storage. Historically, most classification systems have grouped related categories of materials together on the shelf, but several systems also tried to group materials near their service points in particular buildings. All libraries have faced some version of this question as they decide between on-site and off-site storage or settle on the optimal number of copies to collect. Some models of storage, such as the Open Archival Information System, have attempted to make a similar connection between the elements of a digital storage and delivery system to guide development of effective and reliable digital archives.

The answers to these questions are as many and varied as the communities that libraries serve. In describing the classification system he developed for the New York Public Library, a system intended to place subject collections close to their respective reading rooms, John Shaw Billings wrote that “it is

not logical so far as the succession of different departments in relation to the operations of the human mind is concerned; that it is not recommended for any other library, and that no librarian of another library would approve of it.”

The book stacks that Billings had in mind were themselves the result of a strategic decision about how to store books, and attempted to make the best use of the best technologies of their era. They were designed by Bernard Green and first used at the Library of Congress (USA), being soon adopted by the Ontario Legislative Library (Canada), New York Public Library (USA), and Widener Memorial Library of Harvard University (USA). These stacks, which were manufactured by Sned & Co. Ironworks, were intended to fulfill a program of requirements that includes many aspects of library services:

- Accommodation for books of every variety, shape, and binding;
- Direct and immediate access to every volume with a minimum distance to travel;
- Location in close communication with cataloging, reading, and delivery rooms;
- Thorough illumination, either natural or artificial, by day and night;
- A constant supply of fresh air and an evenly regulated temperature, in order to prevent the deterioration of both paper and bindings;
- The greatest possible freedom from dust;
- Facilities for proper classification, arrangement, and rearrangement;
- Maximum development of book space and provision for indefinite expansion.

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What resulted from these requirements was stacks consisting of a framework of cast-iron supports which carried bookshelves and platforms that subdivided the storage area into decks between 7 and 7.5 feet high. At the turn of the 20th century in central Europe, very similar considerations led to a standardized, flexible, self-supporting system of steel shelving that improved the ratio of storage to space compared to previous models of shelving. These systems were installed in numerous European library buildings between 1889 and the 1920s, and some of them are still in use today.

Improvements in storage and space ratios continue to this day. As we go to press with this special issue, the Library of Congress is completing construction of a new storage facility from a design originating at Harvard University and widely adopted by American libraries. These high-density facilities embody a strategic decision to change the program of requirements—with collections being located off-site and less accessible to the reading room—towards improving storage density and achieving better preservation outcomes. The preservation environments of these facilities use technologies of our current era to reduce light exposure, temperature, and humidity, and carefully manage fire risks.<sup>1</sup>

Although our authors in this issue are focused on the present day, it would be interesting to examine the interrelationships between the continents in terms of the professionalization of the storage of books and the lines of development that have led to modern requirements. Further advances in storage design include facilities technology—low oxygen storage, for example, and automation of storage systems along with further increases in storage density—as well as operational models that share the costs of storage as a preservation function through shared print archiving or distributed digital archives that ensure there will be many copies of data to avoid loss.

The flexibility afforded by digital storage and access has a fertilizing effect here. With a growing range of digital library options and the desire to support research that uses both digital and physical holdings together for their distinctive characteristics, there are intriguing possibilities for the purpose and design of library storage systems. In ways that are guided by the goals of the library and enabled by the technologies and other resources available to them, librarians continue to embody strategic decisions in their choice of storage methods. They ask: What happens when libraries envision a new service model, and how can the library rethink the repository's purpose in terms of preservation of the holdings themselves and the services that exist around the repository?

For one answer to this question, in the introductory article of this issue, we have invited Peter Whitehead and colleagues at the National Library of New Zealand (Te Puna Mātauranga o Aotearoa) to tell us about the Tāhuhu: Preserving the Nation's Memory Programme, a large collaborative effort to update the buildings and services for the National Library, Archives New Zealand, and Ngā Taonga Sound & Vision. Whitehead describes this entire plan as *tāhuhu*, the “backbone” of the *whare tupuna* or “meeting house.” The backbone is a fundamental structure and serves the National Library's program as a powerful metaphor of support for the *mahi* (“work”) that is planned over the next six to seven years, which includes the *heke* (“ribs”) as the individual projects within the backbone of *tāhuhu*. The entire project grows out of thoughtful planning to promote use and ensure the sustainability of the collections and the infrastructure required for their preservation.

The Tāhuhu project includes plans for a new, resilient, purpose-built facility for the Heke Rua Archives in Wellington to preserve memory of government and *taonga* (“treasured materials”). This will include support of best-practice storage, conservation, and digitization services. Alterations to the National Library's building are envisioned to enable co-location and greater collaboration between the Archives, National Library, and Ngā Taonga in a vibrant new campus-like setting where visitors can access and learn about the nation's recorded and documentary heritage all in one place. In addition, a fit-for-purpose, resilient, and sustainable facility in the lower North Island is planned to provide preservation storage across the National Library, Ngā Taonga, and Archives, with the potential for wider sector use.

In planning this special issue, we discussed the aforementioned questions and many other ways of thinking about storage. Ultimately, we decided to pose the question of how storage—and the policy-driven rules and services associated with it—plays a strategic function in libraries. Storage is something libraries must do, a cost they must bear, so they must manage that cost and, ideally, benefit from that investment. The storage projects of large collecting institutions like the Berlin State Library and Library of Congress help to break ground and advance the field, but the way national and research libraries solve these problems cannot be taken as a turnkey answer for every library of every size in every place. In this issue, we strive to include a variety of articles that, while not comprehensive, provide many points on the map, showing solutions from libraries in a variety of geographic locations and with a variety of different levels of resources available to them.

Two articles describe housing projects for collections in distinctive formats that take into account decisions for user and access services: “Dunhuang scrolls: Innovative storage solutions at the British Library” and “The David O Selznick storyboard rehousing project: A case study.” In both, libraries reckon with the challenge of how to create safe storage housings for these materials—scrolls in one case, storyboards for films in the other—and to design those housings in a way that made the materials easy to serve to users while also being efficient to produce. This efficiency is measured in terms of labor as well as choice of materials, and raises important practical questions about the level of skill required for this work, and how best to apply the skills of various staff.

Another article, “Preservation storage in a flood damage mitigation effort at the National Library of France,” also describes innovative housing solutions based on strategic decision-making, but, in this instance, preservation staff designed storage containers with a different purpose in mind. Like many libraries, the Bibliothèque nationale de France must contend with increasingly frequent floods driven by a changing environment, and the book-storage containers described in this article are intended to facilitate the rapid evacuation of collections.

The environment and the impact of the climate is also the focus of “Curation of manuscripts in the tropical savanna climate of north-eastern India.” This article provides a review of issues facing a distinctive set of archives in a region that has not received significant discussion in the literature but whose risks and constraints can be recognized around the world: a warm and often humid environment, with little access to the infrastructure needed for heating, ventilation, and air-conditioning systems to mitigate these risks.

A pair of articles reminds us that history often provides useful clues in our culture and environment for how to work in the future. “Applicability of traditional storage methods in Indonesia for today’s conservation practice” reviews the outcomes from several conservation projects in Java, Indonesia, that rely on traditional cultural methods to care for collections in a museum of contemporary art, a traditional puppet theater, a museum of traditional art, and an archive. In “Natural ingredients for a bacteria-free library collection,” we have a review of another look at traditional methods that make use of various herbs and spices to preserve reading materials, and their comparison to fumigation or other chemical treatments.

These articles on storage decisions in subtropical climates should also prompt us to think about sustainable development. There is an ecological fingerprint required by the air-conditioned storage systems that

are the standard practice in the western hemisphere. A change in thinking is taking place, and libraries are revisiting the assumptions that guided the construction of storage spaces for decades in order to look for more ecologically sustainable solutions. The ideas and practices in countries that do not have the same level of energy resources and financing options thus take on a completely different relevance as we give collective attention to sustainable and suitable preservation on a global scale.

Although much of this special issue focuses on physical collections, usually paper-based, libraries and archives face significant storage challenges for other media. “Identification and storage of plastics in libraries and archives” provides an overview of a variety of plastics in library collections and guidance on identifying the most high-risk instances of these materials.

Two other articles turn from physical collections to digital collections. Digital collections are a rapidly growing category of library collections and often framed as a new type of content with new challenges. As this issue goes to press—itsself a digital process—it is just over 50 years after the first Advanced Research Projects Agency Network transmission between universities (the University of California, Los Angeles to Stanford in 1969) and roughly 30 years since the first web browsers were introduced (the World Wide Web in 1990, NCSA Mosaic in 1993, and Netscape Navigator in 1994). Digital content is a well-established part of the information environment and, for many librarians, the predominant information format in use throughout their lives and their professional careers.

In this issue, we touch both poles of digital libraries: an aspect of our work that increases access to collections through new methods and an ever-growing storage project of its own. The article “Experimenting with 360° and virtual reality representations as new access strategies to vulnerable physical collections: Two case studies at the KB, National Library of the Netherlands” builds a bridge between physical and digital storage, describing the early stages of testing the applicability of 360° imaging to support virtual access to the special collection storage and using virtual reality to render pop-up books for educational purposes. “Deciding how to decide” introduces the Digital Preservation Storage Criteria and an accompanying Usage Guide to support organizations in a variety of situations in preparing for digital preservation. This article explains the Criteria and their recent updates to map them to relevant international digital preservation and information technology standards. In addition, the article reviews the latest updates to the Usage Guide and gives examples

of using the Criteria in various contexts to help organizations apply the Criteria to their own situations.

Around the world, libraries are making conscientious decisions about their service models. These decisions, shaped by each library's resources and goals, are often realized in a storage strategy: Where will this library keep this item, and how will it be kept? While this special issue cannot provide a complete and comprehensive review or study of the variety of storage choices made by libraries, we hope that it provides interested readers with enough examples of collections from around the world to stimulate careful thought about how storage decisions factor into the life of the library. They all demonstrate how the preservation of our collective memory—whether in physical or digital form—is recognizable as a common task of libraries. Libraries embody a fundamental social mandate for preservation, and this is the special responsibility of library professionals. The need for critical attention to preservation, and that it plays a strategic function in libraries, is especially significant against the backdrop of the fateful issue of “sustainability,” which confronts us day by day with increasing challenges in so many aspects of our lives and livelihoods.

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### Note

1. It is worth noting that the Green-Snead design's well-intentioned air circulation plan may do more for the spread of fire than it does for the preservation of collections—books may benefit from some air exchange but they do not breathe oxygen, while fire thrives on access to this element.

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# Tāhuhu: Preserving the Nation's Memory Programme: An interview with Peter Whitehead and Hinerangi Himiona

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For this special issue, the editors (Reinhard Altenh-öner and Jakob Nadal) spoke with Peter Whitehead, Collection Care Leader at the National Library of New Zealand, and Hinerangi Himiona, archivist and Principal Māori Advisor on the Tāhuhu Programme.

**Editors:** *The National Library is involved in a large programme of building works. What can you tell us about that programme?*

**Peter Whitehead (PW)** Figure 1: The Tāhuhu: Preserving the Nation's Memory Programme is a large collaborative programme to update the buildings and services for Te Rua Mahara o te Kāwanatanga Archives New Zealand, Te Puna Mātauranga o Aotearoa National Library of New Zealand and Ngā Taonga Sound & Vision. The Programme grew out of a property review conducted by the Department of



**Figure 1.** Alexander Turnbull Library newspaper team. From left to right: Laura Mirebeau (Books and Paper Conservator), Lorraine Laulau (Project Manager), Graeme Shaw (Newspapers Curator), Peter Whitehead (Collection Care Leader) and Amy Cosgrove (Collection Registrar). Photograph courtesy of Mark Beatty, National Library of New Zealand.

Internal Affairs. The review identified over 60% of Archives and National Library buildings in the North Island are not fit for purpose. Archives Wellington has been full since 2017 and the National Library will be close to capacity by 2030. The Tāhuhu Programme provides a once-in-a-lifetime opportunity to create a national documentary heritage campus within the parliamentary area and build more resilience across the sector.

A *tāhuhu* is the ‘backbone’ of the *whare tupuna*, a ‘meeting house’. The backbone is a fundamental structure and can be seen as a powerful metaphor of support for the *mahi* (‘work’) we are doing over the next six to seven years. We have extended this metaphor to include the *heke* (‘ribs’) as the projects within Tāhuhu. Tāhuhu is a multi-year programme of work that encompasses seven projects and workstreams. The three key projects relating to storage are:

- Heke Rua Archives: a new, resilient, purpose-built Archives facility in Wellington will house and protect our memory of government and *taonga* or ‘treasures’, and provide specialist facilities for conservation and digitisation. The new building will be joined to the National Library by a link bridge, and some services and staff will be co-located across the sites.
- Heke Puna Library: alterations to the current National Library building will help to enable that co-location and greater collaboration between Archives New Zealand, the National Library and Ngā Taonga. This project is also core to the creation of a vibrant new campus-like setting where visitors can access and learn about our nation’s recorded and documentary heritage with three of these major institutions in one place. Budget 2020 included funding for the design and procurement process for National Library alterations. A Budget 2023 submission will be required to deliver the alteration works.
- Regional Shared Repository: a fit-for-purpose, resilient and sustainable facility in the lower North Island, the Regional Shared Repository will provide specialist preservation storage across the National Library, Ngā Taonga and Archives with the potential for wider sector use. This involves the acquisition of a suitable piece of land and the delivery of design, build, fit-out and the transfer of collections to the new facility.

## Background

**PW:** Archives New Zealand and the National Library are the official ‘stewards’ or *kaipupuri* of our

nation’s documentary heritage and *taonga*, valued at NZ\$1.5 billion and growing. Together, the valuable collections include government records, publications, books, manuscripts, artwork, scientific data, images, films and much more. Across the entire portfolio, these physical records total over 271,000 linear metres and are continually growing.

In 2018, Ngā Taonga Sound & Vision was included within the scope of the Tāhuhu Programme, as New Zealand’s audiovisual archive. The central Wellington facility of Ngā Taonga was no longer fit for purpose and the collection had outgrown their storage capacity. Ngā Taonga cares for New Zealand’s most extensive audiovisual collection, with over 980,000 items. The Wellington-based staff of Ngā Taonga moved into the National Library Molesworth Street building in September 2019.

## Transition planning

**Editors:** *You also have facilities in Christchurch and Auckland. I have to ask if there was damage to the Christchurch facility from the 2011 earthquake. International news highlighted the cathedral damage, as well as other buildings, but little information about the National Library building. Did the old library building have any specific earthquake-resistant construction or renovation?*

**PW:** The National Library does have facilities in Auckland and Christchurch. Both facilities are centres for the National Library’s Services to Schools. They do not have collection repositories but do hold and supply the important schools collections across those regions. The Christchurch building, although not that old, was damaged beyond repair by the earthquake, so the library moved to another leased facility.

Many of the Christchurch library and heritage institutions were badly affected by the 2010 and 2011 Canterbury earthquakes. Now, 10 years on, many have reopened with new or refurbished facilities, including the Christchurch City Library, Archives New Zealand Christchurch Regional Repository and Christchurch Art Gallery. Christchurch had not previously been considered a high earthquake-risk area, so buildings were typically not designed or strengthened to withstand the size and forces of these earthquakes. Those and subsequent earthquakes in New Zealand have resulted in a raft of revisions to building standards, for building resilience for both existing and new buildings. Because of these major events and subsequent new legislation, we undertook a full review of the Wellington facilities.



Last year, we received a detailed seismic assessment for the National Library's Wellington building. The assessment outcome for the building was excellent, and we are confident the National Library building presents a low risk exposure for staff and our collections.

**Editors:** *We'd like to know about the plans for future use of the current National Library and the new Archives New Zealand and Regional Shared Repository buildings, and how that relates to planning for new storage facilities for your national collections. Will both the National Library and Archives Wellington buildings continue to be used?*

**PW:** A purpose-built Archives facility in Wellington began construction in February 2022 on a site adjacent to the National Library. Alterations to the existing National Library building, including a link bridge connecting the new Archives building, are being designed and will change how people and collections occupy the space. Completion is scheduled for 2026. The library conservation and digitisation studios and staff will move to brand-new facilities in the new Archives building, co-locating with Archives teams. Ngā Taonga Sound & Vision staff will co-locate in the National Library. This provides an opportunity for new shared access spaces where holdings and collections of all three organisations can be seen together in one campus. These alterations to the current library building will enable this co-location and greater collaboration.

There will continue to be collections stored in the National Library building, but there will be some changes to how stores are configured and organised. So, we are planning for major building works. The campus does not have capacity to accommodate all collections and the anticipated growth for the next 25 years across the three organisations. A new Regional Shared Repository will provide that extra capacity and the opportunity for improved storage that optimises preservation, access and sustainability. The site for the new repository is in Taitoko Levin, which is about 90 kilometres north of Wellington. The location and site for this repository is important. As New Zealand experiences earthquakes on a regular basis and Wellington itself lies on a fault line, the repository needed to provide a geographical separation of collections, to provide the best protection from natural and man-made risks, yet remain accessible for business continuity and ongoing access to collections. The process of selecting the site has ensured all of these requirements were met.

**Editors:** *What criteria will be used to divide up the holdings?*

**PW:** The criteria used to establish 'what goes where' are different for each organisation, but for the National Library the principles focused on are:

- Separation of duplicate or multiple copies. The library holds duplicates, second copies or preservation surrogates of many collection items to support preservation and access. All have a preservation status, and physical separation is a way of managing the risk of total loss of collections from natural disasters while keeping one copy accessible.
- Digitised material or microfilmed material to be moved off-site in most cases. This will include material intended for digitisation, although transfer may be later.
- Anticipated use, with medium- and high-demand collections to stay close to access points in Wellington and low-demand collections considered for off-site storage. We anticipate that use will change over time as interests change and material is digitised, so these collections may move again in future.
- Existing specialist storage and benefits realised through earlier refurbishments at the library—for example, cold stores. Where we already have a specialist storage that continues to meet the requirements, it will be utilised. However, any new additional cold and cool collection stores should be accounted for in the Regional Shared Repository, where preservation and sustainability can be optimised.

Using these principles, we looked at all the collections, including both the general collections and the heritage collections, and tested each against these criteria to identify what needed to remain in Wellington. There are some obvious collections, like the microfilmed newspaper collections; one of the two copies of New Zealand publications deposited under legal deposit or digitised AV [Audio-Visual material]; and photographic collections that require specialist long-term storage. Less obvious are those items that do not meet these criteria yet will do in the future once digitised, or where the levels of use are not easily anticipated. The Regional Repository is planned to include digitisation facilities, so we are investigating digitisation on demand as an option for future access of some collections.

**Editors:** *Could you help our readers with some counts on how much storage (and type of storage) over time can you project to have for physical materials?*

**PW:** The new Regional Shared Repository is intended to meet the storage and growth needs until 2045. It is being designed to accommodate a range of different materials and formats, with some in specialist environments. The size of the land purchased also allows for future growth.

As a high-level starting point for the National Library, the collections currently occupy about 110,000 linear metres of shelving, and the existing capacity of all sites is about 115,000 linear metres. About 70,000 linear metres (65%) of this are the heritage collections and 40,000 linear metres (35%) are the general collections. We anticipate being at capacity by 2030, although in some areas this will be sooner.

Counting, measuring and estimating growth rates has kept us very busy for several years now, and is ongoing. For designing specialist stores, the numbers need to be accurate and more detailed, as different formats of collections or methods of storage occupy space in different ways. A linear metre of newspapers is different to a linear metre of cassette tapes, and space efficiencies can be made (especially with low-use collections) by how they are organised, packaged or boxed. High-level figures are only indicative and will change as more detail emerges. Each collection format or type has been counted according to the way we plan to store it and access it. This can be on standard or bespoke shelving and cabinets or within general or specialised storage environments. Our calculation of growth rates anticipates trends and how the digital shift may mean fewer physical collections in the long term. At the same time, we have also experienced an influx of physical material as other organisations stop collecting their own physical material.

Our approach has been to look at each area of the collections and split growth predictions between 2030 and 2045. This has allowed us to estimate growth with more confidence and accuracy, and provide numbers to plan for each facility to accommodate these changing trends. Using newspapers as an example, our collection currently occupies 19,000 linear metres and grows at a rate of *circa* 450 linear metres a year (new publications and retrospective collecting). Due to its size, it cannot be accommodated at the Wellington site for much longer. We anticipate growth rates will remain steady until 2030 then decrease by up to two-thirds until 2045 as we shift to digital. We are therefore planning for 23,500 linear metres of newspapers by 2030 and 26,000 linear metres by 2045.

Newspapers were traditionally microfilmed; now they are digitised, these are one of the most accessed collections through the online Papers Past platform, but there is still the need to maintain the original

copies. Physically, they are large and often on unstable acidic paper, so our planning is taking into consideration our preservation and access plans for newspapers, the optimum storage environment and the most efficient systems for managing. We plan to store all newspapers in the Regional Repository in a general storage environment, which we anticipate will have passive temperature control providing stable and cool conditions. Together with boxing, this will provide the appropriate preservation environment. Newspapers are also large and awkward, and we have recently improved storage efficiency in part of the collection by 40% by designing shelving to fit *them* rather than just putting the newspapers on our standard shelving.

Archives New Zealand and Ngā Taonga Sound & Vision have been doing similar work and with similar high-level counts, although the collections differ both in format and organisation. These projects aim to meet our combined storage needs across all these formats, so we have been collaborating to combine our requirements wherever possible to avoid duplication, maximise efficiencies and achieve the most sustainable outcome. For this, we are considering shared locations and shared stores where possible. This also requires our collection management systems to work well together.

**Editors:** *Will the new facility have storage for a variety of collections/media and will that mean a variety of environments?*

**PW:** Yes. The facilities will accommodate all the variety of formats and collections from all three organisations. This will include traditional paper-based holdings of archives and manuscripts; books and bindings; maps and plans (rolled and flat); works of art and objects; film and photographic collections; and audiovisual collections from lacquer discs, vinyl, magnetic media tapes, video and digital carriers like optical discs. Those formats which are chemically unstable will require more specialist environments like cold or sub-zero stores. We are collaborating with colleagues from Archives New Zealand and Ngā Taonga to review different options based on our preservation requirements for each. We hope to simplify our combined requirements and maximise the potential for passive or low-energy systems. The projects will map out the locations to storage spaces with appropriate environments and with storage systems to accommodate specific collections. The programme is buying a box-making machine to assist with preparation work, as boxing and packaging solutions can provide a range of additional benefits, including buffering of environments.

## New facility plans

**Editors:** *The intertwining of building and storage planning with the collection-specific treatment is a particularly interesting aspect of your planning that would help our readers to understand the overall context and underline how you are proceeding holistically. Can you describe your team and the kind of preservation expertise involved, how treatment is organised on a regular basis— and are there any expected changes with the perspective of a new building?*

**PW:** The Collection Care team at the National Library sits within the Alexander Turnbull Library, which is home to our heritage collections. The Alexander Turnbull Library Collection Care team covers a broad range of collection-care activities, including collection-stores planning and management, collection logistics and the collection registrar, as well as the conservation team, with specialist roles in paper, books, photographs, sound, audiovisual materials and preventive conservation. Conservation technicians and library assistants within the team support the range of activities that include conservation treatments, loan and exhibition preparation, packaging projects, and support for the usual business activities and projects such as digitisation, acquisition, reading rooms, etc. Collection care starts when items come into the library and continues for the life of the item. We try to ensure appropriate conservation is in place to support access, use and ongoing storage.

Since January 2021, I have been on secondment to the Tāhuhu Programme team as a conservation and collection-care Subject Matter Expert, providing advice on requirements to the business, project and design teams. I'm working closely with other Subject Matter Experts from both Archives New Zealand and Ngā Taonga. The Tāhuhu Programme will see the Alexander Turnbull Library conservation team use co-located purpose-built facilities with the conservation team from Archives New Zealand in the new Archives building.

While the operational model is still to be confirmed, it will mean a significant change to the way we work. Team members from both organisations have been actively involved in planning the new facility, and it has been an opportunity to review the way we each work and to design new studios and laboratories based on the different types of work and specialist areas. The new conservation facilities will occupy a whole floor, with good natural daylight and functional areas to allow a full range of conservation activities to take place without one impacting the other. It includes dedicated areas for film and audiovisual conservation and digitisation;

specialist treatment areas for wet, dry or chemical treatments; and areas for preservation activities like boxing or exhibition preparation.

**Editors:** *As you work on a new facility, how are you developing the requirements and scope of the project? Is that done with experts within your organisation or does it also include outside experts?*

**PW:** The scope of the programme has evolved. For the National Library, it began as a project for a new off-site repository to replace the existing library out-store, which has reached its end of life. We joined with Archives New Zealand, who were planning a new Archives facility in Wellington and needed a regional store. With the land available next door to the library for the Archives New Zealand project and the opportunity for a heritage campus, the programme has further developed to where it is now. With the scope of the programme confirmed, the requirements for the projects could also be developed further, and the broader scope also gave further opportunities for collaboration, especially looking at how shared stores could be more sustainable.

The Tāhuhu Programme team is large and includes 42 permanent roles and draws on a pool of over 75 Subject Matter Experts from across the three organisations. It has contracted a range of consultants to assist with developing requirements and reviewing designs. Another 120 people are engaged with the programme governance structure and peer review, so there are many minds working together across all projects.

Each project includes collections stores, but all are very different. The high-level requirements focused initially on the space and access needs, but we are now looking in more detail at storage systems and environments. These are developed in workshops with Subject Matter Experts from the three organisations, including preservation, collection management, Māori specialists and curators, facilities teams, etc. We have drawn on a number of external experts contracted to advise, and we have reached out to the international community too for advice and inspiration.

By developing a Sustainability Policy and Framework we have given ourselves some tools to better incorporate sustainable design into the requirements. It has been essential to work closely with architects and engineers to finalise and test the viability of requirements as they move from concept through to developed design. For the combined collection-storage requirements, there are a lot of interdependencies so that working groups made up of multidisciplinary specialists, who can review collection risks, analyse or model environments, develop and review options. This is challenging,

as the projects have developed separately, so each had to adjust to accommodate a holistic approach.

**Editors:** *Can you tell us about your current storage of physical collections and how that compares to what you hope to have for your new storage facility? We are especially interested in understanding your ideas in terms of sustainability, optimal storage for collections and current technology.*

**PW:** Archives New Zealand, the National Library and Ngā Taonga have different storage arrangements and the collections have different histories, all of which are important as we design for the future.

The National Library building in Wellington was purpose-built for collection storage in the 1980s. A project in 2010 upgraded several of these storage areas to improve efficiency of the plant and space. Together with the out-store in Whanganui, there are 15 repository stores holding both the heritage collections and the general collections. The current stores have been designed to deliver specific environments, each with its own plant and operating within tight parameters for temperature and relative humidity. These include two cold stores running at 2 °C, 30% relative humidity, for photograph negatives and colour photography; ten cool stores that run at 13–15 °C, 45–50% relative humidity; and four stores with general environments of 18 °C and relative humidity less than 60%. While these are excellent storage conditions for improving life expectancy of collections, they do not offer a sustainable preservation strategy and have a heavy demand for energy.

The National Library is required to keep its heritage collections in perpetuity, but this can be an ambiguous preservation goal, especially where material is unstable or where other preservation strategies, such as digitisation, are a high priority. Our approach is to agree our preservation goals for the collections—for example, life expectancy—to understand the risks to specific collections, especially from broader ranges of temperature or humidity or seasonal setbacks, and design stores to deliver the optimum environment to manage the risks, rather than depending on energy-hungry systems.

Specialist storage environments are an important element for all sites, and we are undertaking a review on what the shared requirements are so we can optimise preservation, access and sustainability. The holdings of all three organisations include significant quantities of material that can be described as low stability, which means many are close to end of life. This includes roll and flat film on cellulose acetate and cellulose nitrate, colour photography and film, magnetic media, optical and digital formats, lacquer discs and acidic papers. For all this material, we are aiming

for a storage strategy that best matches our short- and long-term preservation objectives with the best and most sustainable collection environment. For example, magnetic media is unstable but will also soon be inaccessible due to obsolete playback equipment. Our preservation plan is to digitise this material in the next five years, and a project is already in flight to do this.

The storage objective is for a preservation environment that best preserves magnetic media for this time frame only, and facilitates efficient digitisation. Once digitised, the preservation storage environment is less critical, and even though we will want to retain the material, it may not require such specialist environments. All the low-stability collections will need a preservation plan, and we will be considering cold and sub-zero options. In each case, we are working closely with the design teams, especially engineers, to ensure we can achieve the most sustainable solution. Designers are using a range of tools to test and model building performance.

The advantage of a new build on a greenfield site for the Regional Shared Repository is that designers can select materials and systems to meet both a preservation and sustainability objective. The sustainability requirements are complex and can be impacted by a number of different elements. The programme's sustainability framework has identified some important benchmarks we should aim for, with each project agreeing on a strategy based on what is most appropriate and achievable. This is challenging work but, for me, perhaps the most interesting and exciting part of the project.

**Editors:** *Do you plan an IT [information technology] system in order to document the collections based on their physical condition, treatment events and the optimal storage conditions?*

**PW:** It has always been challenging to incorporate conservation and preservation documentation into the existing collection management IT systems, especially in the National Library where there are different systems for the published and unpublished collections. Not all preservation documentation can be managed this way, and we often need different systems while still maintaining some physical records.

The library's collection management system does include a conservation module, which can record condition, treatments and events such as exhibition and loans. It is used for logging conservation requests and monitoring workflows. This, together with the library's published collections catalogue, is being developed further to include more detailed collection location data, which will be critical for tracking and managing collection movements across multiple sites.

In February 2022, another of the Tāhuhu projects replaced the Archives New Zealand collection management system. The project has mapped over a billion data points from Archives New Zealand's four current systems into one new collection management system. The new system includes conservation and location modules. The programme will investigate how the various systems will best interface.

**Editors:** *How will the storage conditions be defined in relation to preservation needs of collections?*

**PW:** We are following an approach recommended in the current standards like ISO/TR 19815, BS 4971 and Chapter 24 of the 2019 *ASHRAE Handbook*. This will focus on management of storage environments for optimisation of preservation and sustainability, and to meet the ongoing access requirements for different collections. As mentioned above, the programme has also developed a sustainability policy and framework, which provides aspirational benchmarks to aim for, including carbon reduction.

New Zealand's documentary heritage collections mostly date from around 1840, and a significant proportion of them are on unstable media or formats that deteriorate quicker at room temperature than older paper-based collections. Even for general collections, we would aim for cooler and dryer conditions, and we will also have a requirement for cold and sub-zero stores, which increase life expectancy of unstable collections. These will be an important element for each site, but we aim to minimise the use of these stores wherever possible.

The local climates in New Zealand mean that it should be possible to use passive systems for controlling temperature, but with relative humidity above 80% all year round there will need to be dehumidification systems, so it won't be possible to eliminate HVAC [heating, ventilation and air-conditioning] systems.

Earlier approaches to setting environment requirements that are based on standard set points demanded 24/7 HVAC systems to maintain them. Our early request to the design team for the new shared repository was to investigate what can be achieved with passive control systems before looking to HVAC as the solution. For the existing library building, we are using tools like the Image Permanence Institute's Methodology for Implementing Sustainable Energy-Saving Strategies for Collections Environments. Although sustainability is a new driver, our goal is to provide an optimum preservation environment for the collections.

The specific environment requirements have not been agreed for all collections yet. This is to some extent dependent on how the general storage

environments will perform, and modelling done by the design team. With the buildings aiming for high thermal mass, insulation and low air exchange, we are hoping the general stores can be passively maintained to cool and dry conditions.

Our preservation strategy will differ across collections. The National Library has different retention policies for its collections. However, the Alexander Turnbull Library's mandate is to preserve all its collections in perpetuity. Our different preservation strategies for each collection or format may result in different short- and long-term storage requirements. For some, a special environment will preserve the collections until we can digitise; for others, a special environment will preserve the collections for centuries to come. For each project, we are working with a different design team. However, the approach will be the same: clarifying the needs of the collections stored at that location and working with the design team to establish the optimum environment.

**Editors:** *Are there plans to integrate the conservation goals and technical building management, for example, with alarm systems when climatic parameters in the building change and there is a need for preservation action, for example, to readjust storage conditions or relocate stocks?*

**PW:** Yes. Not only are the buildings being designed specifically to meet our preservation goals, but the systems will also be in place to monitor and report both the preservation environments and how well the buildings are performing energy-wise. This may be through the building management system or through independent monitoring systems. We do anticipate the collection-storage-environment requirements will change over time and we expect the local climates to change too, so the buildings should have some flexibility to accommodate this.

**Editors:** *How crucial is the creation of a quarantine space for the arrival of new items, or are you looking to build a disinfestation chamber?*

**PW:** The collection reception areas are crucial, especially when multiple businesses are bringing in collections from different sources. Items can sometimes be delivered in person by the donors but, on other occasions, delivered from agencies by the truckload. For this reason, a new collection reception area and dockway has been designed for the Wellington campus that separates the 'in' and 'out' collection moves from all other dockway functions. Activities that introduce risks or complicate the space— including facilities work, mail deliveries, contractor deliveries, rubbish storage and

removal, staff end-of-trip or catering deliveries— will all be restricted to a separate dockway.

The collection reception area is designed to be welcoming and culturally appropriate for receiving material. It comprises a dedicated dockway and suite of rooms and spaces to allow safe and efficient movement of collections. This includes reception areas, packaging and boxing rooms, an out-store for items awaiting transfer or loan, and the quarantine rooms where material can be assessed and, if necessary, decontaminated before moving further into the building. Risks of contamination vary; pest risks in New Zealand are low, so there is no need for a disinfestation chamber, although we do have access to freezers if required.

The Tāhuhu Programme is currently planning for a disaster-response centre in the new regional repository, which will include a vacuum freeze dryer and other equipment for recovering material damaged in a disaster. This would be available if we encountered large collections requiring disinfestation.

### Future of the National Library

**Editors:** *Finally, although this issue of IFLA Journal is focused on storage, we store our collections so they are available for use, and we would like to know about the plans for patron access to collections. Will the ability for on-site or off-site retrieval be a significant consideration for the new facilities?*

**PW:** Access is central to the Tāhuhu Programme and an important consideration for how we store our collections. There will be reading rooms and access points in the Wellington campus for people to access the holdings of all three institutions. The programme is still working through all the options for appropriate retrieving and access models. The principles for storage locations mentioned earlier ensure that high-use collections remain close to access points and collections stored off-site are either low use or available through other copies, both physical and digital.

Digitisation is now an important process that benefits both preservation and access. For many of the very fragile or unstable materials, digitisation, combined with specialised storage, provides the best option for both.

**Editors:** *What is the user experience you imagine for this next step in development of the National Library's facilities?*

**PW:** The Tāhuhu Programme is undertaking audience research, using the new heritage campus and our online platforms as an opportunity to improve overall user experience of services available across the National Library, Ngā Taonga and Archives

New Zealand. The research will investigate how we can better provide a connection with new audiences and create a deeper understanding of what access to our heritage collections means for New Zealanders.

### Theme: co-designing with iwi Māori

**Editors:** *New Zealand has an international reputation for its race relations and, in particular, the bicultural partnership with Māori people under the 1840 Treaty of Waitangi. How are the Tāhuhu Programme and the three organisations working with Māori in the design work across the new facility?*

**PW:** I'll pass this question directly to Hinerangi Himiona, archivist and Principal Māori Advisor on the Tāhuhu Programme, to answer.

**Hinerangi Himiona:** At the time of the signing of the Treaty of Waitangi (6 February 1840), the *iwi* ('tribes') living in the Wellington Harbour area originated from the Taranaki region of the North Island. The collective name given to these *iwi* is Taranaki Whānui ki Te Upoko o Te Ika (Taranaki Whānui). Their occupation at the time and continued residence attributes them the rights and duties of *mana whenua* ('traditional guardians') of the Wellington Harbour and associated lands.

The life and memories of the people of Taranaki Whānui still reside in the *whenua* ('land'). In 2006, the Crown acknowledged and issued an apology for their leading role in the forced relocation and subsequent dislocation of Taranaki Whānui from their home, Pipitea Pā (their traditional village). Pipitea Pā is the land upon which the National Library and imminent new purpose-built Archives New Zealand facility will stand for years to come. In looking forward to new and enlightened ways of working together with Māori, the New Zealand government, through the refurbishment of the National Library and the new Archives New Zealand building, have committed to working in close partnership with *mana whenua* to ensure that the memories, hopes and aspirations are expressed in the resulting design of the buildings, user and staff experience, and delivery of services.

The continued development and design of the future of Pipitea must reinstate, truly set ablaze, the *turangawaewae* [a place to stand] of Te Matehou, of Hamua, of Puketapu and Mangatuku. No longer shall they be an extinguished flame, a forgotten fire, but a continued intergenerational flame of existence that exercises and reinstates these great nations in Wellington city, protecting our landscape and environment through the revitalisation and expression of our rich cultural narrative of *ahikaa* [burning fires].



# Identification and storage of plastics in libraries and archives

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## Abstract

The safe storage and handling of plastic objects presents a pressing and often overlooked problem in many library and archival collections. Plastics are notoriously difficult to care for because they can deteriorate faster than other materials in archival collections. The so-called “malignant” plastics can also produce harmful degradation products that damage surrounding materials, including photographs and papers. Part of the issue is the myriad available tools for plastics identification, which can be both cumbersome and daunting. The other is that ideal storage environments for plastics recommended in the preservation literature are often difficult to achieve due to the accessibility needs and space constraints faced by many libraries and archives. This article introduces a current project at New York University Libraries that evaluates existing recommendations for the identification and housing of plastics, and provides guidelines for making scalable housing types that support user access.

## Keywords

Preservation, conservation, collection development, archival collections, special collections, rare books, graphic materials

## Introduction

The safe storage and handling of plastic objects presents a pressing and often overlooked problem in many library and archival collections. Plastic objects in the collections are diverse and plentiful, ranging from artworks to banners, artifacts, photograph albums, and architectural drawings and models, to name a few (Calmes, 1991; Quimby, 2013). Plastics are notoriously difficult to care for because they can deteriorate faster than other materials in archival collections. The so-called “malignant” plastics can also produce harmful degradation products that damage surrounding materials, including photographs and papers (Fenn and Williams, 2018; Williams, 2002). Protocols for the preservation of cellulose acetate (CA) and cellulose nitrate (CN) films and photographic negatives are well established, but the preservation of other types

of malignant plastics such as polyvinyl chloride (PVC), polyurethane (PUR), and rubber remains to be addressed. Part of the issue is the myriad available tools for plastics identification, which can be both cumbersome and daunting. The other is that ideal storage environments for plastics recommended in the preservation literature are often difficult to achieve due to the accessibility needs and space constraints faced by many libraries and archives. This article introduces a current project at New York University Libraries that evaluates existing recommendations for the identification and

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**Figure 1.** Item 092.2.0543 being used by a researcher.

housing of plastics, and provides guidelines for making scalable housing types that support user access.

### The plastics project

The plastics project at NYU Libraries' Barbara Goldsmith Preservation and Conservation Department is supported by the Kress Conservation Fellowship, which funded the hiring of a research fellow for a nine-month period to study plastic objects in the David Wojnarowicz Papers MSS 092. Our goal is to (1) conduct a collection condition survey; (2) evaluate published techniques and guidelines on plastics identification; (3) identify plastics using attenuated total reflectance Fourier-transform infrared spectrometry (ATR-FTIR);<sup>1</sup> and (4) create housing that supports user access.

The David Wojnarowicz Papers MSS 092 was selected for this project because the collection represents a broad range of issues facing plastic objects in libraries and archives. The multimedia artist and activist David Wojnarowicz used objects in the collection as props, models, and parts of installations. While this collection had been processed at an item level, most of the plastic items were housed in overcrowded boxes that impeded user access (Figure 1). This presented a major issue

**Table 1.** List of benign and malignant polymers that are frequently found in library and archival collections.

Polymer	Common name or abbreviation	Benign or malignant
Acrylic		Benign
Cellulose acetate	CA	Malignant
Cellulose nitrate	CN	Malignant
Polystyrene	PS	Benign
Acrylonitrile butadiene styrene	ABS	Benign
Polypropylene	PP	Benign
Polyethylene	PE	Benign
Polyethylene terephthalate	PETE, polyester, Mylar, Melinex	Benign
Polymethylmethacrylate	PMMA	Benign
Polycarbonate	PC	Benign
Polyvinyl acetate	PVA	Possibly malignant
Polyvinyl chloride	PVC	Malignant
Polyurethane	PUR	Malignant
Polyamide	PA, nylon	Benign
Rubber		Malignant

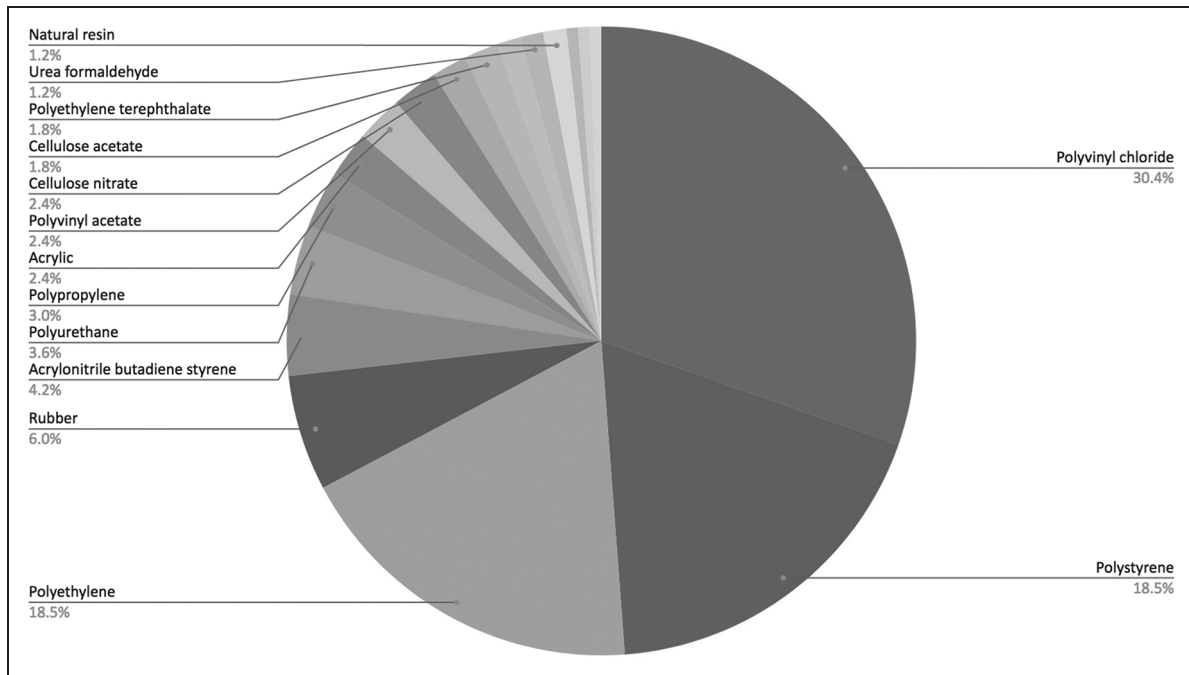
as these materials are frequently used for teaching, research, and exhibition. Plastics in this collection date from the 1960s–1990s, a broad span of time during which many plastic types were produced.

### Identification of plastics

The term “plastic” refers to a wide variety of polymeric materials that can be molded through heat and pressure. Each plastic type is based on a different polymer and can be further modified through additives such as plasticizers, stabilizers, colorants, and fillers, among others. Today, there are over 50 different types of basic plastic polymers and over 60,000 different plastic formulations (Shashoua, 2001: 1). The various polymers follow different degradation pathways, making the identification of plastic type of paramount importance in determining storage solutions. A list of the benign and malignant polymers that are frequently found in library and archival collections is presented in Table 1.

Plastics can be categorized through their optical or physical properties, such as appearance, hardness, density, odor, melting properties, solubility, or signs of visible degradation (Shashoua, 2008). Cross-referencing these characteristics with published tables and workflows—such as the Plastic Identification Tool questionnaire (Cultural Heritage Agency, n.d.) and Museum of Design in Plastics (2021) identification route map online—or with reference samples—





**Figure 2.** Breakdown of plastic types in the David Wojnarowicz Papers MSS 092.

such as the SamCo reference sample collection (Lagana and Keneghan, 2012) or the Plastics Group of America's (n.d.) ResinKit—can help narrow down the possibilities and is often a starting point for plastics identification.

However, this ambiguous and subjective process is full of practical pitfalls and often fails to achieve definitive identification (Coxon, 1991). Testing how a material melts, or whether it sinks or floats, simply cannot be done on collection materials. Identifying plastic types using smell, touch, and sound is a skill set that must be honed over time, using a broad range of reference samples, and includes downsides and limitations. Some plastic components, especially those released after combustion during a burn test, are hazardous to human health (Tsang, 2010), so odor tests cannot be recommended by the authors. Touch tests are nearly impossible to do while wearing gloves, which are recommended in handling plastics to avoid the risk of contact with certain harmful—and skin-permeable—plasticizers. As for using sound as an identification tool, it often seems to depend more on the shape of the object than its material properties.

Microchemical spot tests can also be useful for identification. This technique requires a small quantity of chemical reagents and a very small sample size (e.g. a cut sliver of < 1 mm or residue from scraping the object against a frosted microscope slide). A characteristic reaction will indicate the presence of a specific material. Fortunately, there are microchemical spot tests to identify each of the malignant plastics,

including the diphenylamine test for CN, Molisch's test for CA, the Beilstein test for PVC, the dimethyl amino benzaldehyde test for PUR, and the lead acetate test for sulfurous rubber (Odegaard et al., 2007; Remillard, 2007). The benefit of this type of testing is that the reagents are low-cost and the tests are relatively easy to carry out. However, it requires sampling, an appropriate laboratory space for testing, and staff trained in laboratory safety and protocols.

For more definitive identification of all plastic types, instrumental analysis via FTIR is the most effective method. FTIR can be used to identify additives in addition to the basic polymer, and can be carried out on-site with portable spectrometers, making it a very powerful identification tool (Shashoua, 2008). When coupled with an ATR accessory, it can dramatically reduce the need for sampling. For collecting institutions that house large quantities of plastics, access to FTIR analysis is the most accurate and efficient method of identification.

For this project, an initial condition survey was conducted on the 138 plastic objects. After experimenting with various identification methods, all of the plastic objects were identified using ATR-FTIR and then separated into two categories: benign and malignant. The survey data revealed that over half of the collection contained malignant plastics, and a third of the collection specifically contained PVC components (Figure 2). Once the plastics had been identified, storage strategies could be devised.



**Figure 3.** The rectangle highlights plasticizer stuck to the packing tissue.

### Storage

Plastics are traditionally stored in similar environments to organic materials, with relative humidity levels of 55%, the temperature at 18 °C, light levels limited to 50–300 lux, and adequate ventilation. However, this recommendation does not hold true for all plastic types, and a re-evaluation of commonly accepted materials and methods for housing is necessary for proper care of plastics. Wrapping in buffered tissue, for example, may actually accelerate the degradation of several common plastics (Fenn and Williams, 2018). Tissue and cloth are inappropriate because plasticized objects may become sticky (Figure 3), so storage with silicone paper or polytetrafluoroethylene (Teflon) sheet is recommended instead. Plastics should be stored separately from cellulosic and metallic items, which can be damaged by off-gassing plastics (Social History Curators Group, 2009). While these recommendations are a starting point, there are no internationally accepted guidelines for *all* plastics, since polymers and degradation pathways vary. For example, some plastics benefit from low relative humidity while others benefit from high relative humidity (Shashoua, 2008).

It is also important to understand the scope of the collection and its intended use before embarking on a storage plan. The David Wojnarowicz Papers alone, for example, includes over 100 plastic-containing

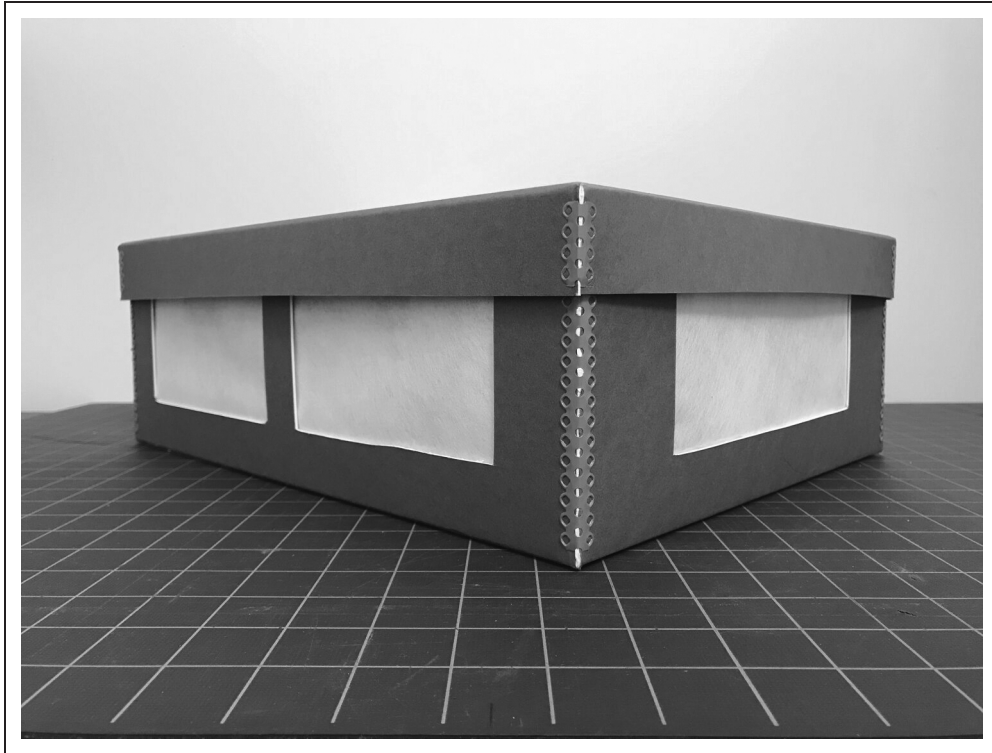
objects that are handled regularly by users, so housing needed to be scalable, reproducible, and easy to handle. For this project, the benign plastics will be rehoused together in standard archival boxes. These items will be partitioned from each other and padded with walls of rolled archival tissue covered in a sheet of silicone-coated polyester (also known as silicone-release Mylar or Melinex). The malignant plastics were pulled for priority rehousing. They will be housed according to polymer type and polymer-specific requirements and recommendations.

### CN and CA

As CN and CA degrade, they emit acidic compounds that can harm surrounding materials. Variants in existing protocols for the preservation of CA and CN include cold storage to slow down degradation; adsorbents to adsorb acidic compounds; and vented storage to release gases (Shashoua et al., 2014; Williams, 1994). Cold storage remains impractical for collections that are handled regularly, and adsorbents require frequent maintenance and replacement, so vented storage was chosen as the most appropriate method for this collection. We selected acid-free boxes—the same as those used for other collection materials—and modified them for increased airflow by cutting windows into the sides and covering them with nonwoven polyester spunbonded fabric (Reemay; Figure 4).

### PVC

Sometimes, the most appropriate storage solutions are counterintuitive, as in the case for PVC, which makes up one-third of the plastics in the collection. Traditional storage materials and methods can be very detrimental to PVC. Highly adsorbent polyethylene bags and vented environments can both accelerate plasticizer loss, the main mechanism by which PVC degrades. Plasticizers make up 15%–50% of the total weight of a PVC object (Shashoua, 2001: 13) and their loss can result in a brittle plastic body, a tacky surface, discoloration, and the onset of dehydrochlorination—another mode of PVC deterioration (Coughlin et al., 2019). Instead, it is recommended to store PVC objects in sealed, non-adsorbent containers, such as glass containers or polyester envelopes (Shashoua, 2001, 2003, 2008). For this project, we chose to use a biaxially oriented film made of polyester—specifically, polyethylene terephthalate (which is commercially available as Mylar and silicone-release Mylar). We selected this material because it does not adsorb plasticizers and is able to provide a non-vented environment due to its low vapor and gas permeability. It



**Figure 4.** Vented box for CN and CA objects.



**Figure 5.** An encapsulated PVC object.

is a chemically inert and dimensionally stable material that has passed the Photographic Activity Test ISO 18916:2007 (International Organization for Standardization, 2007), indicating its safety for use with photographs and, by extension, a broad range of collection materials. Lastly, polyester film is also affordable, readily available, and easy to seal.

The PVC objects in the David Wojnarowicz Papers were encapsulated in polyester envelopes with an

interior sleeve of silicone-coated polyester (Figure 5). The exterior envelopes were created using 3 mm thick polyester sheets, which were sealed on three edges with a Monarch Plus Polyester Sealing Machine; the fourth edge was to be sealed after the object was placed inside. To prevent plasticizer sticking, interior sleeves were created from folded silicone-coated polyester. The PVC objects were placed into the silicone-release sleeves, the object tags were placed

between the sleeves and the exterior envelopes, and the packets were sealed shut. Because the polyester is transparent, the objects can be seen and handled within their packets. The packets were designed with extra length so that, if necessary, they can be cut open and then resealed. The flat design, along with the standardized sizes of the polyester sleeves, resulted in an efficient and easily reproducible housing model that could be applied to collections with a large quantity of PVC objects.

### PUR and rubbers

The final steps of this project are to determine storage strategies for the remaining problematic plastics: PUR and natural and synthetic rubbers.<sup>2</sup> Oxidation is a major concern for both plastic types (Hatchfield, 2002; Lovett and Eastop, 2004; Van Oosten, 2011), so they will be housed in anoxic storage created out of oxygen-barrier (Escal) film and (Ageless) oxygen scavengers.

### Conclusion

The identification of plastic types remains a hurdle for many libraries and archives, as the most efficient and accurate method (ATR-FTIR) is costly and requires a high degree of operator expertise. Published characteristics and workflows can help narrow down the most probable options, and microchemical spot tests can help identify problematic plastics for specific priority rehousing.

The storage solutions devised through this project are specifically designed to support the needs of high-use collections in academic research libraries. While many objects within the David Wojnarowicz Papers have been digitized, access to the physical object is sometimes irreplaceable for use in teaching and research. Our work thus far has shown that it is possible to produce scalable and cost-effective enclosures that are appropriate for different plastic types.

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### Notes

1. The ATR-FTIR analysis was conducted using a Thermo Scientific Nicolet iS5 FTIR Spectrometer.
2. We will be posting updates on our project through our Instagram account: nyupreservation.

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# Curation of manuscripts in the tropical savanna climate of north-eastern India

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## Abstract

The tropical savanna climate of north-eastern India has special features due to the region's alternative weather and geographical location. There are more than 50,000 rare manuscripts stored in different manuscript preservation centres in this region. The National Mission for Manuscripts has taken many initiatives to preserve these manuscripts, including digitization. However, no significant changes related to the physical condition of the manuscripts have been observed. Most of the manuscripts are deteriorating naturally due to improper care. The process of the deterioration of manuscripts due to the effects of the environment, weather and climate can be minimized by taking appropriate measures. This article discusses the status of the physical condition of the manuscripts in this region along with the effects of climate and weather. It also discusses the need for special care of the manuscripts in this geographical location with simple preventive measures or techniques.

## Keywords

Manuscript, curation, tropical savanna climate, climate, weather, north-eastern India

## Introduction

India has had a rich tradition of preserving sustainable knowledge through oral and written means since ancient times. The north-eastern part of India has among the highest diversity of cultures and traditions in the country, with more than 40 different indigenous groups of people each with their own languages and art, as well as cultures and unique living styles. There are also huge numbers of manuscripts that have been written by these groups in different languages at different times. A good number of unique and valuable manuscripts from this north-eastern part of India relating, for example, to art and culture, astronomy, the Mahabharata, the Puranas, the Vadas, yoga and medicine are available for research and reference purposes.

However, these rich manuscripts are gradually deteriorating physically due to improper care and the effects of the environment, weather and climate. The major parts of north-eastern India fall under the monsoon climate zone and tropical savanna climate zone. This climate causes the physical deterioration of manuscripts throughout the year, but the process of

the deterioration of the manuscripts can be minimized with appropriate precautions and proper care. There are many types of appropriate precautions and proper care. They can be divided into two main categories: preventive measures and interventionist measures. Preventive measures include environmental control, care and handling, storage, pest management and disaster readiness, whereas interventionist measures include conservation treatment and the stabilization of damaged books and archives. Since preventive measures depend directly on the environment, weather and climate conditions, it is essential to understand the weather and climate of the particular place where manuscripts are kept for preservation. The preventive measures for such manuscripts can be made more effective by taking proper care on the basis of the climate and weather conditions.

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Against this backdrop, this article discusses the physical effects of weather and climate on the manuscripts and what kinds of preventive measures can be brought under consideration to preserve these manuscripts, particularly in the tropical savanna climate regions of the north-eastern part of India. The article also highlights the need for special care of the manuscripts in this geographical location with simple preventive techniques. This will help us to determine the prospects of preventive preservation in such geographical areas and preserve our glorious cultural heritage for future generations.

## Methodology

In order to discover the effects of weather and climate in the tropical savanna climate zone of north-eastern India, the respective places in the climate zone were visited personally from January 2019 to February 2020. The primary data was collected during the personal visits by recording observations on a self-designed questionnaire and then seeking conclusions by comparing the results with secondary sources of information collected from the available literature, such as books, reports, journals and websites. Based on the current status of the manuscripts and the review of the available literature, recommendations and suggestions are proposed, which will help to provide a clear picture of the issues and challenges faced by the professionals in this location.

## Literature review

### *Weather and climate conditions in north-eastern India*

The north-eastern part of India, which is also known for some of the largest panhandles of land in the world, comprises eight states. This region is basically an extension of the north-eastern Himalayas, having an altitude (high-peak) range from 244 m to 8586 m and featuring mostly hills and valleys. Its total area is 262,230 km<sup>2</sup>. According to the Köppen climate classification, the north-eastern part of India consists of four main climate zones: the oceanic subpolar climate, humid subtropical climate, monsoon climate and tropical savanna climate. The wide range of altitudes and different patterns of climate zones make it difficult to predict the weather in this region throughout the year.

There have been a number of studies related to climate change and its effects on agriculture or the economic structure of a country (e.g. Mendelsohn and Dinar, 1999; Mendelsohn et al., 2006). While addressing agriculture or economic conditions, factors such as floods, humidity, rain and temperature are also

discussed in these studies. Huq et al. (2004) discuss the mainstream adaptation to climate change in developed countries. However, the effect of the climate on manuscripts cannot be observed from a review of the literature.

The north-eastern part of India has a huge collection of manuscripts written by more than 40 different indigenous groups. According to a report by the National Mission for Manuscripts, this zone has more than 50,000 manuscripts in four states (Lund, 2019; Sahoo and Mohanty, 2015). These collected manuscripts are usually stored in the manuscript research centres in Assam, Manipur, Mizoram and Tripura. However, more than 75% of the total manuscripts of north-eastern India are stored in a tropical savanna climate zone – mainly the two states of Tripura and Manipur, but also some parts of Assam and Mizoram. Although the tropical savanna climate is one of the major climate zones in India, due to the high altitude differences and geographical location of the north-eastern region, it is quite different from the rest of the country. It is one of the rainiest regions in the country, with an annual precipitation of 2000 mm. The temperature varies at different altitudes and is also influenced by the proximity of the sea, ranging from 28 °C to 38 °C. The climate of this region varies according to the season and has both wet and dry seasons. Winter, summer and the rainy season are the three main seasons in this area that belong to the tropical savanna climate. Floods, landslides, high humidity, high temperatures and dusty weather are very common natural phenomena.

### *Preservation and conservation processes in north-eastern India*

Several studies regarding the status of manuscripts and best practices have been conducted at different times with different parameters. For this article, some significant studies in the field that focus on different aspects of manuscripts related to the objective of the study have been thoroughly reviewed. Before the 21st century, manuscripts in India were mostly being preserved and conserved in traditional ways. India has a huge number of manuscripts that are stored in research institutes, archives, museums, private collections, collections under trust, religious institutions and libraries. Most of the manuscripts are very unique and rare (Majumdar, 2005). Since the manuscripts are spread throughout the country, it is impossible to give proper attention to all the manuscript preservation centres equally. Thus, thousands of manuscripts lie neglected around the country. Tremendous pools of knowledge are under threat and are disappearing at an

alarming rate. In 2003, the National Mission for Manuscripts was established by the Department of Culture, Ministry of Tourism and Culture, Government of India to save this heritage of knowledge. In this respect, the necessary infrastructures, resources and trained personnel have been deployed to take proper care of the manuscript collections either under the National Mission for Manuscripts or independently. With the passage of time, the digitization of manuscripts has become the main activity of the National Mission for Manuscripts in India (Saikia and Kalita, 2011). From previous studies, it is clear that the National Mission for Manuscripts has digitized a large number of manuscripts. In his study, Mazumdar (2009) describes the manuscript collection in Assam and highlights the status of digital preservation in Assam with reference to the Krishna Kanta Handique Central Library at Gauhati University. From the 15th annual report of the National Mission for Manuscripts, it is observed that emphasis has been placed on the digitization of manuscripts in most of the northern and central parts of India. Sahoo and Mohanty (2015) highlight the status of the digitization of manuscripts throughout India by state. There is no doubt that the digitization of manuscripts is the need of the hour. If we fail to preserve the original manuscripts themselves, we will fail to safeguard a rich heritage for our future generations.

It is estimated that India possesses more than five million manuscripts. Sarma (2007) discusses the various kinds of materials that were widely used in India, including the north-eastern part of India. Before the development of writing paper, manuscripts were mostly written on the long and sturdy leaves of the palm tree, tree bark, banana leaves or pieces of wood. Devi (2008) describes the importance of the preservation of the Manipur manuscripts and emphasizes their proper care for future reference. Gaur and Chakraborty (2009) assert that the history of Indian culture lies in these manuscripts, which have great research value and represent basic historical evidence. However, due to the lack of adequate human resources and funds, the physical condition of these rare and unique manuscripts is deteriorating at an alarming rate.

#### *Effects of the climate on manuscripts in north-eastern India*

Since most of the manuscripts are kept in a tropical savanna climate, it is necessary to find out the effects of this climate on the manuscripts. Although the tropical savanna climate is one of the major climate zones in India, the differences in altitude and its geographical location make the north-eastern area different from the rest of India. Thus, it is essential to take

extra care with the preservation and conservation of the manuscripts in this region (Devi, 2008; Londhe et al., 2011). The major characteristics of the tropical savanna climate zone in north-eastern India which might affect manuscripts are as follows:

1. In the tropical savanna climate zone, high rainfall is one of the main problems for the preservation of manuscripts. There is always the fear of floods. Moreover, due to the heavy rain in the monsoon season, fungi grow on paper and materials made of leather. Most manuscripts are disappearing due to problems related to the heavy rainfall.
2. Moisture or humidity is another major problem in this area. This region witnesses high humidity levels (85% or above on average) and so the growth of organisms such as mould or fungi is very common. High humidity influences the growth of fungi on materials made of cloth and leather (Mazumdar, 2009).
3. The north-eastern region is very close to the Tropic of Cancer and thus usually experiences high temperatures – between 10 °C and 25 °C in winter, and 28 °C and 38 °C in summer. High temperatures cause the deterioration of manuscripts mainly during the summer season, leading to fading, the weakening of leather, discoloration and the yellowing of paper.
4. This region suffers from the further effects of drought during the winter season. Consequently, there is an increase in dust particles during such periods. These dust particles are another cause of the deterioration of the manuscripts. Since dust particles also attract moisture and act as a catalyst by increasing chemical reactions, they contribute in destroying the material of manuscripts.

#### **Current status of manuscripts**

The manuscript research centres at the Manipur State Archives, Manipur University, and Tripura University, and other manuscript preservation centres at Gurucharan College (GC College), Assam, and Maharaja Bir Bikram College (MBB College), Tripura, were visited personally in order to obtain a clear picture of the status of the manuscripts. These four preservation centres are located in the tropical savanna climate zone of north-eastern India. The current status of the manuscripts in this area is discussed below.

It was found that Manipur State Archives and the archives at Tripura University preserve various types of materials in their archives (Table 1). Among these



**Table 1.** Types of materials present in the archive centres.

	Palm leaves	Tree bark	Wood	Bamboo	Metal	Paper	Animal skins
GC College	✓	x	x	x	x	✓	x
Manipur State Archives	✓	x	✓	✓	✓	✓	✓
Tripura University	✓	✓	✓	✓	✓	✓	x
MBB College	✓	x	x	x	x	✓	x

**Table 2.** Condition of materials at the archive centres.

Type	Condition	Remark
Palm leaves	Not good	Dusty and not properly maintained
Tree bark	Not good	Some are damaged due to fungi attacks
Wood	Good	No recent damage observed, but need to be kept in a safe place as most are kept on the floor at Manipur State Archives and Tripura University
Bamboo	Not good	Improve shelving, getting discoloured
Metal	Good	No recent damage observed, but need to be kept in a safe place as most are kept on the floor at Manipur State Archives and Tripura University
Paper	Not good	Becoming faded and discoloured; no proper pest control
Animal skins	Not good	Becoming damaged due to fungi growth

materials, palm leaves, wood, bamboo, light metal, paper and animal skins are preserved most frequently. The other archive centres at GC College and MBB College preserve materials mostly made from palm leaves and paper.

Further investigations were made to establish the physical condition of the various kinds of manuscripts at these centres (Table 2). It was found that most of the materials are not in a good condition. The manuscripts made from palm leaves, wood, bamboo, etc. are basically stored by merely wrapping them in a red piece of cloth and placing them on open shelves. In the Tripura University archives, palm leaves and tree bark are stored in a dusty environment and no proper maintenance is observed.

Most of the ancient and rare manuscripts are becoming damaged due to insect and mould attacks. The condition of other manuscripts made from bamboo and paper is also poor. The paper materials are becoming discoloured, yellowing or fading. Most of the pages of the rare paper manuscripts are also being eaten by insects. The materials made from wood or metal are in a comparatively good state. Most of these manuscripts are kept on the floor at the Manipur State Archives and the archives at Tripura University. It was also observed that manuscripts made from animal skins are kept in the collection (but they are few in number). The condition of such materials is also not very good as they are becoming damaged due to the growth of fungi or mould. Irregular maintenance is the main cause of this. Moreover, it was observed that no proper cleaning is

carried out in these archives. The manuscripts preserved at GC College and MBB College are the worst when compared with the two other manuscript research centres.

The infrastructure of an organization plays a very important role in the preservation and conservation of manuscripts. The manuscript preservation centres are lacking modern physical facilities and infrastructures. There are no air-conditioning systems at these storage places and it seems that no proper care has been taken to preserve the heritage items artificially (details are shown in Table 3). Even when present, the ventilation systems are not up to the mark in any of the four main centres. There is a need to repair windows and install proper ventilation and lighting systems. It seems that fans and LED or tube lights are used in all of the centres most of the time, which shortens the life of manuscripts. The tropical savanna climate of north-eastern India also brings with it a lot of challenges for the manuscripts due to its changeability. It is therefore necessary to pay more attention to the preservation of manuscripts in such a climate.

Trained archivists are essential to ensure that preservation efforts are effective. However, it was found that there was only one trained archivist at the Manipur State Archives and archives at Tripura University, and no trained personnel at GC College or MBB College (see Table 4). Since the collections of the Manipur State Archives are scattered in different locations, more trained personnel are needed. It was also found that each year trained professionals are

**Table 3.** Infrastructure and facilities at the archive centres.

	<b>Air conditioning</b>	<b>Fans</b>	<b>Heaters</b>	<b>Windows with sun protection</b>	<b>Low-beam lights</b>	<b>Humidity control</b>
GC College	x	✓	x	x	x	x
Manipur State Archives	x	✓	x	x	✓	x
Tripura University	x	✓	x	x	✓	x
MBB College	x	✓	x	x	x	x

**Table 4.** Status of human resources at the archive centres.

	<b>Trained archivists</b>	<b>Other personnel (related to the archive centre)</b>
GC College	0	2
Manipur State Archives	1	4
Tripura University	1	3
MBB College	0	2

brought in from outside the institutions for the preservation of documents.

### Recommendations and suggestions

Although the National Mission for Manuscripts has introduced various initiatives to preserve manuscripts, there is a need to protect these manuscripts in other ways, particularly when dealing with the tropical savanna climate zone of north-eastern India. Many things can be done to protect manuscripts and slow down the deterioration process by taking proper care and using simple technology.

#### Light

The tropical savanna climate zone of north-eastern India lies very close to the Tropic of Cancer and there is thus the impact of direct sunlight and always an increase in temperature during the day (Sahoo and Mohanty, 2015), and changing climate conditions. Extra care is therefore essential. The best and most simple way to protect the manuscripts is to develop special windows with ultraviolet-light protection at the storage facilities. Another precautionary measure would be the development of closed cartons to protect rare materials and avoid exposure to direct or indirect sunlight or other kinds of (artificial) light sources. This will decrease any kind of thermal chemical reactions in the materials of the manuscripts.

#### Temperature and relative humidity

Organic matter gains and loses water with increases and decreases in relative humidity (Adcock, 1986). The tropical savanna climate zone of north-eastern India is a high humidity zone with an average humidity of 85% (ranging from 70% to 97%) throughout the year. The best way is to develop a special chamber (an area the size of a large room) which can solve the problem of moisture and temperature control. This special chamber must be fitted with a temperature and humidity control system. However, the development of such a chamber for manuscripts would be a costly task. Adequate funding from the government is therefore essential to develop such a chamber. The government must take the necessary steps. In humid parts of the world, where the relative humidity does not fall below 65% throughout the year, institutions are air-conditioned day and night all year round at great cost (Adcock, 1986). A simple and cost-effective method would be the use of heaters and fans in such rooms, which would control the humidity and could be a simple solution if there are financial constraints (Devi, 2008). Although this system may not be an effective solution, it may serve as a precautionary measure in places where there are fewer manuscripts (such as GC College and MBB College).

#### Pest control

High humidity also influences the growth of fungi on materials made of cloth and leather (Mazumdar, 2009). Manuscripts can be preserved by making a container, which might be the size of a large box, where 10 to 40 manuscripts, depending on their type and size, can be stored. The box must be developed in such a way that the moisture levels can be controlled, with a range between 50% and 55%, along with the temperature (Williams, 2006). This will reduce the deterioration process of the manuscripts. Another simple technique would be to wrap the manuscripts in a plastic-material and create a vacuum so that no microorganisms can grow on the manuscripts (Huq

et al., 2004). Manuscripts made from animal skin must be kept at a lower humidity so that fungal growth can be stopped. Further, they must be kept away from water.

### Storage

The tropical savanna climate zone of north-eastern India experiences problems with dust during the winter. For day-to-day housekeeping operations, the manuscripts should be properly covered with cloths or other materials so that dust particles do not cause any kind of damage to the manuscripts.

### Cleaning

Manuscripts must be cleaned with a soft brush (Mendelsohn et al., 2006). It is also preferable to use a vacuum cleaner specifically designed for this purpose and for large-scale cleaning projects at manuscript centres.

### Digitization

Humans are also considered to be enemies of manuscripts. They generally use these items for knowledge or research purposes, but, with use, the manuscripts' longevity may decrease unless they are handled with due care. The digitization of manuscripts is one of the best solutions to spare them from the human touch.

### Trained personnel

Trained and adequate human resources are essential for taking proper care of manuscripts. Staff members should be given proper training so that they are able to handle manuscripts with due care.

### Conclusion

There is an urgent need to improve the condition of the manuscripts in the manuscript research centres in north-eastern India. Proper care must be taken to save these heritage materials. Although digitization processes are proceeding as part of the project of the National Mission for Manuscripts, the preservation of manuscripts against natural deterioration is equally important. The preservation techniques that are discussed in this article may be implemented in practice to bring changes to save our rich heritage. Thus, in order to establish the rate of deterioration of manuscripts in different climate conditions, a separate study could be conducted to give a clear picture and measure the process of deterioration. The preservation of manuscripts are affected due to less trained personnel in this location. The development of large

storage chambers or small box-sized chambers may be a solution to overcome the problems of moisture and temperature control. Moreover, changes are needed in the national manuscript preservation policy of India, taking into consideration the climate conditions of a particular location. If the recommendations and suggestions detailed in this article are implemented, many of the problems of the preservation of manuscripts may be solved, especially in the tropical savanna climate zone of north-eastern India.

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# Preservation storage in a flood damage mitigation effort at the National Library of France

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## Abstract

During a flood alert, the decision to evacuate a threatened collection of a library is an important one. If not thought out carefully, a hastily executed move can expose valuable collections to unforeseen threats. Although floods are usually slow to develop in Paris, the decision to make a preventive evacuation must be taken at the appropriate moment, considering the time needed for the relocation, the reality of the threat and the need for service continuity. In the context of its flood protection plan, the National Library of France has conceived a box model that contributes to saving time in case of a flood and prevents damage during an evacuation. Combining accessibility to documents with security requirements, this model can be implemented in different contexts.

## Keywords

Preservation, conservation, collection development, cultural heritage management, principles of library and information science, special collections, rare books

## Introduction

The increasing number and intensity of natural disasters, likely related to climate change, is affecting countries all over the world. In 2016 and 2018, severe floods affected the city of Paris in France, where the river rose to a level that occurs every 20 years. The National Library of France has established the vulnerability of its Plan de protection contre les inondations (PPCI) for each site, as requested by the Plan de Prévention des risques d'inondation (PPRI) of Paris for public service organizations situated on the floodplain.

The Arsenal Library, one of the National Library's Parisian sites, is situated next to the former island Louviers, close to the banks of the river Seine. Since its origin, the library has been located in the Hôtel du Grand Maître de l'Artillerie, a historic building dating from the 17th century. The core of the collection encompasses the personal library of the Marquis de Paulmy (approximately 80,000 items when he died in 1788), which was considerably extended during the Revolution when the library

became national and public. The sumptuous interiors of the apartments from the 17th and 18th centuries are partly classified as a historic monument. In the 1960s, the basement was the only place where a repository could be accommodated. Three linear kilometres of precious documents are still kept in this repository. According to the Plan for Flood Risk Prevention, this repository could be prone to flooding from the river overflowing or rising groundwater tables. Although the basement has no specific protection, there is no record of a flood in 1982 when the water level reached 33.5 metres above the Ordnance Datum Newlyn.

Due to its imbricated history with the building, the collection has to be kept on-site. A solution has been

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found to facilitate its relocation and preserve it from flooding.

## Background

The collection of printed heritage kept in the basement of the Arsenal site is at the core of this library, together with the manuscripts and rare book collections kept in the upper levels of the building. The printed heritage collection represents almost half of the books that are consulted daily at the Arsenal Library.

Managing this collection poses two significant challenges: housing its 7 linear kilometres while at the same time fully respecting its coherence and avoiding its splitting. Two repositories have been fitted out to house it, one on the ground floor and the other in the basement, and they are connected by an internal staircase. Mobile shelving increased the capacity of storage up to 3.5 linear kilometres per floor. To optimize the space, intermediate shelves have been placed according to the four sizes of documents. As a consequence of densification in a narrow space, the width of the aisles is quite narrow, creating more challenging conditions for the evacuation of threatened collections.

A flood protection plan should demonstrate to the administrative authorities the achievement of a diagnosis of vulnerability and the development of an action plan. Such a plan presents a description of the organization and the means, which after various studies and adjustments have demonstrated their practical effectiveness.

The propagation of the flood wave in Paris is considered to be slow. The average 10-day flood lead time (the time between the announcement of a flood and its arrival) is used to complete preparations and check the position of equipment and the availability of staff or external companies. Even though flood rates vary, it has been established that a major flood in Paris is foreseeable 3 days in advance, giving 72 hours to remove collections from areas that are at risk. One of the important side effects of a flood in Paris is a power shortage. This risk is already well mapped and it has been clearly established that the district where the Arsenal Library is located is prone to power shortages. This would affect fundamental security and safety functions in the library before the water reached the basement. As a consequence, the transfer of the collections should be completed prior to a degradation of operational conditions due to a possible power shortage. Furthermore, streets may not be passable because they are either flooded or have been requisitioned by the local authorities.

In a complex situation fraught with many uncertainties and obstacles, the evacuation plan has been based on self-organization, giving preference to the relocation of the collections in the upper storeys of the building. The 3.5 linear kilometres of collections in the basement should be moved in 72 hours under the most suitable conditions for the documents. The feasibility of this scenario has been strengthened by the installation of a water sensor in the basement of the building and a power generator.

## Results

The decision to evacuate a threatened collection of 3.5 linear kilometres of books is an important one. If not thought through carefully, a hasty evacuation could expose valuable collections to unforeseen threats. Looking for a long-term solution, the challenge was to accommodate security requirements and the need for accessibility to the collections. The boxing up of the collections was intended to facilitate their evacuation and prevent damage during the multiple operations of extraction, relocation and return of the collections to their original location. It was conceived to facilitate intermediate storage in remote locations for several weeks.

The repository in the basement is conventional for a library, where the holdings, mainly comprising standard-format books (quartos and octavos), are kept on shelves that are 1 metre in length. The homogeneity of the materials allowed for the idea of gathering the documents in large units. These units are large four-sided boxes. In order to reduce the weight of the boxes and facilitate handling during an evacuation, the content of each shelf has been distributed between two boxes.

The homogeneity of formats is only relative, and differences of height had to be considered to avoid a complete readjustment of the position of the shelves. Accommodating this situation and financial matters, four sizes of boxes have been designed. Foldable crates have been considered more convenient for oversized or heavy items. These are stored on-site and would be filled up during the alert phase.

The boxes are made of cardboard in compliance with the French standard NF Z40-014 (Association Française de Normalisation, 2005), which specifies the requirements for boxes and file covers, made of cellulosic material, to be used for the long-term storage of documents on paper or parchment: a pH between 6 and 9.5; a target kappa number below 5; an alkaline reserve of 2% weight by weight; and paper and board should be subjected to a series of tests of

migration, with no resulting fluorescence on the wathman paper or any transfer of colour.

The board selected is a solid board with a thickness of 13 millimetres. Its density is higher than 7. The construction of the boxes is done by riveting. The number of rivets is calculated to strengthen the boxes. The rivets have been placed on the outer face of the boxes to avoid any risk of abrasion when documents are fetched for readers. It was important to achieve the best conditions for accessibility. To avoid any additional manipulation for the staff when fetching books, the front faces of the boxes are left open. During evacuation, the boxes would be turned face up so that the books are oriented with their front edges towards the bottom of the box. Lids would be put on the boxes during the evacuation phase. The lids are made of extruded polypropylene of 550 grammes per square metre. They provide rigidity and solidity for the boxes, permitting them to be stacked during temporary storage in a remote location. The lids are kept on-site so that they are immediately available.

The traceability of collections is crucial in an evacuation phase in order to identify any possible losses and, after the crisis, to enable a rapid return of the collections to their initial location. For this purpose, all of the boxes have been labelled with an identification number. A call number is inappropriate for use in an emergency situation. Instead, the identification number of a box is a combination of characters relating to the location of the box in the repository. This number combines the size of the item, the name of the fonds, the number of the row of stacks and the number of the intermediate shelf. The identification numbers of the boxes are part of an overall system that combines the layout of the repository, mapping the holdings in their original place, and a list of the shelf numbers.

These types of boxes and the traceability method are combined in a system that works as a whole. The system is intended to permit an evacuation of the holdings in no particular order. It allows for the arrangement of the collections in remote locations according to the physical constraints of the room. Their return to their original place is facilitated, with no possibility for error. As a result, the task of relocation could be given to an outside company under the supervision of librarians. This system allows for any possible rearrangement of the repository in the future.

## Discussion

The installation of this new system has been a long process and involved a lot of logistics. To put the

4953 boxes in place, 2402 linear metres of printed books and 2890 shelves have been moved. It required adjustments on the ground and took several months for the local team to install 892 boxes for 430 linear metres of collections. This was carried out in addition to their regular duties. When faced with this huge task, it was decided to hire a specialized moving company. Four full-time employees were dedicated to rehousing the collections in the boxes over the course of a month. However, the supervision by library staff and the updating of the signage was still time-consuming.

Despite every effort to have the boxes fit the different heights of the documents, adjustments were needed, resulting in a loss of space. In the end, three rows of stacks have been lost due to the thickness of the boxes, where the documents were already arranged tightly.

Although the basement was not threatened during the 2016 and 2018 floods, we took the opportunity to test the system and two evacuation scenarios, involving either the library staff or a moving company. The conclusion was that the evacuation of the two lowest shelves requires a full day. Extrapolating, we deduced that the repository could be moved out entirely in a maximum of five working days. This amount of time could reasonably be reduced to a total of 48 hours with a continuous working session.

## Conclusion

By avoiding the individual retrieval of items and reboxing during an alert phase, valuable time is gained in an emergency situation and the risks for holdings are reduced. Offering a range of possibilities when faced with a difficult decision, these new types of boxes were the best option to secure the collections against a slim risk with possibly devastating consequences, and maintain the integrity of the collections in their historical context.

The box model is the logical outcome of a comprehensive preservation strategy based on a risk assessment. As a result of a compromise between accessibility and preservation, the type of box used for the Arsenal site of the National Library is designed for durability and long-term conservation, allowing easy access for delivery to the public and routine inspection. Reducing the handling of objects to a strict minimum, this type of box represents a simple and efficient way to facilitate the movement of objects. This type of boxes was first designed in the context of a flood protection. They also facilitate the movement of library collections and provide a protection for a set of items in case of

leakage. As such, the box model is a more sustainable and cost-efficient solution than individual boxes.


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# Dunhuang scrolls: Innovative storage solutions at the British Library

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## Abstract

The British Library's Stein collection contains about 14,000 scrolls, fragments and booklets in Chinese from a cave in the Buddhist Mogao Caves complex near Dunhuang in north-west China. This article describes storage and access solutions for the collection in the context of a busy research library and the currently ongoing Lotus Sutra Manuscripts Digitisation project. The article presents the various technical and organisational challenges that its rehousing presents to the library conservators. Restricted by the existing storage facilities, budget limitations and tight project deadlines, the conservators must provide housing that is adequate for the scroll format, is practical and prevents dissociation, but is also cost- and time-effective. With the best storage practice in mind, they have developed original solutions, balancing the specific housing requirements and constraints. These storage solutions allow the conservators to ensure the long-term safety and accessibility of the collection while laying down a foundation of standardisation that will ensure a homogeneity of approaches for future projects.

## Keywords

Scroll, storage, Dunhuang, Central Asia, conservation, paper

## Introduction

The British Library's Stein collection contains over 45,000 items from Central Asia, of which approximately 14,000 are manuscripts in Chinese from a small cave in the Buddhist Mogao Caves complex near Dunhuang in north-west China. The so-called Library Cave (Cave 17) in Dunhuang, discovered in 1900, has been home to tens of thousands of documents, paintings and other artefacts dating from the late 4th to the beginning of the 11th century. The British Library's collection, relocated from the British Museum on the establishment of the Library in 1973, encompasses around 6,000 complete Chinese scrolls and close to 8,000 smaller scroll fragments (Lawson and Barnard, 1996: 7). This article describes storage and access solutions for the collection in the context of a busy research library, as well as the current ongoing Lotus Sutra Manuscripts Digitisation project, which aims to conserve and digitise almost 800 copies of the Lotus Sutra from the Stein collection.<sup>1</sup>

Due to its large size and the fragile nature of the materials, proper storage of the collection is an ongoing challenge for the British Library's curators and conservators, as evidenced by the many different solutions implemented over the past few decades. As our understanding of their impact on the collection's long-term preservation grows and the conservation work progresses, we strive to adapt our approaches to address the issues which have arisen and successfully balance the specific housing requirements with institutional budgeting and logistic constraints. Currently, due to limited financial and human resources, there is no systematic rehousing project. All works are carried out alongside the Lotus Sutra Manuscripts Digitisation project, and the rehousing of items that

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have undergone conservation and digitisation is an integral part of the project. We aim to lay down a solid foundation of adequate and standardised solutions that will ensure homogeneous storage across the collection and a continuous availability of the same methods for future projects.

This article outlines the various technical and organisational challenges that this task presents. We discuss essential housing considerations such as the characteristics and specific needs of the collection, and existing storage methods and facilities, as well as accessibility, cost and sustainability factors that impact our decision-making process, and alternative practical solutions. The final designs that are presented in this article are a result of our thorough understanding of existing storage issues that had to be addressed. They took shape over many months of experimentation with different techniques and materials. Under normal circumstances, these would have been incorporated into our day-to-day project workflow, but the COVID-19 pandemic and our subsequent inability to access the conservation studio for many months led us to investigate and research different possible ideas. As a result, the original storage methods we have developed successfully balance the above-mentioned requirements and constraints. In the spirit of sharing skills, we hope that colleagues around the world will find this helpful.

## Literature review

There is a considerable body of existing literature in English discussing the damage mechanisms and storage of collection items in handscroll format. The most important contributions are discussed below.

Winter (2008) dedicates a whole chapter to the mechanical deterioration of scrolls. He describes the stress imposed on handscrolls upon unrolling and rerolling, which leads to the development of irregular longitudinal creases that are especially prominent near the beginning of the scroll. These may progress further, causing the support to crack and split (Winter, 2008: 135). Because they are usually very long, handscrolls are typically not fully unrolled all at once, but examined one small section at a time (no more than a metre long). This requires readers to temporarily roll up the scroll as they progress and, consequently, leaves the unsupported right-hand part at risk of being crushed if held too tightly. As a result of excessive squeezing, scrolls can become distorted and develop horizontal creases (Winter, 2008: 135). Moreover, scrolls that are rolled tightly around a slender rod tend to be more prone to overtension and

creasing, and at risk of further mechanical damage when handled.

As pointed out by Chongrun (2007: 110), the Dunhuang scrolls usually have rollers of a very small diameter or lack them altogether, which in many cases has resulted in the manuscripts being easily pressed flat, leading to cracking of the paper support. Experience shows that doubling the rolling diameter significantly decreases the risk of scrolls developing creases and cracks (Winter, 2008: 160). Conservators at the National Library of China recommend the use of 4–5 cm diameter rollers as optimal for reducing stress in Dunhuang scroll manuscripts (Chongrun, 2007: 110–111). In Japan, this is achieved with a wooden clamp known as *futomaki* (太巻), which encloses the original roller. Rolling around a core has the added benefit of providing scrolls with good support and facilitates their handling. These views are shared by authors such as Chongrun (2007), Hare (2006), Hare and Shintani (2015a, 2015b), Hamill (2017), Smith (2011: 58, 80) and Wakeling (2019).

Since *futomaki* are not easily available in the western hemisphere, different authors propose various cost-effective alternative solutions using more readily available, modern conservation materials. Hare and Shintani (2015a, 2015b) give detailed instructions on making a *futomaki*-style roller out of Melinex and double-sided tape or just by using Ethafoam, which is intended to increase the rolling diameter for storage while also accommodating the original rod.<sup>2</sup> A Melinex roller can easily be made to custom diameters, and the finished product containing the collection item can then be housed in a box with a hammock-style support made of Volara.<sup>3</sup> In the case of an Ethafoam roller, a channel to house the original rod is carved out of the foam and covered in a stockinette. According to the authors, this solution is recommended for larger-sized items measuring approximately 0.9 m (3 ft) or more in width. This second approach is successfully followed by Williams (2018), who describes an Ethafoam *futomaki*-style roller finished with a covering of soft-grade Tyvek that was made for storing a large 18th-century map.<sup>4</sup>

Hamill (2017) discusses the use of tubes for the storage of sizeable items such as maps, posters and architectural drawings to increase the rolling diameter, therefore distributing weight more evenly and providing firm support. The use of acid-free, buffered archival-grade tubes is preferred. However, she also considers the use of non-archival tubes if a barrier layer is used in between the item and the tube. After rolling, an outer layer composed of sturdy archival paper and/or polyester film is added for light and dust protection. Reppert Gerber (2016) investigates the use

of standard cardboard postal tubes for rolled storage as a cost-effective alternative to expensive archival-grade tubes. A barrier layer of Melinex between the postal tube and the collection item is applied and secured using polyester double-sided tape. This modification resulted in saving 90% of the cost traditionally spent on archival-grade tubes. All of the above-mentioned solutions have been considered for the storage of scrolls in the Stein collection.

Winter (2008) also discusses the impact of environmental factors on scroll preservation. The response to changes in relative humidity depends on the type and composition of the paper support, as well as the presence of sizing and/or backing layers. While fluctuations may result in shape changes, cracking or even detaching due to excessive stress – especially in laminated areas such as mountings, joints and linings – a sudden drop in relative humidity can lead to considerable shrinkage and mechanical damage (Winter, 2008: 167–168). For their East Asian paintings collection, the Freer and Sackler Galleries in Washington, DC, aim for display and storage conditions of 50%  $\pm$  5% relative humidity and 20–22 °C  $\pm$  2 °C. However, Hare (2006: 74) notes that a range of 50%–60% relative humidity and 18–22 °C is more common among East Asian collections. This range of relative humidity is also implemented at the National Library of China, specifically for the storage of Dunhuang manuscripts (Chongrun, 2007: 111).

Humidity variations can be buffered with some storage solutions, such as Japanese paulownia wood boxes or pouches and scroll bags made from fabric (Winter, 2008: 167–168). Hare (2006: 78) argues that Oddy testing has shown that Asian woods used for storage (paulownia, Japanese cedar, ebony, rosewood) have the potential to off-gas and show signs of being as corrosive as other woods used in western collections.<sup>5</sup> While the benefits of creating a microclimate with wooden storage boxes have historically outweighed the potential harm caused by their off-gassing, the developments in technology of climate control and closed storages have led Hare to question whether this method should be reconsidered.

Wooden boxes, wrappers and bags that can no longer be used due to their condition should be kept but stored separately from the scroll (Hare, 2006; Smith, 2011: 86, 91). As pointed out by Belard (2009: 106–107), Buddhist manuscripts in handscroll format were not regarded as ‘art objects’ at the time of their creation. Therefore, it is unlikely that they originally had individual storage boxes, which were expensive and time-consuming to produce, or *futomaki*, which are a modern invention. However, in modern practice, the use of storage boxes is recommended (Chongrun,

2007: 111; Hare, 2006: 78–79; Smith, 2011: 69), for they offer good protection from pests and pollutants, creating a stable microclimate that minimises the negative impact of atmospheric changes. Some authors mention archival-grade card boxes as a cost-effective alternative to wooden boxes. Hare (2015) describes a solution using an acid-free corrugated board with fall-down ends to facilitate removing and replacing the scroll, as well as Volara sheeting to further support it while stored. Smith (2011: 69, 74) points out that rigid boxes can be stacked for a more efficient use of storage space, which is an important consideration for many institutions. If scrolls are stored unboxed, she recommends utilising foam supports to help distribute their weight more evenly and avoid damage. Zhiqing (2007: 11) describes the use of cabinets made of *nanmu* wood at the National Library of China, which were implemented for the storage of Dunhuang material in 2004. Each cabinet contains 120 equal camphor wood cases equipped with axles and grooves for the secure housing of individual scrolls. Hare (2006: 77–78) and Smith (2011: 76) describe an optimal ‘multi-layered’ housing system consisting of four distinct layers: a wrapper (Layer 1), boxes (Layer 2), cases, drawers or shelves (Layer 3), and, finally, a closed climate-controlled storage room (Layer 4).

## Storage considerations

### *The British Library’s Stein collection: size and formats*

As mentioned in the introduction, the British Library’s Stein collection is an incredibly rich body of textual material, of which about 14,000 items alone are manuscripts in Chinese that were excavated from a single site in Dunhuang. While the conservation and rehousing work on the collection has been ongoing at the Library since 1973, the recent Lotus Sutra Manuscripts Digitisation project narrows down our rehousing scope to about 800 objects. But even in the current case, the cost of a solution, while reasonable for a few items, grows exponentially when multiplied by the substantial number of objects.

However, it is not only the vast size that poses a great challenge. There are different formats represented in the collection. The handscroll is by far the most common, although small paper fragments, bound booklets and other objects are also present. Naturally, all these formats have different housing requirements. Even within the same format group, there are some notable differences. For example, scrolls vary significantly in terms of size and condition: their length ranges anywhere from 10 cm to almost 14 m, which results in considerable differences in diameters when they are rolled. As the scrolls are



**Figure 1.** Part of the strongroom (left) and a close-up of the pigeonholes where scrolls are stored (right).  
Source: Photograph credit International Dunhuang Project.

usually relaxed in the conservation process, they typically expand in diameter compared to their very tight rolling before treatment and, consequently, require more storage space. Some of the scrolls survive with their original rods still attached, but, in some cases, the rods are inadvertently separated and at risk of dissociation. Detached rods are not usually reattached as part of the conservation treatment. It is important to store them safely and together with their original object – otherwise they can be lost and almost impossible to (re)match with their corresponding scroll. Therefore, different solutions must be implemented in order to respond to these individual housing needs. These variations may seem nuanced but are amplified by the number of items and possible issue combinations (e.g. a scroll that is both very long and has an original roller still in place), which makes it challenging to store the collection safely and successfully within the existing facility. A unification of approaches and solutions across the collection is therefore crucial for a more effective use of the available space.

### *Existing storage facility*

Since the British Library moved to its current St Pancras location, the Stein collection has been stored in a climate-controlled strongroom with an Inergen fire suppression system, which reduces oxygen levels inside in case of smoke detection. The scrolls are kept in wooden, glass-front pigeonhole cabinets, which were made bespoke for the collection in the early 1970s by London-based cabinetmakers Pegasus (see Figure 1). Although designed with great care, we are beginning to see certain shortcomings in this solution as the conservation work on the collection progresses.

The scrolls are stored in individual pigeonholes, which are organised chronologically by shelf marks in ascending order. While small adjustments can be made to the width of a single compartment thanks to movable separators, their height is fixed at about 8 cm. As a result, longer scrolls no longer fit after being rolled on increased-diameter cores. The same issue arises when scrolls on the same shelf happen to all be larger in size, and the separators cannot be successfully tweaked around to provide each with an appropriate amount of space to facilitate access and prevent mechanical damage and deformations. The organisation of storage where the location of a particular scroll is dictated by its shelf mark, and therefore fixed, is very convenient for the retrieval of items but does not allow much flexibility for scrolls to be moved around and replaced according to their size. In cases where we have no other option but to move a scroll, a paper slip indicating its new location is placed in its original pigeonhole. Moreover, because of the vast size of the collection, in some instances, multiple small scrolls have been stacked in a single pigeonhole. This kind of improper storage puts items at risk of potential mechanical damage, and these scrolls should be rehoused as soon as it is possible.

Over the years, as the collection has undergone conservation treatment, different solutions have been employed to address some of these issues. Existing British Library conservation records from the 1980s reveal that cotton, silk or linen wrappers impregnated with Mystox (an insect-resistant agent) were used for storage of individual scrolls. In the 1990s, these were replaced by Japanese boxes made from paulownia wood (Lawson and Barnard, 1996: 13). Boxes offer good protection against pests and pollutants, and minimise the negative impact of atmospheric

changes; therefore, they are a popular storage method in institutions around the world. However, in the case of the British Library's Stein collection, they unfortunately do not fit within the compartments of the pigeonhole cabinets. The scarcity of space and enormous costs of such an undertaking for a collection of this size are forcing us currently to consider this solution only for the most precious and fragile objects, as well as those that are too large in diameter and therefore cannot be placed back in the cabinets after treatment.

We also need to remember that while the cabinets themselves create a microclimate for the objects and offer stable atmospheric conditions, they simultaneously accelerate the risk of potential harmful off-gassing from both the cases and the materials we use for storage, limiting the solutions available for rehousing. Due to economic restraints and the difficult organisation of such an endeavour, getting a new storage facility is not feasible at the moment. Although new integrated solutions may be implemented in the future, until then we must work around the existing infrastructure to address the most pressing housing needs.

#### *Contextualising practices: busy research library and ongoing digitisation of the collection*

Another key factor that needs to be considered is that the British Library is a busy public research institution. While the aim of the Lotus Sutra Manuscripts Digitisation project is to make the collection freely available online to readers and researchers around the world, reducing significantly the need to handle the originals, the collection items that have not yet been digitised can be requested by scholars for close examination in the reading rooms. Typically, there are around 30 requests for physical access to Stein collection materials per year, and many researchers tend to investigate a larger number of objects at once or over the course of their visit. But accessibility is equally important in the context of a digitisation project. Conservation and imaging processes have separate, differently paced workflows and, rather than going to the imaging studio directly from conservation, objects are often returned to storage and retrieved from there for the imaging staff independently. Since conservation supervision can only be provided in individual instances of particularly delicate objects, the scrolls cannot be difficult to access and replace. While the internal staff handling the collection items have received training, the scroll format still presents some difficulties, especially in the case of particularly long objects or those with their original

rods still attached. The final design of any storage solution must therefore be easy to apply properly in order to prevent the potential risk of damage and dissociation arising from incorrect use.

#### *Materials: function, accessibility, cost and sustainability*

In the above-described context, where there are tight timelines and economic constraints, it is essential to deliver solutions which use materials that are easily sourced, accessible and cost-effective. The materials must be safe for the collection items; therefore, all the components in our storage solutions must be of a reliable archival grade. Sourcing materials abroad dramatically increases the costs, as the shipping charges are usually much higher and additional custom duties must be paid. Furthermore, this increases our overall carbon footprint, which we are seeking to reduce as an institution. However, suitable solutions are not always available locally in the UK; some of the suppliers we used to work with have discontinued the necessary products or materials. We try to find and rely on materials that will be available for future projects to keep things consistent. For this reason, we aim to use what is already available to us – the materials commonly found in most conservation studios – which takes advantage of surplus stock and limits the need for outsourcing. For materials that must be outsourced, we ensure that they can be easily obtained from reputable suppliers.

It was essential to develop solutions which would be sustainable over the long term. Our storage solutions allow for consistency in the Lotus Sutra Manuscripts Digitisation project and can be made quickly using simple on-site workshop facilities. All the factors outlined above also come into effect when thinking beyond this particular project. The sheer scale of the Stein collection requires consistent, sustainable long-term solutions, which can also be applied to potential future projects involving the material in this collection.

#### **Storage solutions**

With the considerations outlined above in mind, the Lotus Sutra Manuscripts Digitisation project's conservators – Marie Kaladgew, Paulina Kralka and Marya Muzart – have combined traditional methods with modern materials to produce practical solutions that address the storage issues and are also functional, accessible and sustainable in terms of both the environment and future projects. Following the recommendations for the best storage practices for handscrolls, we have now implemented increased-diameter support



**Figure 2.** A 5.5 cm core being used as a handling aid.

cores as the standard solution for all scrolls within the scope of the Lotus Sutra Manuscripts Digitisation project. We found 5.5 cm diameter cores composed of acid-free cardboard tubes to be appropriate for the majority of scrolls, offering overall time and cost efficiency.<sup>6</sup> We source them in large numbers from reputable conservation suppliers. We arrived at a standard length of 33.5 cm, which allows a few generous centimetres at the top and bottom of the scrolls to protect the edges during their handling and storage. We have a mixed stock of cores which have been ordered pre-cut and some old stock that requires cutting and sanding of the edges using the on-site workshop facilities. In both cases, we cover them in a layer of *xuan* paper (宣纸), using wheat-starch paste as an adhesive. The paper covering is applied smooth side up, which results in a homogeneous non-slip surface that can also easily be removed and replaced were it to become too worn or soiled. The cores we use as part of the rehousing not only increase the rolling diameter to help prevent over-tension and creasing, but also offer proper support for the scrolls, enabling their safe handling in and out of the pigeonholes in the storage facility. These cores are also of significant use as handling aids

during the unrolling and rerolling for examination, providing support and protecting the temporarily rolled side from squeezing (Figure 2). As a final step of rehousing before the scrolls go back into storage, we add a *xuan*-paper wrapper. As the outermost layer, the *xuan* paper protects the scroll from dust, friction and soiling when handled, and can also easily be replaced. It bears the shelf mark of the scroll in pencil, which allows for quick and easy identification.

While the standard cores work well for most scrolls included in the Lotus Sutra Manuscripts Digitisation project, it is not a one-size-fits-all solution. Over the course of the project, we have identified four major housing issues for which alternative solutions had to be found: (1) the storage of exceptionally long scrolls without their original rollers – *reduced-diameter cores*; (2) the storage of average-length scrolls with their original rollers still in place – *standard clasp cores*;<sup>7</sup> (3) the storage of exceptionally long scrolls with their original rollers still in place – *reduced-diameter clasp cores*; and (4) housing for detached original rollers to avoid dissociation. The occurrence of the COVID-19 pandemic and the inability to access the conservation studio for some months during 2020



**Figure 3.** A standard 5.5 cm diameter core outsourced from conservation suppliers (left) and a 3.5 cm reduced-diameter core handmade by International Dunhuang Project conservators (right).

allowed us time to thoroughly investigate and research different ideas and solutions. The results are described in detail below.

#### *Reduced-diameter cores*

We have found that some exceptionally long scrolls, once they are placed on a standard core, are too large to fit back into their respective pigeonholes with sufficient space for safe handling. Previously, scrolls that could not fit back into the existing storage would have to be boxed and placed elsewhere in the strongroom. Our experience shows that most scrolls over 10 m in length tend to encounter this issue. However, considering the variations in the condition and thickness of the paper support between the scrolls, this measure can only act as an estimate. In some cases, a final decision on whether or not an item may be stored using a standard core can only be made after treatment has been completed and the actual height of the scroll on the core can be measured. As the project progressed, it became clear that boxing and moving these scrolls was not a good long-term solution due to space concerns in the strongroom. An estimate of 22 scrolls being treated in the project would have to be boxed and moved – a figure that is likely to increase. For the sake of a sustainable long-term solution which could also be used in future projects treating items in the collection, reduced-diameter cores were needed for storage.

We arrived at the conclusion that a 3.5 cm diameter core would be small enough to ensure that the scrolls could fit into the pigeonholes while still increasing the diameter enough to prevent damage (Figure 3). Unfortunately, sourcing reduced-diameter archival-grade cores in small quantities proved incredibly

difficult. The lack of a suitable ready-made product available on the market led us to test the alternative solutions described in the literature. We were optimistic for the Melinex core designed at the East Asian Painting Conservation Studio at the Freer and Sackler Galleries, for it was easily adaptable to fit objects of varying diameters (Hare and Shintani, 2015b). Unfortunately, the resulting core was too flexible and, compared to a cardboard core, did not seem to offer enough support for the scrolls, both in storage and as a handling aid. We also briefly considered regular postal tubes with an interleaving layer, for they are readily available in different diameters and are cost-effective. However, given the microclimate inside the pigeonhole cabinets, there was a risk of potential harmful off-gassing. To be suitable for long-term storage, this method would have required thorough scientific testing before it could be implemented, which was unfortunately not possible in the climate of the COVID-19 pandemic. This points to how there is never a one-size-fits-all approach when it comes to storage solutions: whether a method works well or not really depends on the particulars of the collection, the project and the institution.

The inappropriateness of these solutions for our specific purposes and the need to find reduced-diameter cores urgently led us to develop a technique of making our own archival-grade cardboard cores (Figure 4). The inspiration was drawn from an online blog post on making paper tubes for general crafts (Instructables Craft, 2012) and adapted to be suitable for use in conservation. We experimented with several types of adhesives, as well as diverse types of paper. For instance, cores made with ethylene-vinyl acetate (EVA) were found to be too flexible even once dry;<sup>8</sup> the adhesive was also difficult to apply without causing extensive cockling of the paper, and we found it became tacky too quickly to allow for any adjustments in the making process. On the other hand, wheat-starch paste diluted to a thin but not overly watery consistency gave enough strength to the core once dry, was easier to work with and, with a slower drying time, gave more room for adjustments where necessary. We tested out several types of paper in varying thicknesses and found that archival-grade kraft paper, which is commonly found in most conservation studios and suppliers, was well suited for the purpose. Using six to seven layers of thin 120 gsm kraft paper was found to be effective but too time-consuming, given the necessary drying time in between applications. Fewer layers of a much thicker 350 gsm kraft paper were difficult to mould around the support, and the resulting core did not keep its shape well. Consequently, a 170 gsm kraft paper, of



**Figure 4.** Making a reduced-diameter core.

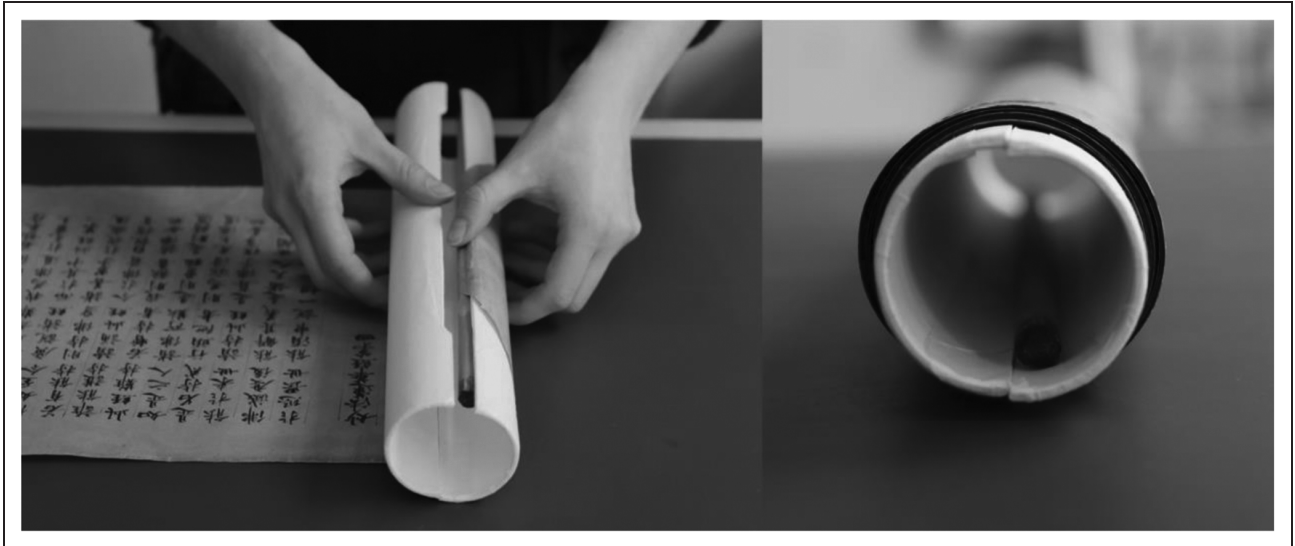
Note: Using wheat-starch paste as an adhesive, layers of kraft paper are wound around a plastic pipe support. The bottom-right photograph shows the core before being cut to size and wrapped in *xuan* paper, next to the finished product.

which a minimum of four layers was applied with wheat-starch paste, was found to be the optimum solution. It produced a particularly good supporting core with a reduced diameter that could be made relatively quickly. While these handmade cores are, of course, more time-consuming to obtain than the standard 5.5 cm diameter ready-made cores, they make up only a minority of the supports required for the project.

Learning to make these cores has become invaluable knowledge in creating our own rehousing. The detailed instructions are as follows:

1. A plastic plumbing pipe with a diameter of 3.2 cm and approximately 50 cm in length is used as a support. These can be easily sourced online from building suppliers and plumbing merchants. To make a 3.5 cm diameter core with a length of approximately 33.5 cm, the use of four layers of 170 gsm kraft paper is optimal. The kraft paper should be cut in advance, with each strip measuring approximately 61.5 cm x 8 cm.
2. The first base layer, applied in a spiral formation with no space or overlap, is kept secure with masking tape on either end (the masking tape will not be part of the final product as the edges will be trimmed). This layer should not be applied with an adhesive as it will become stuck to the support. If a more uniform appearance matching the outside covering is desired, the base can be composed of an additional layer of *xuan* paper.
3. Once the base layer is secured, a thinned wheat-starch paste is prepared. The paste must not be overdiluted, so that it retains enough strength (a consistency like cream is ideal). The paste is applied generously and evenly onto the kraft paper strip with a *noribake* paste brush. The strip is then applied in a spiral formation onto the tube, ensuring no space or overlap as it progresses up the tube. The angle of the spiral formation is dependent on the length and width of the strip – this may involve some trial and error. The wheat starch's slower drying time allows for any





**Figure 5.** The standard 5.5 cm diameter clasp core modified to accommodate scrolls where the original roller is still attached.

necessary adjustments. The strips should be pressed firmly onto the support to avoid air pockets. The seams of the subsequent additional layers should not fall directly over the seams of the layer beneath them to achieve a stronger core. Letting each layer dry between applications is recommended to avoid cockling.

4. After all of the layers have been applied and dried fully (at least overnight), the tube can be removed from the support. The edges are trimmed to acquire the desired length and then sanded. Finally, a layer of *xuan* paper is applied with wheat-starch paste as the adhesive to act as a covering. If different dimensions of the core are required, the details of each component outlined above (the size of the support, the thickness of the paper, the number of strips required, and the length and width they should be) should be adapted accordingly.

#### Standard clasp cores

As already mentioned, many of the scrolls in our collection survive with their original wooden rod still attached to the left end. Therefore, standard cores are not a suitable solution for their safe storage. We ruled out the possibility of using the wooden *futomaki* as they would have had to be custom-made in Japan – a solution that was both impractical and expensive. We also tested the Melinex core designed at the Freer and Sackler Galleries, but found it to be too flexible to provide the desired level of support. To house the roller safely while

providing appropriate support for the scroll, we experimented with modifying our standard 5.5 cm diameter cores for the purpose (Figure 5).

The design incorporates the key features of the *futomaki* clamp but uses modern inert conservation materials. It is therefore more lightweight and economical to source. It also utilises offcuts of *xuan* paper which are too small to be used for other purposes and minimises the waste of this expensive material. The detailed instructions are as follows:

1. The standard cardboard core is cut in half lengthways and a small groove is cut out in one half to accommodate the wooden roller and the paper end of the manuscript. The groove should only be a few millimetres deep – 5–7 mm typically suffices – but this should be adapted to the width of the original roller. The length of the groove should allow for a gap of at least 10–15 mm both at the top and the bottom edges of the manuscript in order not to damage the paper. Once the cuts are satisfactory, all edges are sanded to create a smooth surface. The edges where the hinges will be pasted should not be purposely smoothed down as a rougher surface provides better bonding.
2. A system of paper tabs is then pasted on to allow the core to open and close smoothly. The tabs are made of *xuan* paper; usually there are eight tabs of equal size cut to fit the length of the core with a small 1–2 mm gap between each. The tabs are pasted on in an alternate fashion using thick wheat-starch paste.



**Figure 6.** Making a reduced-diameter clasp core.

Note: The core is cut in half lengthways with a groove to accommodate the original roller. *Xuan*-paper hinges are pasted on to allow smooth opening and closing. The core is then covered in *xuan* paper. The bottom-right photograph shows the finished product in use.

3. Once the tabs are pasted on and fully dried, and the hinge mechanism is working, the core is covered in *xuan* paper using wheat-starch paste to secure it. The inside may also be covered if a neater appearance is required.

#### *Reduced-diameter clasp cores*

One of the biggest challenges we face is the housing of very long scrolls where the original rod is still attached. We approached solving this storage issue by trying to combine the clasp-core mechanism with the reduced-diameter core. However, converting the handmade cores into clasp cores using the technique outlined above proved to be difficult, as the layers of kraft paper tended to delaminate when the core was being cut lengthways, resulting in an unstable structure. Therefore, some modifications to the original design and making method were necessary. We found that applying the kraft-paper layers with a slightly thicker wheat-starch paste, as well as adding two more layers of the 170 gsm kraft paper (a total of

six), resulted in a sturdier and stronger structure which holds its shape well when cut and converted into a clasp core (Figure 6). With these small modifications in mind, one can follow the steps for reduced-diameter cores and clasp cores described above.

#### *Housing for detached original rollers*

There are some instances where the original wooden roller is detached from the scroll, which creates yet another storage challenge. When the historical roller is completely separated, our approach is not to reattach it as we cannot assume its exact original position. For this reason, we utilise a standard core rather than a clasp core for rehousing. However, we want to avoid storing the scroll separately from its historical roller because doing so creates an undoubted risk of dissociation. One solution would be to box them together. However, as mentioned earlier, boxing items and moving them out of the pigeonholes is not a sustainable solution, given the limited size of our current storage facility. We needed to create an alternative way in



**Figure 7.** Housing for a detached original roller made out of polyethylene foam tube and stored within a standard core.

which the original roller could still be stored safely and securely with the collection item.

We initially experimented with making rectangular core inserts using a few layers of thin Plastazote adhered together with EVA, with a custom-cut groove to accommodate the original roller.<sup>9</sup> While the end product was functional enough, the process was far from ideal, being too messy and time-consuming. Inspiration struck after spotting some polyethylene tubes being used by our colleague who specialises in textile conservation to store rolled textiles. These are, in fact, pipe insulation tubes, but they have been previously Oddy tested by the British Library's collection care scientist, Dr Paul Garside, and are deemed safe to use with collection items. Because of their original purpose, they have a cavity inside, and their sides are already pre-slit, making them quick and easy to split neatly open. Moreover, the material is available in different diameters, and it was possible to find one that fitted perfectly inside the standard core. The storage solution we consequently developed using these tubes not only provides safer housing for detached original rollers, but is also incredibly easy to make and requires no adhesive (Figure 7). This design

was a significant improvement and was implemented from then onwards.

The detailed instructions are as follows:

1. We utilise tubes with a 22 mm inner diameter and a 13 mm wall (to use them inside the 3.5 cm diameter cores, we simply trim down the foam to reduce the overall diameter of the tube). The tube is cut to the same length as the core, then cut in half using the existing pre-scoring and hinged on one side with Filmoplast SH cotton tape to allow for smooth opening and closing. The Filmoplast tape adheres well to the foam surface.
2. Two pairs of small slits, both close to each end, are cut in the tube half that is intended to house the roller. Cotton tying tape is then threaded through; it will be used to secure the stored item in place.
3. A small tab made of Filmoplast SH cotton tape is placed at the bottom of the hinged side of the tube to facilitate removal from inside the core.
4. The rod, wrapped in a protective layer of *xuan* paper, is placed inside and secured in place



**Figure 8.** Scroll supports made from polyethylene foam tube and positioned at either end of a 3.5 cm diameter core.

with the cotton tying tape. Both the roller and the scroll wrappers are clearly labelled with shelf marks and instructions to ensure safe handling.

### Scroll supports

While experimenting with the above-described design, we found another, unexpected, use for the polyethylene insulation tubes. This idea came about when insulation tubes of the wrong diameter were accidentally ordered. We were left with tubes that we thought were too large to use for any purpose. However, we found that these, in fact, fitted perfectly around the reduced-diameter cores and could therefore be used as supports. The size and greater weight of very long scrolls means that if the scroll rests on itself in storage for an extended period, it is at risk of permanent deformations. Many Japanese-inspired storage-box designs have insert supports, whereby the scroll can be suspended inside; however, this solution was previously not easy to adapt in the pigeonhole context. The foam supports we created are functional as they lift the scroll off the surface, but at the same time they do not add any more bulk to it (Figure 8). Therefore, they do not affect how the scrolls fit inside the existing cabinet compartments. Another important feature is that they also fit snugly onto the core, minimising the risk of handling-related accidents while taking the scroll in and out of the pigeonhole.

The detailed instructions are as follows:

1. The supports for reduced-diameter cores are made from polyethylene insulation tubes with a 22 mm inner diameter and a 19 mm wall. The tube is first cut widthways into 3–3.5 cm slices, then a single slit is cut at the top to allow for opening. The cut edges are sanded down to create a smooth surface.
2. The supports are then placed at either end of the core, leaving a small gap from the scroll.

They can be covered in a conservation-grade stockinette if a white appearance is desired.

### Conclusion

The storage of the materials from the Stein collection presents many organisational and technical challenges to the British Library's conservators. There are various essential considerations that must be acknowledged: the specific needs of the collection, and the existing storage methods and facilities, as well as accessibility requirements, budgetary limitations and tight project deadlines. We must provide housing that is adequate for the scroll format and feasible to deliver in terms of the size of the collection, and that prevents dissociation, which has been an issue in the past. In an ideal world, we would design a new storage facility that comprehensively address the above-mentioned from the ground up. Unfortunately, as in the case of many fellow institutions around the world, our situation is not ideal. Operating within the current limitations and requirements without compromising the collection's safety and accessibility is a fine balancing act.

While working on the ongoing Lotus Sutra Manuscripts Digitisation project, we have been faced with the fundamental task of rehousing a vast number of collection items, mostly in the handscroll format. This created the need to develop original solutions that successfully balance the specific housing requirements and constraints with the best storage practice for scroll manuscripts. They allow us to ensure the long-term safety and accessibility of the collection, while being sustainable as well as cost- and time-effective. The final designs of the new storage solutions presented in this article have been developed with a thorough understanding of the existing storage issues. These designs have taken shape over many months of research and experimentation with different techniques and materials. They combine some practical aspects of more traditional East Asian methods with modern materials for an optimal balance of functionality, sustainability and accessibility. In developing and subsequently implementing these designs, we are positively contributing to the long-term preservation of this material and laying down a foundation of standardisation that ensures homogeneity of storage not only throughout the project, but also across the Stein collection for the most effective use of the available storage space.

Our work is ongoing, and we strive to continue to research and develop further innovative storage

solutions to overcome any issues we may encounter. We also hope that, in sharing our ideas with the wider library and conservation community, we may help colleagues facing similar rehousing challenges.

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### Notes

1. The Lotus Sutra Manuscripts Digitisation project is generously funded by the Bei Shan Tang Foundation.
2. Melinex is a brand of archival-quality clear polyester film and Ethafoam is a brand of medium-density inert polyethylene foam.
3. Volara is a brand of inert polyethylene foam sheeting.
4. Tyvek is a brand of inert non-woven material composed of polyethylene fibres.
5. Oddy testing tests the gasses that are emitted by a particular material in a sealed environment, determining whether or not a material is deemed 'safe' for use with museum objects.
6. This is true for scroll fragments measuring more than 80 cm in length and without an original roller still attached. Shorter items are usually encapsulated in Melinex, which has been used successfully at the British Library since the 1980s. It allows us to carry out minimal treatment as the scroll is not directly handled. Scroll fragments which are to be encapsulated must undergo a gentle flattening. The edges of the Melinex pocket are sealed using a heat welder, and a spot welder is used in close proximity to the fragments to help keep them in place. A label comprising the shelf mark of the object is also welded on. The encapsulated manuscripts are housed flat in custom-made folders. Scroll fragments in Melinex are safe and easy to handle as both sides can be easily accessed, whether by our imaging staff during digitisation or by researchers wishing to examine

the manuscripts in the reading rooms. However, we must also be acutely aware that by using this rehousing technique, we are altering the original format of the item. For a discussion on alternative storage solutions for scroll fragments, see Brandt (1996) and De and Licheng (2007: 143–144).

7. These scrolls would have been stored on a standard core if it was not for the roller being in place.
8. Ethylene-vinyl acetate (EVA) copolymer is a neutral-pH adhesive that is free of plasticisers and less susceptible to acid hydrolysis than more common adhesives.
9. Plastazote is a brand of inert polyethylene foam that is available in a range of densities.

### Supplemental material

Supplemental material for this article is available online.

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### Author biographies

**Paulina Kralka** is a Digitisation Scroll Conservator who joined the Lotus Sutra Manuscripts Digitisation project at the British Library in March 2020. She holds a Master's in Art Conservation and Restoration from the Jan Matejko Academy of Fine Arts in Cracow and a Bachelor of Arts in Art History from Jagiellonian University, Cracow. She has also completed a Postgraduate Diploma in Asian Art at SOAS University of London. Prior to joining the British Library, she spent six months training in the conservation of East Asian paintings in the Hirayama Studio at the British Museum.

**Marya Muzart** is a Digitisation Scroll Conservator who has been working on the Lotus Sutra Manuscripts Digitisation project at the British Library since 2018. She holds a Master's in Paper Conservation from Camberwell College of Arts and a Bachelor of Arts in Art History and Material Studies from University College London. Her training has included placements and internships at the British Museum, the London Library, the Museum of London and the National Library of Spain.



# The David O Selznick storyboard rehousing project: A case study

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## Abstract

In 2018, the Harry Ransom Center at the University of Texas at Austin rehoused over 300 illustrated movie storyboards from the popular and frequently used David O Selznick Collection. Preservation technicians tracked this project from its inception to the survey and design conception, and through to its execution. By creating a new housing model and refining it over the course of a year, the Preservation Unit was able to consider how housing affects an object, which led to new systems and structures to facilitate process management and workflow, and how an object is impacted by its housing.

## Keywords

Preservation, conservation, collection development, arts and humanities literatures, academic libraries, information providers, special collections, rare books

This case study recounts an extensive rehousing project undertaken by the Preservation Unit in the Harry Ransom Center at the University of Texas at Austin over the course of about 12 months in 2018. Over 300 illustrated movie storyboards from the David O Selznick Collection were surveyed and rehoused. As preservation technicians, we create housings for everything: handwritten letters, delicate bindings, modern movie props, etc. Our preservation staff during this time consisted of Genevieve Pierce (myself), Alan Van Dyke, and Jill Morena. We were tasked with the extraordinary opportunity of rehousing one of the Ransom Center's most exciting collections. The project involved surveying the entire Selznick storyboard collection, designing housing and workflow for it, moving the collection from one storage space to another, keeping disparate departments abreast of developments, and ensuring that the day-to-day work went smoothly. The project yielded an inventive new housing design, a workflow model on which to base future projects, and new preservation-management questions.

Overall, the project was a success. Among other things, it brought to light how an object's housing changes it in terms of its size, storage, durability, sustainability, and identity. Housing and storage are at the very center of preservation, yet rarely does an institution as a whole consider an object in

conjunction with its housing. Nevertheless, an item and its housing together constitute a single object, and proper preservation housing adds value beyond the protection it provides.

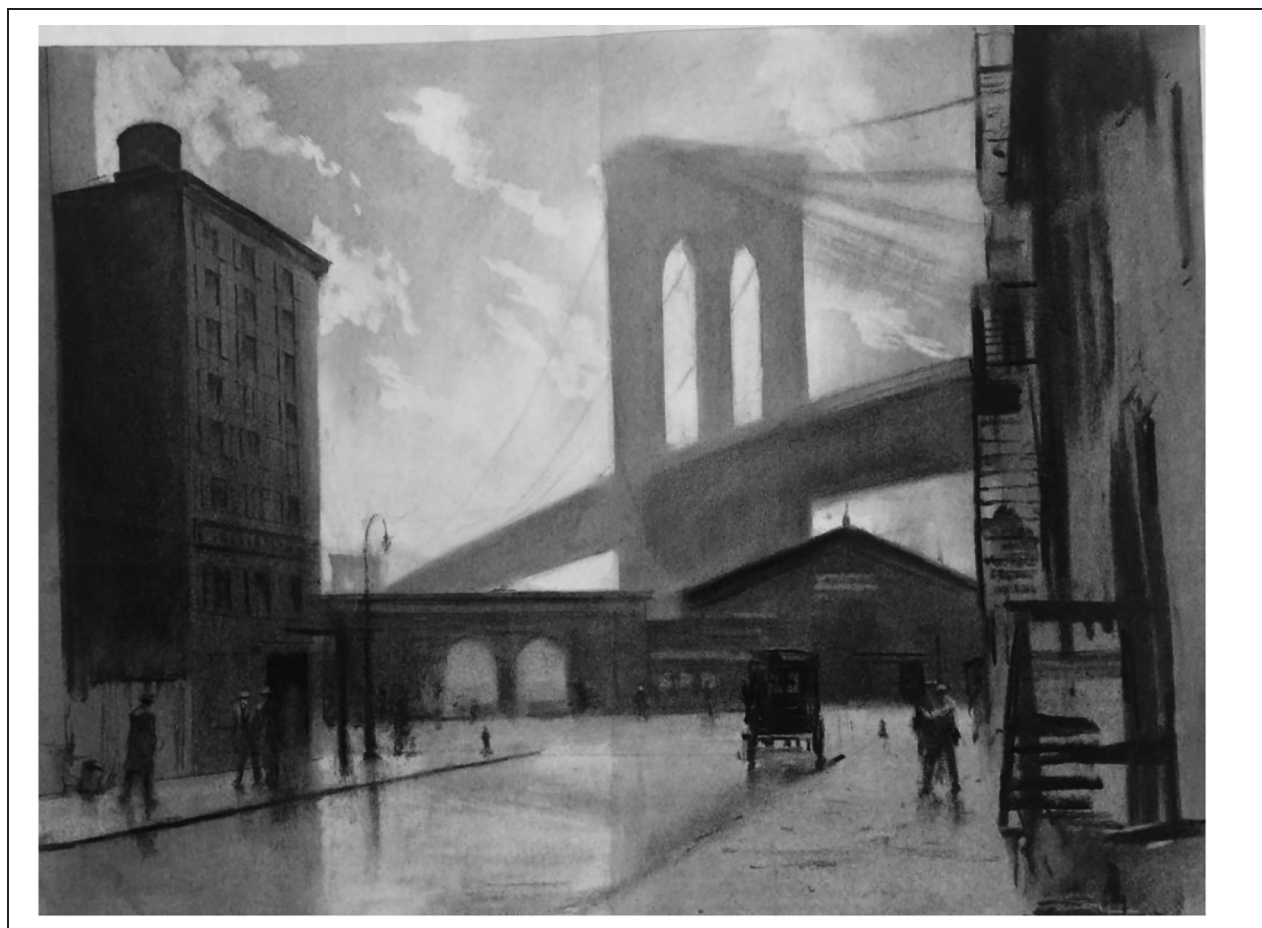
During this process, we also had the opportunity to ponder how past preservation decisions alter the future of collections. When preservation departments make compromises out of constraints of time, money, staff, and space, these choices are incorporated into how we think of an object. Initial housing decisions tend to color future preservation decisions, from rehousing to shelving to exhibition. Not all initial decisions are wrong, but it behooves preservationists to consider how their actions will influence future judgements about an object.

This case study is divided into four sections. The first outlines the history and characteristics of the Selznick Collection; the second details our survey of the items, including the construction design and materials used, workflow, assembly steps, and labeling/access; the third recounts our takeaways from this year-long housing project; and the final section considers both how this project will inform future project

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**Figure 1.** Storyboard from the David O Selznick Collection (photograph by Genevieve Pierce).

management at the Ransom Center and what preservation housing may mean in the context of an item and a collection, and within a larger institution.

## The Selznick storyboard collection

### History

The David O Selznick archive is one of the largest and most popular collections at the Ransom Center, and is vital to the study of the golden age of Hollywood. David O Selznick was a movie producer during the 1930s, 1940s, and 1950s at Metro-Goldwyn-Mayer, Paramount, RKO, and, most importantly, his own company, Selznick International Pictures. His archive spans from 1916–1966. He produced such classic films as *A Star Is Born*, *The Adventures of Tom Sawyer*, *The Third Man*, and *Gone with the Wind*. Selznick also brought Alfred Hitchcock to Hollywood and produced Hitchcock's pictures *Rebecca*, *Notorious*, and *Spellbound* (Harry Ransom Center, 2020b).

The history of the Selznick Collection is, in some ways, the history of early American cinema, and represents a massive collaboration of writers, directors, performers, musicians, art directors, and designers.

These movies are beloved and critically important to those interested in American culture. Storyboards, moreover, are beautiful pieces of art in their own right (see Figure 1). Many artists are featured in this collection, including Dorothea Holt, Mac Johnson, Lyle Wheeler, and William Cameron Menzies. Selznick had a high regard for Menzies especially; he was responsible for the art direction on *Gone with the Wind*, and Selznick later called on Menzies to lead the art direction of *Spellbound* and *Rebecca*. The Selznick archive contains many of Menzies' original pieces, with the "slashing diagonals, overreaching shadows, the low horizon, and worm-eye views" that make Menzies' style so distinctive (Halligan, 2013: 21–22). The storyboard artists' work as creators and film designers is one of the principal draws of this collection.

### Collection scope and materials

The object of the project was to rehouse over 300 unique storyboards and drawings. The Harry Ransom Center contains approximately 2300 linear feet of Selznick archives, but this project focused on rehousing 35 flat-file drawers of storyboards (Harry Ransom



Center, 2020a). The size of each object was, on average, 30" x 20", although the items varied in size considerably. The scene illustrations are painted in watercolor or mixed media on artist board, and depict set designs, costumes, and interior and exterior shots. The different kinds of paper and stages of deterioration of the items in the Selznick Collection made the material complexity of this project quite high (Murphy, 1987).

The storyboards, which were not created to be standalone pieces, are incredibly fragile. Most are illustrations painted directly onto artist board or onto paper that was adhered to artist board. The board used for these objects was made by pressing adhesive and cheap wood pulp paper together to form a thick support; it is now brittle and delaminating. The artists used a wide range of paper for their illustrations, from Bristol to newsprint, which they then adhered to the board with rubber cement. These multiple layers of unstable material both add to the bulk of the pieces and increase their fragility (Murphy, 1987). The Selznick paintings are watercolor or gouache and the drawings are graphite or charcoal. All the media in this collection is prone to cracking, flaking, fading, or smudging. The friability of this media is another reason why the housing had to be carefully designed and sufficiently protective. Most of the art is quite thick, probably 5 mm on average. Many corners and pieces are tenuous or missing, and the boards have bowed, warped, and cracked, and sometimes been taped back together.

### *Use and previous housings*

The popularity of David O Selznick and his movies has led many patrons to seek out this collection. The visual appeal of the storyboards also makes them a favorite. These objects have frequently been handled by researchers and scholars, displayed for tours and classes, and exhibited. The collection was stored on the seventh floor of the Ransom Center and, whenever an item was called down for classroom or reading-room use, a page had to find the piece, carefully lift it out of its drawer, put it on a cart, and, finally, maneuver it through the stacks onto an elevator and to the second floor. Pieces in this collection have made this journey many times, and every trip increases the chance of injury in inadequate housings.

This system presented many problems. Previous housings were either insufficient or nonexistent. Many of the pieces were put in 20-point or 40-point folders and stacked on top of one another; in consequence, the folders made direct contact with the face of the paintings, subjecting them to smudging or

offset. Moreover, the labeling of the folders was not standardized, adding to the difficulty of finding a specific piece. Faulty housing can lead to a cascade of issues, including potential physical damage, cramped storage, and improper labeling. Preserving this collection is especially complicated because each piece is valuable and unique. Consequently, the project necessitated individual housing for each piece. Outsourcing this work was cost-prohibitive, so the Ransom Center relied on staff resources. The institution also had to adopt a plan that would be feasible in the lab space available, provide protection in flat-file storage, cut down on material loss by reducing human error, and still not require years of staff time. In short, we needed a hybrid between mass-produced and customized housing.

To meet the project's needs, the preservation team created a sink-mat structure out of archival-grade corrugated board, which is both extremely light and strong (see Figure 2). The team settled on two different sizes that could be built in assembly-line style. The team also pasted in Permalife paper corners to hold each piece securely in place. We carefully measured these corners to fit each piece individually.

## **Process**

### *Survey*

The team conducted an extensive survey of the collection before deciding on appropriate housing. Because this collection is used so often, it was important to have every piece organized in one survey. In the end, we studied the collection through the lens of preservation and did not do extensive condition-reporting. We recorded measurements, support type, media type, general condition, and any major condition issues, such as losses or cracks.

All told, four staff members, in rotation, measured the pieces and recorded data over two months. The data revealed that the pieces could be sorted into two major categories based on the size of the file drawer into which each one would ultimately be placed. Because we knew where the collection would be stored, the team worked the storage space into the initial design and planned housing to meet its restrictions. This foresight made the project much more efficient. Anything over 20" x 30" was considered large and was housed on 36" x 48" supports. Anything smaller than 20" x 30" went into a 24" x 36" folder. The folder sizes correspond nicely with standard flat-file storage and leave enough space to retrieve the folders easily out of their drawers.

In the past, the Preservation Unit has usually handled large projects like this one in batches, and



**Figure 2.** A storyboard in sink-mat housing (photograph by Genevieve Pierce).

housed items in vendor-purchased housings. For example, for the Ransom Center's collection of 300 oversized photographs, most were separated by size and housed in premade sleeves in batches of about 50. When large photographs needed customized pockets, however, the project often required a considerable amount of material and staff time. Housing a very large photograph in mylar is difficult and, despite our best efforts, creating 300 custom housings necessarily would have taken a massive amount of time, energy, and materials. We created the mass-production model for the Selznick project specifically to cut down on such waste.

#### *Housing concept and design*

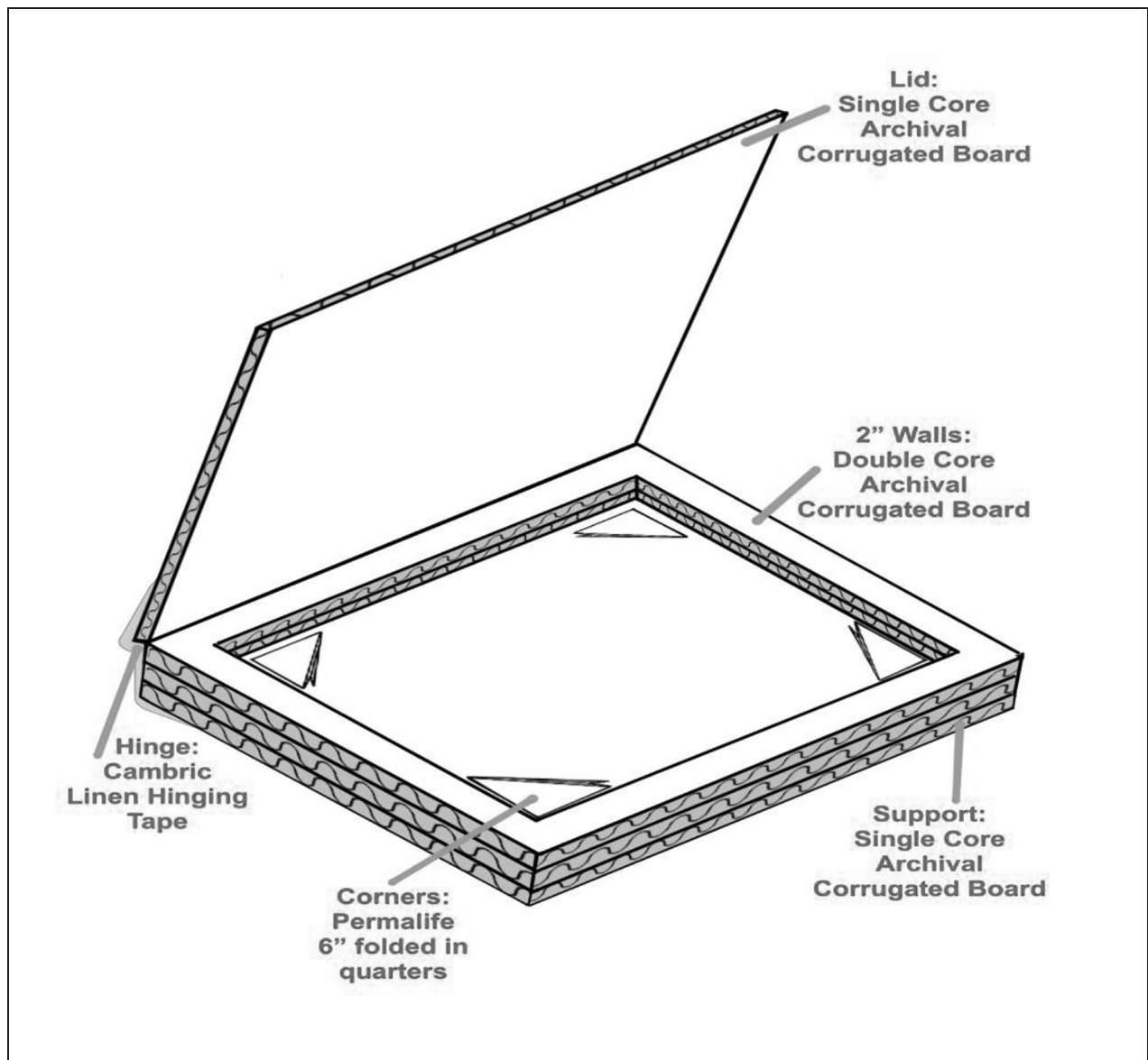
For this project, the usual concern of making a bespoke sink to fit each item was irrelevant; the goal here was to create 300 sink mats that would give each item a protective "box" before customizing each box for its piece. The housing design was, essentially, an oversized sink mat with a lid. Permalife paper corners would then be pasted onto the base support board, which would hold the object gently, but firmly, in place. Traditionally, the walls of a sink mat come

right to the edge of the object to provide maximum protection. For this modified sink mat, however, the walls create a structure in which the object sits, which provides protection for the face of the painting or graphite illustration without coming too close to the object itself.

This modified sink mat consisted of a single-core support board with 2" double-core walls glued around the perimeter. This design created a standard-sized frame in which the storyboard could sit. The storyboard was then secured in place with four Permalife paper corners, much like those used for photograph storage. Finally, a single-core-board lid the same size as the support was hinged on top, creating a "box" which enveloped the storyboard and protected the fragile illustrations (see Figure 3).

#### *Materials and supplies*

We created a plan with simple components and simple assembly to facilitate a smooth workflow. The principal material we used for this project was archival corrugated board, which is both lightweight and strong, making it ideal for large housing projects.<sup>1</sup> The team used single-core archival corrugated board



**Figure 3.** Illustration by Chloe Gise, HRC Preservation Technician.

for the primary support and cover. For the walls, we used double-core archival corrugated board cut into 2" strips. Corrugated board is three pieces of paper glued together with potato starch. Because two pieces of paper flank a fluted inner layer, corrugated board is both lighter and stiffer than boards made by laminating many layers.

The team cut Permalife paper, which is both strong and acid-free, into 6" x 6" squares and folded each one twice to create a protective corner.<sup>2</sup> Polyvinyl acetate (PVA) adhesive was used to glue the walls to the primary support. PVA is a synthetic copolymer emulsion that is commonly used in bookbinding; it is incredibly stable and bonds material tightly with minimal drying time. The preservation lab frequently uses acid-free archival-grade PVA.

Gummed linen hinging tape fixed the cover to the base support board. We use this water-activated adhesive tape for much of our framing because it bonds quickly and is incredibly strong. Wheat-starch paste was used to stick the paper corners to the primary support board. Starch adhesives are made by cooking powdered wheat starch in water until a paste forms. They are mainly used for paper-conservation treatments due to their reversibility and pH neutrality (Preservation Self-Assessment Program, 2016).

### Workflow

Developing our workflow helped us also to better envision the design of the housing. The key to both the workflow and structure design was knowing where this collection would be housed. Separating the

items to be housed based on the size of the flat-file drawer for which they were destined also informed the workflow. Similarly, ordering the supplies and determining how many supports, walls, and lids would be needed helped us to organize the project. Our first goal was to prepare a stock of pre-cut boards from which a technician could readily assemble the parts of the boxes. A work-study student was assigned the bulk of the materials preparation. She cut standard-sized pieces and stacked them in the labs; this way, the preservation technicians could focus on the sink-mat assembly.

Two part-time preservation technicians and one work-study student were dedicated exclusively to this project. I led the project and the other staff member allotted it 10 hours per week. The student employee was available for approximately 11 hours per week and spent almost all her time on this assignment. Neither of the full-time staff members, however, could focus solely on this project. Balancing our responsibilities was complex, and we adjusted our methods continually to increase their efficiency.

### *Structure and assembly*

Each folder consisted of two large single-core corrugated boards, one for the bottom support board and one for the hinged lid. To create the sink structure, four double-core corrugated pieces cut in 2" strips were glued down to the main support board as a frame. We never varied the size of the walls, which saved time by ensuring consistent sink-mat construction.

The folders were either large (36" x 48") or small (24" x 36"), so we had batches of corresponding support boards pre-cut each day. This way, there was a constant supply and the preservation technicians did not have to pause to replenish the components. All told, we cut 200 small (24" x 36") boards, 400 large (36" x 48") boards, and 1200 (2") walls. In addition, we cut and folded 1200 Permalife paper corners.

We did this work across two labs because the project required a lot of space. In the Paper Lab, we handled, measured, and pasted the corners, and stored the art pieces in flat files; this segregation kept the work space cleaner. Once we had measured the storyboard onto the support and added the custom corners, the supports were transferred to the Preservation Lab, where we glued on the walls and attached the box lid. Because we had access to two labs, we had plenty of space for board storage and construction.

The structure and assembly involved four steps. First, our student worker pre-cut the primary support boards and stacked them according to size in the Paper Lab, where the storyboards would be measured. She also pre-cut all the corners and grouped them alongside the support boards so that each piece of the assembly was easily accessible to the preservation technicians. All of the other pieces—the sink, walls, and lids—were stacked in the Preservation Lab. Segregating the two labs ensured that the storyboards were kept in a separate area away from the PVA.

In the second step, the preservation technicians carefully measured each storyboard onto its support. We could not “eyeball” where each piece went; the process required that we measure each piece and center it on the mat. The piece was centered on the support board and position-marked by using small sticky notes to indicate each of the corners. By using sticky notes, we could avoid drawing graphite marks on the support surface. It also made the work go more quickly than if we had marked the board directly. Once the storyboard had been measured, it was put away, and 6" x 6" folded Permalife paper corners were adhered to the boards using wheat-starch paste (see Figure 4). The boards were stacked with sheets of blotter paper in between and given ample time to dry.

After the corners had dried, the support boards and their adhered corners were taken to the Preservation Lab and 2" double-core walls were glued onto the main supports, creating a frame around the corners. The newly glued frame was allowed to dry and then a lid that was the same size as the support board was hinged on top using gummed linen hinging tape. Building this frame structure was essentially assembly-line work, which allowed us to maximize our time and energy. Although precision was still important, it was relatively easy to glue the walls to the support boards and hinge on the lids. We were not yet dealing with the storyboards, just fabricating sink mats. In other words, this part of the project was mass production.

The final, tailored step of the project was challenging because, by this point, the team was fatigued. This portion of the project demanded meticulousness and forced us to focus intensely after performing so much rote assembly; the overall patience for the project was waning. Because the artist board was so fragile, transferring the storyboards to their new housing took both skill and a lot of time to prevent further damage. Handling the delicate pieces was far more difficult than we imagined. The storyboard corners, many of which were tenuously attached, had to be carefully fitted into the Permalife paper corners. Lastly, the housings, which had taken months to design and



**Figure 4.** Preservation technician Jill Morena pasting Permalife paper corners (photograph by Genevieve Pierce).

build, sometimes did not fit correctly and had to be modified. However, this last step of the process was also the most gratifying. Seeing a delicate object in a new, successful housing is rewarding, as is showing off the work that will help preserve these objects (see Figure 5).

#### *Labeling, description, and access*

The last, but essential, step of this project was applying labels. Labeling was not something that we had considered when we began the project. As preservation technicians and conservators, we usually leave this responsibility to cataloguers and archivists. However, we observed during our survey of the original folders that the labeling was inconsistent. In this collection, different movies had different labeling standards, which made counting the items difficult. The team consulted with archivists, cataloguers, and our film curator before settling on a standard numbering system based on the Ransom Center database and divorced from drawer-location assignments. This alleviated a lot of frustration about a piece belonging to a particular drawer—now it could go in any of the

collection's drawers and not be as easily misplaced. This approach allowed for fluidity, which better connected the collection as a whole. We also included a photograph of the corresponding piece on the new lid of each folder so that a page or archivist could easily recognize each one. In this way, the items are much less likely to be put in the wrong folder. In the new drawer layout, the folders stack neatly in tiers, and each label is clearly visible. During the rehousing process, the cataloging and description records for each piece were also updated.

### **Successes, failures, and reflections**

#### *Successes*

*The survey.* From a preservation perspective, one of the most important steps of rehousing this collection was our thorough survey. Although we were not able to create a conservation-treatment report for each item, our assessment provided a snapshot of the overall condition of the collection. The time spent with the materials allowed us to evaluate the needs of each piece and consider several different housing designs before making a decision.



**Figure 5.** Genevieve Pierce housing a Selznick storyboard (photograph by Genevieve Pierce).

*Staff time and communication.* When starting a project that may take hundreds of hours to complete, staff time is one of the chief considerations. Because the most complicated steps of creating housing tend to come at the end, progress seems to decelerate as one goes on. A flexible and understanding attitude regarding the difficulty of a large project like this is helpful. In addition, open communication that allows one to acknowledge challenges and ask for help is essential. Among the other advantages, open communication allowed our team to shift deadlines when needed, reevaluate our goals throughout the year-long process, and confer with everyone involved to move the process forward in mutually agreeable ways.

Because we welcomed open communication from the beginning, we were able to take a more measured approach to the mass production that was necessary at the start of this project. This method took into account not only efficiency, but also the preservation technicians' capacity to produce excellent work over time. Worried about fatigue setting in, we reevaluated the timeline about six months in and delayed the projected completion by another eight weeks. To facilitate our best work as the project progressed, the team found that we needed to pace ourselves. Organizers usually consider material sustainability in projects like these, but it is equally important to consider a

project's toll on its contributors. The workflow and construction design should account for workers' ability to sustain their energy throughout.

The Harry Ransom Center's film curator, Steve Wilson, provided vital support to the Preservation Unit by helping us define our project and set clear goals. He is the steward of this collection and gave excellent advice on what requirements the housing had to satisfy, including handling needs, staff and patron use, future exhibit requirements, and it offering sufficient space. His contributions throughout the project were essential, especially in helping us to correct our course whenever he spotted something that was incompatible with how the collection would be stored, moved, handled, or exhibited.

*Sustainability.* The question of sustainability for this project is twofold. We used far more materials to create the customized housing than had been used in the past for similar projects. However, by creating a longer-lasting box for each piece, we cut down on the need to make additional folders in the future. Also, by investing in robust materials, the housings will protect the items for many years to come. The conservation of collections is the goal of preservation and, without a doubt, the new housing is far superior to what preceded it. The items are now in little danger of damage,

despite heavy use and their frequent movement through the stacks. Also, most of the offcuts from this corrugated B-flute board were either used for this project—making the walls of the sink mat—or saved for other initiatives. Inevitably, there was some waste, but we were able to repurpose most of the board that went unused for future projects. Additionally, the environmental impact of this project was minimal because the housings were made entirely out of paper products rather than mylar.

The material costs for this project were greater than those generally allotted for housing a single collection. However, because this collection had never been properly housed, is popular, and is of great research value, the expenditure was justified. Nonetheless, giant projects such as this place strains on time, budgets, resources, and staff. These challenges may discourage preservationists from even attempting a fix, for fear of not being able to finish the project or of wasting time and resources. However, taking into account the cost of potential future damage caused by neglect or improper housing, the expense of this project was a good investment.

**Storage and use.** This collection's popularity made it a priority for the Ransom Center. For this reason, finding new space for it was relatively easy. We moved the collection, wholesale, to newer, larger flat-file drawers on a different floor, and our housing design took full advantage of this additional space. Having a storage plan in place from the beginning both informed the design and workflow and contributed to the project's overall success.

Similarly, renumbering and relabeling each piece benefited the collection; now, anyone searching for a particular piece can identify it from the photograph pasted on the housing. Although clear labeling is not usually considered an issue of space, any measure that helps keep a storage space tidy prevents items from getting lost in drawers or mishoused. Clear access to an object, without obstruction, also lessens handling and, thus, chance of injury. Although all materials need housing and proper storage, collections that are constantly handled and exhibited are in greater danger of loss.

### **Failures**

Our principal misstep was not initially incorporating digitization into our workflow. As we were labeling each object, we realized that only the most popular items and those that had been previously exhibited were already digitized. Digitization is separate from the Preservation and Conservation Division at the

Ransom Center. Thus, interdepartmental coordination and buy-in from the outset would have been necessary to digitize the rest of the collection. Unfortunately, we did not have the foresight to propose this additional step at the beginning.

Several other impediments also existed to taking these steps. Digitization would undoubtedly have delayed the project, possibly by another few months. Because we were motivated to finish the project, we may have shortchanged this facet of preservation. In addition, because the storyboards are so large, it would have taken a substantial amount of time and expertise to photograph each one adequately. Nevertheless, we might have missed a great opportunity to add research value to this collection. In future large-collection rehousing projects, because the objects are already being handled, the team should allot time for recto and verso photography.

### **Reflections**

This project presented contradictory goals. Bespoke sink mats had to be mass-produced; delicate, popular pieces needed housings that privileged handling and exhibiting, rather than simply storage; and although the workflow was protracted and labor-intensive, the most delicate and intricate work occurred at the very end of the process. Nevertheless, our dual-purpose design met all the Preservation Unit's goals and still had a reasonable cost. For easy production, we designed a support that would come in two sizes. All the pieces would be cut and assembled identically, yet each measure was tailored for the specific piece. The housings would be strong and durable, light enough to carry, and robust enough to bear frequent handling, moving, viewing, and exhibiting. The workflow was based on open communication between departments, and the stakeholders acknowledged the requirement to tailor the project's timelines to the workers' needs.

By quickly creating hundreds of sink mats, the team established a new precedent in the Preservation Unit. We now regard sink mats as a standard boxing option, alongside tux boxes, phase boxes, drop-front boxes, and folders. Also, the preservation technicians are now so familiar with sink mats that we can easily build, design, and tailor them to whatever object needs to be housed. One of the best ancillary benefits of a mass-production project like this is that it gives our team lots of practice. It was gratifying to be able to refine the technical aspects of this design and monitor its future use by staff and patrons. Moreover, part of the value of completing such a large project is being able to

collect data and establish procedures that will facilitate future workflows and designs. In short, we can use the tools we learned here to create more efficient projects going forward.

The Selznick storyboard project highlighted one of the questions that hounds preservation departments, especially when working on large projects: Since storage space in institutions like ours is so scarce, how can we justify rehousing projects that may expand the dimensions of the collection several times over? Originally, this collection was housed in thin folders and the storyboards were confined to a smaller storage area. Nonetheless, smaller housings were not the best choice to protect the objects. This project was an excellent example of how initial housing decisions that reduce a collection's storage footprint can lead to future issues when items are properly rehoused and the collection's size expands. Ideally, adequate preservation housings would be integrated into the initial evaluation of the collection, which would guide storage requirements, regardless of the additional footprint. Housing projects, however extensive, are not ancillary to the items they protect; they are as vital as an accession number or cataloging and description.

## Conclusion

### *Future preservation management*

The value of preservation projects is widely acknowledged, but the time, money, staff, and space that rehousing requires can be very costly. To provide proper protection, preservationists essentially change the nature of an object and the space in which it is stored. While this adds longevity and sustainability to the object, there are often practical considerations, such as storage options and space limitations.

Nevertheless, from the time of an object's initial procurement, preservation housing is integral. The benefit of documenting and tracking housing projects such as this one is in learning how housing evolves throughout the life of a collection, and how housing can change a collection for the better. However, in preservation, human comfort is as important as object sustainability. We strove to balance what was best for the objects, the project, and our team. Reimagining a project's design to include consideration for staff will yield better results for both the object and the institution in the long run.

## *Preservation as advocacy*

Having an independent Preservation Unit within the Preservation and Conservation Division gives our team ample opportunity to consider object housing and advocate for proper housing and storage. In the same way as conservators advocate for an item through means of treatment, catalogers through description and access, and curators through research and exhibition, preservationists add institutional value to a collection by ensuring the proper housing and storage of objects.

Sometimes, preservation work is invisible, just as the protective housing of an item is peripheral to its core existence. Nonetheless, housings can give items a chance to be handled, extend their use value, and inform better storage. In sum, well-executed housing is a necessary addition that affects how an object is observed, handled, and protected.

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## Notes

1. For this project we used TALAS conservation, archival and bookbinding supplies. See <https://www.talasonline.com/Heritage-Corrugated>
2. See <https://www.talasonline.com/Permalife-Paper>

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# Deciding how to decide: Using the Digital Preservation Storage Criteria

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## Abstract

The Digital Preservation Storage Criteria (hereafter, the Criteria) grew out of a community discussion at the 12th International Conference on Digital Preservation (iPRES 2015) on the evolving landscape of digital preservation storage approaches. A Working Group convened to develop guidance for organizations that either use or provide digital preservation storage. The first version of the Criteria was presented at an iPRES 2016 workshop and outlined the Working Group's preliminary results and sought feedback. The Working Group has shared iterative versions over the last three years that have been informed by community feedback gathered through conference sessions, online review and a survey. Possible uses of the Criteria include helping organizations to develop requirements for their digital preservation storage, evaluating digital preservation storage solutions, raising awareness about digital preservation storage, and providing training materials to inform practitioners and others, including a game to demonstrate how the Criteria might be adapted for use. A Usage Guide accompanied the release of the current public iteration of the Criteria to help apply the Criteria. This iteration of the Criteria contains 61 criteria grouped into categories: Content Integrity, Cost Considerations, Flexibility, Information Security, Resilience, Scalability and Performance, Support, and Transparency. The unreleased draft, Version 4, includes an additional category: System Security. In addition to introducing the Criteria and providing background about their evolution, this article highlights new areas of development. First, the preliminary results from an ongoing effort to map the Criteria to relevant international digital preservation and information technology standards are presented. Second, updates to the Usage Guide are discussed. The Usage Guide is a supplement to the Criteria that provides the contextual information necessary for implementing the Criteria and includes sections on considerations such as risk management, cost, understanding independence and ensuring bit safety. Finally, examples of using the Criteria in various contexts are provided to encourage organizations to apply the Criteria to their own situation. The Criteria, the Usage Guide, the Criteria game and related documents are open and available for review at <https://osf.io/sjc6u/>, where future additions and updates will be shared.

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## Keywords

Criteria, standards, risk management, digital preservation storage, digital storage, long-term storage, Open Archival Information System

## Introduction

The need to navigate generations of storage technologies is a challenge for formulating effective preservation strategies. The Digital Preservation Storage Criteria (hereafter, the Criteria) are intended to help address the evolving requirements, emerging and competing solutions, increasing need for capacity, and ever-changing resources available for digital preservation that organizations of all kinds face. The Criteria are a result of a collaborative process within the digital preservation community that began in 2015. This article provides context for the iterative development of the Criteria, highlights recent updates and extensions, and looks ahead to further work and possible developments. The Criteria are in the fourth iterative cycle of definition and elaboration by the Criteria Working Group. Throughout this collaborative process, the Working Group has organized and provided opportunities for community review and feedback. After each round of community engagement, the Working Group integrates or otherwise addresses the feedback gathered to produce new versions, which are publicly available on a project website (Goethals, McGovern, Schaefer et al., 2018).

### *Background on the Criteria creation*

An idea arose during a community discussion of digital preservation storage convened at the 12th International Conference on Digital Preservation (iPRES 2015): Would a guiding document that outlined requirements for digital preservation storage be useful? The acknowledgement of the lack of this type of guidance resulted in a call for volunteers, and a Working Group was subsequently formed to design a set of digital preservation storage requirements. It quickly became clear that the ‘requirements’ would vary from organization to organization, making the objective of a definitive list both unrealistic and unhelpful. The Working Group determined that a set of criteria would be most helpful for the development of good practice for digital preservation storage that is responsive to a shifting technological environment and would allow an organization to select the subset of the criteria that fit its situation. That is the objective of the Working Group and the purpose of the Criteria.

The Working Group gathered requirements from organizations of different shapes and types and then synthesized the results into more general criteria. In

preparation for the 2016 iPRES workshop that introduced the Criteria, the Working Group listed this starter set of criteria in a survey of workshop participants prior to the conference. The survey asked the participants to rank each criterion according to the value they would assign to it. This activity engaged the participants with the Criteria and enabled a productive discussion during the workshop. The feedback from that workshop, and from a session at the annual Library of Congress Designing Storage Architectures meeting, informed Version 2 of the Criteria.

The Working Group then used this same pattern in 2017 and 2018: revise the Criteria; share the next version at iPRES and at the Library of Congress meetings; incorporate the feedback to create a new version and repeat. To expand the reach of community engagement, the Working Group created a Google email group for interested community members to discuss and comment on the resulting versions. Currently, the Working Group is drafting Version 4, which is informed by feedback from a paper presented at (Zierau, Schaeffer, McGovern et al., 2019) and presentations at other meetings.

### *Defining digital preservation storage*

Engaging the digital preservation community in developing good practice for digital preservation storage is hampered by the absence of an authoritative source for definitions. Creating working definitions provides a way to develop a shared understanding of core concepts that enables international collaboration. Early in their work, the Criteria Working Group identified the need for a working definition of digital preservation storage. First, the group had to define ‘digital preservation’. As a starting point, they adopted the Digital Preservation Coalition’s (2015) definition: ‘the series of managed activities necessary to ensure continued access to digital materials for as long as necessary’.

Building on that base, the Criteria’s working definition of digital preservation storage is: a fundamental component of digital preservation infrastructure, both organizational and technological, that supports and enables ongoing digital preservation activities. The term ‘digital preservation storage’ encompasses multiple functional areas (or entities) of the open archival information system (OAIS) *Reference model* (ISO 14721:2012; International Organization for

Standardization, 2012b). In the ‘functional entity’ diagram of the OAIS *Reference model*, the ‘archival storage’ functional entity may appear to equate to digital preservation storage. However, the Criteria use a broader definition for digital preservation storage that includes the ‘archival storage’ functional entity as well as other OAIS functional entities and organizational decision-making and practices for digital preservation that are needed to store, maintain, monitor and retrieve Archival Information Packages. The roles and interactions within the OAIS model that relate to digital preservation storage are explained in McGovern and Zierau (2014). Examples of additional OAIS functional entities in digital preservation storage include:

- Preservation planning, which is responsible for monitoring technology for storage options, relevant standards and practices, and media migrations;
- Data management, which maintains the relationship between preserved content and its associated metadata;
- Administration, which is concerned with policies and standards pertaining to digital preservation storage management and for auditing submissions from receipt through deposit in storage;
- Ingest, which creates and updates preservation packages and is responsible for delivering preservation objects to digital preservation storage.

The *OAIS Reference model* provided a starting point for developing the Criteria and a framework for thinking about how the OAIS functional entities relate to preservation storage. The standards-mapping process described in this article uses a range of other relevant standards in addition to the OAIS to inform the Criteria.

The Criteria are intended to continually enable the digital preservation community to weigh the potential opportunities and risks of modern storage services and options while addressing the expectations of modern digital preservation practices.

### *New developments and use*

The Working Group has developed the Criteria as a set of design attributes with associated considerations for digital preservation storage services. The possible audiences for the Criteria include digital preservation managers who need to implement and manage digital preservation storage, providers of digital preservation storage services, auditors of digital preservation programmes, digital preservation instructors and

students, and practitioners in affiliated domains who rely on digital preservation storage. A guiding principle for the versions of the Criteria has been ensuring that the Criteria remain generally applicable to digital preservation storage in any context by avoiding the inclusion of local practices. The Criteria provide a bridge to implementation by including a Usage Guide and accumulating examples to demonstrate the local use of the Criteria.

The remainder of the article includes five sections that give an overview of the Criteria, highlight recent developments and describe future work on the Criteria. ‘Inside the Criteria’ reviews the content, categories and format of the Criteria. ‘Standards mapping’ explains the Working Group’s efforts to map the Criteria to standards. ‘Inside the Usage Guide’ provides an overview of the topics addressed and the implications of those topics for digital preservation storage planning and implementation. ‘Using the Criteria’ demonstrates through examples the ways in which organizations and individuals might benefit from and apply the Criteria. And finally, the ‘Discussion’ section considers the implications of some aspects of developing the Criteria and shares an overview of ongoing work and possible developments.

## **Inside the Criteria**

### *Presentation*

The Criteria are organized into a table with five columns and one row per criterion, as shown in Table 1. The columns are for the ‘Number’ (sequential identification for the criterion), ‘Criteria’ (short descriptive name for the criterion), ‘Category’ (one of eight topical areas used to group the Criteria), ‘Description’ (short definition for the criterion) and ‘Related standards’ (an area to list relevant standards to the criterion). So, for example, in Table 1, the first listed criterion is *integrity checking* in the category of *Content Integrity*. The *integrity checking* criterion indicates that the digital preservation storage ‘[p]erforms verifiable and/or auditable checks to detect changes or loss in or across copies’.

### *Categories*

Initial feedback from the digital preservation community indicated that instead of simply providing a long list of criteria, some sort of organization would be helpful. In response, the Criteria were organized into categories to group similar criteria together and provide an overall structure. Each criterion belongs to only one category. The categories do not have strict definitions and may be edited in future versions as

**Table 1.** Subset of the Preservation Criteria.

Number	Criteria	Category	Description	Related standards
1	Integrity checking	Content Integrity	Performs verifiable and/or auditable checks to detect changes or loss in or across copies – for example, checksum recalculation, fixity checking, identifying missing files	ISO 16363
2	Independent integrity checking	Content Integrity	Supports fixity checking by other parties – for example, the content-owning institution	ISO 16363
3	Cost-efficient	Cost Considerations	Costs relatively less overall than other comparable solutions by being designed with cost efficiencies – for example, has resource pooling and sharing, multi-tenancy (multiple users share the same applications)	ISO 16363 ISO 17797
4	Energy-efficient	Cost Considerations	Takes advantage of energy conservation principles and techniques in full or in part – for example, requires less cooling, consumes less power, uses less rack space, as in green computing initiatives	
5	Storage weight	Cost Considerations	Meets relevant requirements for physical weight as documented in Service Level Agreement (SLA) – for example, weight may need to be under a certain amount required for a particular floor	
6	Adapts to requirements	Flexibility	Able to adjust storage infrastructure in response to changing local requirements – for example, legal requirements or audit results	ISO 16363 ISO 27001
7	Constrain location	Flexibility	Enables the specification of the location – for example, by geographic region or geopolitical characteristics	ISO 16363
8	Customizable replication	Flexibility	Supports user-defined replication rules – for example, fewer copies of a particular stream of content	ISO 16363
9	Interoperability	Flexibility	Includes storage components that can be easily integrated with other systems and applications (i.e. plug and play) – for example, uses standard file access protocols and file system semantics such as Network File System (NFS), Service Message Block (SMB), Rest Application Programming Interfaces (APIs)	

new criteria are added or current criteria are refined. For example, the *System Security* category has been recently created and will be present in the next version of the Criteria. Currently, there are the following nine categories:

1. *Content Integrity*, which refers to practices that ensure the state of the stored data has not changed. The two criteria that make up this category – *integrity checking* and *independent integrity checking* – require that not only are there detection mechanisms to ensure that the data has not been changed, altered or removed, but also these mechanisms can be audited by internal and external entities.
2. *Cost Considerations*, which reflects the financial impact of storage decision-making. This also includes the criteria that the storage be energy-efficient, which is related to both costs and environmental concerns.
3. *Flexibility*, which refers to the adaptability, interoperability and overall ability to customize digital preservation storage solutions to an organization's needs. For example, the *customizable replication* criterion provides for the ability to establish content-based rules to replicate a variable number of copies. This could be particularly useful for organizations which have policies to keep more copies of content that is classified at a higher value level.

4. *Information Security*, which refers to data protection methods to ensure that the data cannot easily be tampered with or removed. The closely related *Content Integrity* category is about detecting changes to content, while the *Information Security* category is about protecting against those changes occurring, especially across all copies of the content. For example, the *geographical independence* criterion requires multiple copies to be stored in geographically separate locations, thus reducing location-specific risks of data loss. Similarly, the *organizational independence* criterion requires copies to be managed by separate organizations, protecting data from the risks associated with one organization managing all the copies of content.
5. *Resilience*, which refers to the durability and availability of the digital preservation storage system. This category includes criteria such as *durable media*, specifying that the storage media have acceptable longevity rates. The *error control* criterion is concerned with storage-level error remedies, such as Redundant Array of Independent Disks (RAID), ZFS and erasure coding, while the *recovery and repair* criterion helps outline how such remedies should occur: within acceptable time frames, without error propagation and, if necessary, with tools allowing the content-owning institution to remedy the error.
6. *Scalability and Performance*, which refers to computational performance and the ability to be scaled up or down according to organizational needs. This category includes criteria such as *supports expansion*, which provides for an increase in storage capacity, as well as its inverse, *supports reduction*, should a decrease in storage needs arise. It also lists criteria related to system performance such as *compute power*, *file system limits* and *Input/Output (I/O) performance*.
7. *Support*, which refers to support contracts as well as services like training, accessibility and additional preservation services such as migration.
8. *Transparency*, which refers to the visibility into the storage system's functions – for example, auditing, reporting, error notification and documentation. Specific criteria include *open storage formats*, which requires support for non-proprietary storage formats such as tar and the Linear Tape File System. *Expose location*, which requires that the specific storage location

be disclosed to the content owner, may be especially useful in cloud storage architectures.

9. *System Security*, which refers to the security of the system itself rather than the data within it. Closely related to the *Information Security* category, *System Security* contains criteria that are related to managing access to the system, whether in person or virtually. For example, *security protocols* may be required when protective measures for access to physical hardware are regulated. *Authentication integration* may be important for organizations wishing to integrate organizational-wide identity services such as Active Directory.

### Standards mapping

The forthcoming Version 4 of the Criteria will include mappings between specific criteria and relevant standards, such as ISO 14721 and ISO 16363. This feature was intended from the inception of the document. Currently, the following standards have been mapped to the Criteria:

- ISO 16363:2012: *Space data and information transfer systems – Audit and certification of trustworthy digital repositories* (International Organization for Standardization, 2012a).
- ISO 14721:2012: *Space data and information transfer systems – Open archival information system (OAIS) – Reference model* (International Organization for Standardization, 2012b).
- ISO/TR 17797:2014: *Electronic archiving – Selection of digital storage media for long term preservation* (International Organization for Standardization, 2014).
- ISO/IEC 27000:2018: *Information technology – Security techniques – Information security management systems – Overview and vocabulary* (International Organization for Standardization, 2018).
- ISO/IEC 27001:2013: *Information technology – Security techniques – Information security management systems – Requirements* (International Organization for Standardization, 2013b).
- ISO/IEC 27002:2013: *Information technology – Security techniques – Code of practice for information security controls* (International Organization for Standardization, 2013a).
- IASA-TC 04: 'Guidelines on the production and preservation of digital audio objects'

**Table 2.** Example showing the standards mapped to the criterion *security protocols*.**Criterion: security protocols**

**Definition: Includes protective measures, controls and documented procedures to prevent security incidents related to hardware, software, personnel, physical structures, devices and deletions that are not allowed as part of an approved policy/strategy.**

ISO 16363	5.2.2	Standard specified that ‘the repository shall have implemented controls to adequately address each of the defined security risks’. It also referred to ISO 27000 and ISO 17797 here.
ISO 27000	4.1	‘Organizations need to: a) monitor and evaluate the effectiveness of implemented controls and procedures; b) identify emerging risks to be treated; and c) select, implement and improve appropriate controls as needed.’
ISO 27001	A.8.3.2	Control: Disposal of media – media shall be disposed of securely when no longer required, using formal procedures.
ISO 27001	A.8.3.3	Control: Physical media transfer – media containing information shall be protected against unauthorized access, misuse or corruption during transportation.
ISO 27001	A.11.1.2	Control: Physical entry controls – secure areas shall be protected by appropriate entry controls to ensure that only authorized personnel are allowed access.
ISO 27001	A.16.1.1	Control: Responsibilities and procedures – management responsibilities and procedures shall be established to ensure a quick, effective and orderly response to information security incidents.
ISO 27001	12.4.2	Control: Protection of log information – logging facilities and log information shall be protected against tampering and unauthorized access.
ISO 27001	A.13.1.1	Control: Network controls – networks shall be managed and controlled to protect information in systems and applications.
ISO 27002	A.8.3.2	Control: Disposal of media – media shall be disposed of securely when no longer required, using formal procedures.
ISO 14721	3.1	‘Follow documented policies and procedures which ensure that the information is preserved against all reasonable contingencies, including the demise of the Archive, ensuring that it is never deleted unless allowed as part of an approved strategy. There should be no ad-hoc deletions.’ (International Organization for Standardization, 2012b)
ISO 14721	3.2.5	‘In particular AIPs [Archival Information Packages] should never be deleted unless allowed as part of an approved policy; there should be no ad-hoc deletions.’ (International Organization for Standardization, 2012b)

(International Association of Sound and Audio-visual Archives Technical Committee, 2009).

Additionally, the following standards are under review for applicability and potential mapping to the Criteria:

- ISO/TR 15801:2017: Document management – Electronically stored information – Recommendations for trustworthiness and reliability (International Organization for Standardization, 2017).
- ISO/TR 18492:2005: *Long-term preservation of electronic document-based information* (International Organization for Standardization, 2005).

Certain criteria map to many of the different standards that were reviewed. One such criterion, *security protocols*, states that the digital preservation storage ‘includes protective measures, controls and documented procedures to prevent security incidents related to hardware, software, personnel, physical structures,

devices and deletions’. As one may expect, this criterion mapped to all three of the related *Information technology – Security techniques – Information security management systems* ISO standards – ISO 27000, 27001, 27002. Table 2 shows the specific areas and wording that relate to the criterion definition. Section 4.1 of ISO 27000 states that: ‘Organizations need to: a) monitor and evaluate the effectiveness of implemented controls and procedures; b) identify emerging risks to be treated; and c) select, implement and improve appropriate controls as needed’ (International Organization for Standardization, 2018: p. 11). ISO 27001 maps to this criterion in eight different areas of the standard, as outlined in Table 2. In addition to noting the standard in the ‘Related standards’ column as shown in Table 1, Version 4 of the Criteria will include a detailed mapping of each criterion to the specific section of a related standard and also the relevant text from the standard, much like in Table 2.

The process of mapping the criteria to standards has highlighted the need to reword particular criterion definitions, as well as identifying new potential criteria. For example, in reviewing the same *security*

*protocols* criteria discussed above, it became evident while mapping to the OAIS that there was a need to refine the original definition to address ad hoc deletions and approved policies, both of which are explicitly mentioned in the OAIS. Thus, the new definition of the criterion was drafted as: ‘Includes protective measures, controls and documented procedures to prevent security incidents related to hardware, software, personnel, physical structures, devices and deletions that are not allowed as part of an approved policy/strategy’.

Another by-product of the standards-mapping process is the identification of new criteria. As standards are reviewed, gaps in the current Criteria are uncovered. One such gap was identified after a review of ISO 27001, which states that: ‘Formal transfer policies, procedures and controls shall be in place to protect the transfer of information through the use of all types of communication facilities’ (International Organization for Standardization, 2013a: p. 51). Version 3 of the Criteria has no criterion relating to policies or procedures around data transfer, yet this is an area of critical concern as the risk of data loss or corruption during transfer is much higher than while data is at rest. To remedy this oversight, a new criterion related to transfer policies and procedures has been proposed. Currently, 18 recommendations for new or revised criteria have been proposed by the Working Group as a result of this standards-mapping work. Each recommendation will undergo further review before being submitted to the digital preservation community for feedback prior to finalizing and publishing in Version 4 of the Criteria.

### Inside the Usage Guide

The Criteria need to be set in the context of basic preservation considerations. For example, an institution’s digital preservation storage solution should be designed so that there is no single point of failure. This means thinking across the solution and making sure that there is enough variability so that incidents or failures will leave possibilities for recovery. Digital preservation storage solutions should be resilient enough to be able to recover from loss of any one part, whether it is caused, for example, by media failure, a malicious attack or the shutdown of a storage company.

Within this larger context of an institution’s overall digital preservation storage solution, an institution may make different decisions about the relative importance of the Criteria for different components – for example, for particular copies, data centres or collections. In this way, some of the Criteria might be

critically important for some of its collections, copies or data centres, but not for others.

The Usage Guide explains the different considerations that need to be taken into account when using the Criteria. Preservation in general is about prevention of loss of data, and the Usage Guide provides context for specific concepts that are important to support that work. The Usage Guide focuses on activities that organizations can consider and perform based on these key concepts. It also addresses the interplay among the concepts and how one consideration has an impact on others. For example, the concept of ‘independence of copies’ is a driver of the concept of ‘risk management’. Similarly, analysis of risks is done in conjunction with ‘cost analysis’, since cost drivers have an effect on which risks can be accepted and which need to be mitigated. The current version of the Usage Guide includes the following key concepts that should be considered in relation to the Criteria:

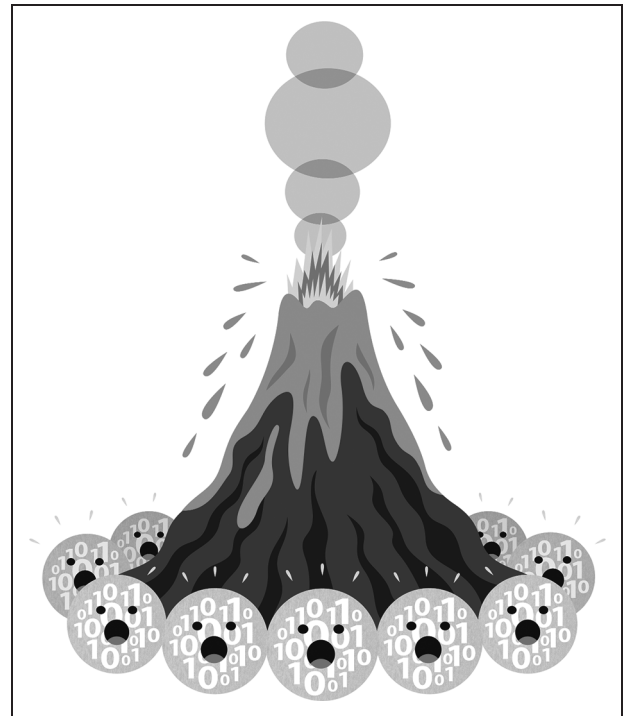
- *Assessing and managing storage solution risks:* An organization can use risk management practices to identify and isolate long-term risks and reduce and mitigate impacts on digital preservation operations. Similarly, an organization can use risk assessment to compare digital preservation storage solutions that address different sets of criteria. Because digital preservation storage solutions must be sustained, it is useful to have a consistent methodology for risk management that can be used by the organization over time, even as solutions change. The description of risk management is based on various literature from both the digital preservation community (Digital Curation Center and Digital Preservation Europe, 2015; Digital Preservation Coalition, 2015) and outside the community (European Banking Authority, 2019; Joint Task Force Transformation Initiative, 2011, 2015).
- *Independence between copies:* For digital preservation storage, risk management must take into account that either no data or only an acceptable amount of data may become lost. This means preventing or reducing the likelihood that one event or incident can harm several copies of the data. The best way to mitigate such risks is to make the copies independent in a way that prevents the same event or incident from harming multiple copies. The individual criteria related to organizational governance, geographic location and technical dependencies should be considered together because of



their combined effect on the degree to which each copy can be relied on. The description of independence is based on a number of references (Rosenthal, 2010; Zierau, 2012, 2018; Zierau and Schultz, 2013).

- *Interplay between number of copies, independence of copies and the integrity monitoring of those copies:* A full risk assessment of digital preservation storage needs to include three essential elements, which are required for evaluating whether a digital preservation storage solution provides the required level of bit safety: (1) ‘number of copies’, where there should be enough copies available to survive the loss of some of the copies; (2) ‘independence between copies’, to mitigate the risks of losing all copies at one event; and (3) ‘integrity checks (of copies and among copies)’, to ensure the continued fidelity of the copies. Together, considerations of these elements determine the degree to which bits are kept safe. Integrity considerations are also a component of information security in combination with requirements for availability and confidentiality, necessitating a balance among these considerations in planning and implementation. The description of the basic elements is based on a number of references (Rosenthal, 2010; Zierau, 2012, 2018; Zierau and Schultz, 2013).
- *Assessing storage costs:* The costs of storage solutions may cause an institution to make difficult decisions about the relative importance of individual digital preservation storage criteria and which risks are acceptable in order to meet budget requirements. An organization can use cost analysis to identify and isolate storage solution costs that are specific to digital preservation, and/or to compare the costs of storage solutions that address different sets of criteria. The description of the cost assessment is based on various literature from both the digital preservation community (4C, 2014a, 2014b; Wright et al., 2009) and outside the community (International Cost Estimating and Analysis Association, 2020; United States Government Accountability Office, 2009).

As the key concepts in the Usage Guide are inter-related, each organization can take into account how these concepts are related and relevant to their particular situation for evaluating and using the Criteria. The Usage Guide is designed to outline issues and provide direction for available resources that may help organizations to get the most out of the Criteria.



**Figure 1.** An image of copies threatened by an erupting volcano, which is used to illustrate the need for the Criteria.

In the work with mapping standards to the Criteria, it has become apparent that there are additional concepts that need to be added to the Usage Guide. These are:

- *Considering how an organization supports storage criteria:* The organization’s policies and strategies are important to maintain and sustain digital preservation storage over the long term.
- *Ensuring sufficient level of documentation:* The level of documentation of digital preservation actions is crucial for performing health checks or proving compliance with policies and audits.
- *Establishment of needed service-level agreements:* Both internal and external service-level agreements can be crucial for ensuring that the service will meet the organization’s digital preservation storage requirements.

The Criteria’s logo illustrates the interconnectedness of the considerations discussed in the Usage Guide (see Figure 1).

If all copies of the digital materials are co-located at an erupting volcano, it will not matter whether there are 10, 100 or 1000 copies, since all will be lost if an eruption occurs. This is because the copies are not placed in geographically independent locations. The Criteria could be used with risk management and, of

**Table 3.** The audiences and uses of the Criteria.

Users	Potential uses
Digital preservation storage consumers	<ul style="list-style-type: none"> <li>• Prioritize facets of digital preservation storage</li> <li>• Inform more detailed requirements for digital preservation storage</li> <li>• Identify gap areas in current digital preservation storage</li> <li>• Evaluate or compare among digital preservation storage options</li> <li>• Evaluate the digital preservation storage for each copy location</li> <li>• Communicate digital preservation storage needs with information technology staff</li> </ul>
Digital preservation storage providers	<ul style="list-style-type: none"> <li>• Reference or indicate compliance with particular digital preservation storage criteria</li> <li>• Compare competing storage solutions</li> </ul>
Digital preservation instructors	<ul style="list-style-type: none"> <li>• Contribute to instructional material on digital preservation storage</li> <li>• Inform good practice for digital preservation storage</li> </ul>
Digital preservation community	<ul style="list-style-type: none"> <li>• Provide a common language and framework for discussion</li> <li>• Bridge digital preservation storage consumer and provider perspectives</li> <li>• Navigate differing views – for example, between practitioners and information technology, or within the digital preservation community</li> </ul>

course, cost considerations to make a set-up which is so safe that we do not need to rely on luck.

### Using the Criteria

The Criteria were developed to help any organization that is responsible for the storage and long-term preservation of digital materials, as well as other audiences – for example, providers of digital preservation storage and digital preservation instructors. For each of these audiences, multiple ways of using the Criteria were envisioned (see Table 3).

In practice, the Criteria have been used in the ways described in Table 3 by a variety of institutions.

At the ‘Using the Digital Preservation Storage Criteria’ workshop at iPRES 2018 (Goethals, Mandelbaum, Schaefer, et al., 2018), individuals from five different cultural heritage and academic organizations shared practical examples of how the Criteria had been used within their organizations. One of these institutions demonstrated well that the Criteria could be used in a variety of ways. This university had used the Criteria (1) as a reference for the Digital Curation Librarian; (2) to expand conversations and thinking between the library and other parts of the university; (3) as a component of its evaluation of institutional repository platforms; and (4) for a gap analysis of the campus’s storage infrastructure. Here are further examples of how the Criteria have been used to advance understanding and good practice:

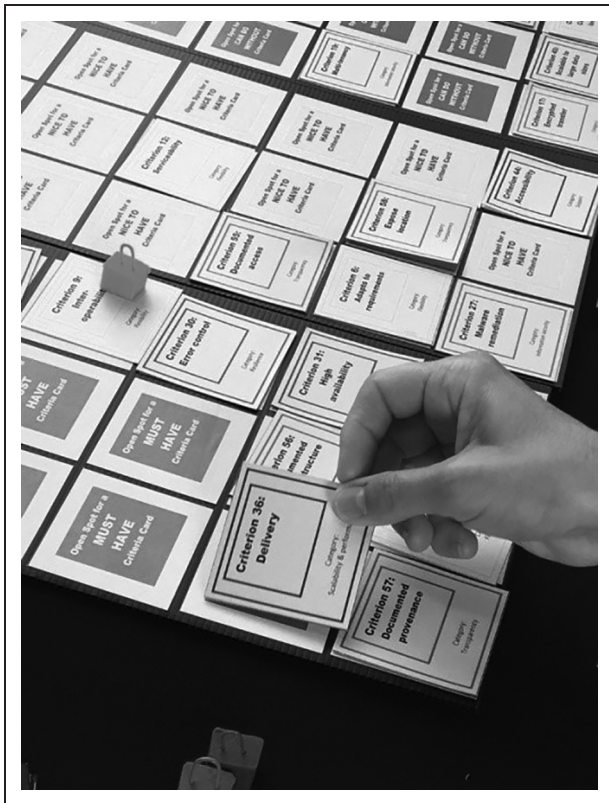
- The Criteria Working Group used the Criteria as a basis for an educational game to help individuals think about the characteristics of digital preservation storage.

- MIT Libraries used the Criteria to develop the appropriate digital preservation service for its collections.
- Archives New Zealand used the Criteria as a framework for the storage component of the digital preservation guidance it provides to institutions.
- The University of Melbourne used the Criteria as a starting point for generating discussion and for ultimately developing its storage requirements for preserving its collections.

### Used for education by the Criteria Working Group

For an iPRES 2018 workshop, the Criteria Working Group created the Criteria game (Goethals et al., 2019) to introduce the workshop participants to the Criteria. The game board is divided into an equal number of tiles labelled as either ‘must have’, ‘nice to have’ or ‘can do without’. Players take turns selecting a criterion card, reading the definition if they are not familiar with the concept, and then choosing to classify it as a ‘must have’, ‘nice to have’ or ‘can do without’ (see Figure 2).

Each player is randomly assigned an organizational role that provides context for considering the relative importance of the criterion. For example, one role is: ‘You are from a small cultural heritage society with few resources but unique material’. A person with this role might rate *high availability* as a ‘can do without’ because of the high financial cost of achieving this objective. Another example role is: ‘You manage an archive with confidential and highly sensitive material’. A person in this role might classify *encrypted*



**Figure 2.** A player of the Criteria game.

*transfer* as a ‘must have’ because of the security requirements of this material.

When a player places a criterion card on a game tile, they must give a reason for classifying it in the way they have. For example, the player classifying *encrypted transfer* as a ‘must have’ could say: ‘My institution’s security policy requires confidential and highly sensitive material to be encrypted whenever it is in transit, so this is a must-have requirement’. The reason for this game rule is that it gives players an opportunity to practise making the case for particular digital preservation storage characteristics, as they might have to do within their own organizations. It also gives them a chance to think about different contexts and how they might affect the relative importance of the criteria.

#### *Used for infrastructure design by MIT Libraries*

During a multi-year project, MIT Libraries used the Criteria to develop and launch its Comprehensive Digital Preservation Services (CDPS). Initially, the Criteria helped the CDPS team discuss and explore the requirements for digital preservation storage, and then to define and complete a review of the Criteria. The process informed the definitions in the ‘Levels of digital preservation commitment’ (McGovern and Smith, 2020) document, which

outlines the categories of digital content that MIT Libraries intends to preserve, with the corresponding care level. The levels helped to right-size digital preservation storage options for components of MIT Libraries’ digital collections. The review results framed the CDPS foundational services that include digital preservation storage and informed the MIT Libraries Maintenance and Support Plan for CDPS. The CDPS Criteria review included the following steps:

1. Rank the Criteria for CDPS: The CDPS team ranked the Criteria as each applied to this phase of digital preservation storage development.
2. Define provider service status: The CDPS team suggested a service status for each criterion, and the two providers for MIT’s digital preservation storage confirmed or modified in completing their responses.
3. Criteria review response review: The CDPS team iteratively reviewed the provider responses until responses for all of the Criteria were complete and documented.
4. Evaluate Criteria review response: The CDPS team combined the responses into one spreadsheet that informed the development of the CDPS Maintenance and Support Plan and is being used to monitor and assess CDPS. This spreadsheet will be updated as new versions of the Criteria are shared.
5. Synthesize results for service features: The CDPS team synthesized the Criteria review results into a set of CDPS service features and characteristics that is appended to the Maintenance and Support Plan and will be used in monitoring and enhancing CDPS.
6. Define service responsibilities: The CDPS team defined an initial RASCI matrix for CDPS that specifies roles (responsible, accountable, supporting, consulted and informed) for digital preservation, digital archives and information technology responsibilities.

MIT Libraries launched CDPS in June 2020 with Archivematica and digital preservation storage. The CDPS team is monitoring the services and will evaluate them at the end of Year 1 using the results of the Criteria review. Details of MIT’s Criteria review with illustrations are available on the Criteria’s website (McGovern, 2020).

### Used for guidance by Archives New Zealand

Archives New Zealand provides online guides and resources to help information managers meet the requirements of relevant laws and standards and implement good practice. One guidance section is on the operational implementation of records and information management, including best practice guidance on digital storage and preservation (Archives New Zealand, 2020). Archives New Zealand used the Criteria as a basis for its guidance on digital preservation storage, adapting them to fit the context of information and records management.

The guidance is structured under headings that map to many of the Criteria's categories:

- Content integrity and authenticity;
- Content discovery, identification and reuse;
- Flexibility;
- Information and system security;
- Resilience;
- Scalability and performance;
- Support;
- Transparency;
- Risk management.

Archives New Zealand adapted the Criteria to emphasize what it determined to be important in its information and records management context. For example, the ability to support content authenticity is made explicit as an important characteristic to consider for digital preservation storage. This is how the Criteria were intended to be used – as a community resource that can be adapted to fit local contexts.

### Used to develop requirements by the University of Melbourne

One of the University of Melbourne's key principles defined in its digital preservation strategy (Shadbolt et al., 2013) is to commit to ongoing investment in high-quality infrastructure, including a secure, persistent storage infrastructure. To define its requirements for digital preservation storage, it ran a workshop (Weatherburn, 2018), bringing together university archivists, records managers and information technology staff to discuss their digital collections and their digital preservation storage requirements. The goals of the workshop were to gain a shared understanding of acceptable digital preservation storage and articulate requirements and general principles. Version 2 of the Criteria was used as a starting point for discussion, and from this a set of 24 of the Criteria was selected as particularly important for the University of Melbourne's context (see Table 4).

**Table 4.** The subset of the Criteria prioritized as important to the University of Melbourne.

Category	Criteria
Content Integrity	<ul style="list-style-type: none"> <li>• Provides integrity checks</li> <li>• Provides preservation actions</li> </ul>
Flexibility and Resilience	<ul style="list-style-type: none"> <li>• High resilience</li> <li>• High availability</li> <li>• Recovery</li> <li>• Designed for zero data loss</li> </ul>
Information Security	<ul style="list-style-type: none"> <li>• Secure</li> <li>• Access controls</li> <li>• Integration with authentication</li> <li>• System error reporting</li> </ul>
Scalability and Performance	<ul style="list-style-type: none"> <li>• Supports expansion</li> <li>• Supports reduction</li> <li>• Use of multiple storage availability levels</li> <li>• Complete exports</li> </ul>
Storage Locations	<ul style="list-style-type: none"> <li>• Geographic separation</li> <li>• Replication</li> </ul>
Transparency	<ul style="list-style-type: none"> <li>• Supports open storage formats</li> <li>• Self-healing transparency</li> <li>• Supports independent preservation actions</li> <li>• Provides content reports</li> <li>• Provides activity reports</li> <li>• Documented infrastructure</li> <li>• Documented access</li> <li>• Documented provenance</li> </ul>

One of the guiding principles of the Criteria is that not all of the Criteria will be applicable to all institutions. They are meant to be used as a base for deciding what is most important given local policies, applicable regulations, needs and preferences. This example of the University of Melbourne shows how organizations can bring together key stakeholders in a similar exercise to prioritize the Criteria based on their local context.

### Discussion

Differences in perspectives can alter the interpretation of the Criteria and highlight additional considerations. Depending on the role an institution plays with regard to digital preservation storage, each criterion could be interpreted as having a 'providing' or 'receiving' implication. For example, the *documented access* criterion is defined as: 'Provides immutable logs and/or reports that show all file system access'. A digital preservation storage service provider could interpret this criterion to mean that they are responsible for

providing the logs and reports, while an institution purchasing digital preservation storage from a vendor could interpret this criterion to mean that it expects to receive the logs and reports.

In addition, the standards currently mapped to the Criteria can provide users with further considerations from the perspectives of different disciplines. For example, the *adapts to requirements* criterion refers to the need for digital preservation storage to be adjustable so that it can adapt to changing requirements. In ISO 16363, the standard for trusted digital repositories, this adaptability is important so that the preservation repository can provide an appropriate level of service to repository users. This standard also points out that supporting processes will be required to regularly monitor technological changes so organizations can evaluate and decide whether to implement these changes to their digital preservation storage (International Organization for Standardization, 2012a). In ISO/IEC 27001, a standard for information security management systems, this adaptability is important, particularly around an organization's requirements for information classification, information value and criticality, cryptographic controls and processes for handling assets, so that the system can adhere to any agreements, legislation or regulation when necessary (International Organization for Standardization, 2013b).

Developing the Criteria using an iterative and collaborative approach ensures that they remain continually relevant to their users and informs quality practices in an era when technological change is commonplace. In each iterative cycle, the Criteria are updated based on feedback and shared learning from users across different types of organizations within the digital preservation community. This approach takes advantage of the collective and evolving experience, knowledge and differing perspectives from within the community to help refine the Criteria and identify gaps where they exist. By reviewing the Criteria and the accompanying Usage Guide iteratively, they can be updated during each cycle to incorporate relevant criteria and key contextual considerations in response to the latest storage technological advances and changing institutional requirements for digital preservation storage. In addition, up-to-date standards that are relevant to digital preservation storage can be reviewed and mapped to better support the Criteria and ensure their ongoing relevance.

### Future development

Looking ahead, the Criteria Working Group will review the working definitions of the Criteria

categories and incorporate new criteria identified as a result of the standards-mapping activity. The Usage Guide will be expanded to include special topics, such as service-level agreements, documentation and organizational aspects, or other areas that will further support the use of the Criteria by the digital preservation community. The Working Group will also share a Standards-Mapping Document, which demonstrates areas of the selected standards that are pertinent to the Criteria. On a continuing basis over time, additional standards relevant to digital preservation storage will be mapped to the Criteria. For example, the upcoming revision of ISO 14721 will be reviewed by the Working Group. The Working Group will continue to engage with the digital preservation community on further development of the Criteria, the Standards-Mapping Document and the Usage Guide.

### Acknowledgements

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# Experimenting with 360° and virtual reality representations as new access strategies to vulnerable physical collections: Two case studies at the KB, National Library of the Netherlands

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## Abstract

In the late 1990s, the explosion of electronic resources resulted in large-scale digitisation projects amid the need for the preservation of digital information. The KB, National Library of the Netherlands, has been actively involved in these activities. Now, it is proposing better ways to both preserve physical library materials and improve their accessibility for educational purposes. This article describes two ongoing projects that involve preservation and public engagement. One, in its early stages, is to test the applicability of 360° imaging to support virtual access to the special collections' storage. The second is the virtual reality production, for educational purposes, of children's pop-up books. Both projects could inspire other libraries to introduce three-dimensional or virtual reality technologies and their applications to new audiences. This article describes each project, shows the methods used, and discusses the expected outcomes.

## Keywords

Collection management, 360° images, virtual reality, automated storage, children's books, preservation, conservation

## Introduction

Collection management is an essential part of everyday library activities. This responsibility includes, among other tasks, selecting, acquiring, maintaining and storing collections. In the late 1990s, the explosion of electronic resources initiated large-scale digitisation projects and digital information preservation. These are two of the main themes of librarianship in the 21st century. One purpose of digitisation is

preservation, but another is making information accessible to the wider public. The KB, National Library of the Netherlands, which was founded in 1798, has collected approximately 7 million physical

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items (books, newspapers, magazines, maps, etc.) that stretch in storage over 125 linear kilometres. Over the past 30 years, the KB has digitised books, periodicals and newspapers on a large scale. These resources are digitised to both preserve them and to facilitate access. Through the website *Delpher.nl*, every Dutch citizen can now search and browse through 120 million pages of digitised newspapers, periodicals and books. Moreover, *DBNL.nl* offers scans of the highest possible quality of Dutch literature. In 2020, both websites were visited in total around 10 million times. To further this massive digitisation effort, the KB is proposing enhanced ways to preserve its physical library holdings and improve, for educational purposes, patrons' access to and engagement with them.

Digitisation has also allowed the library to develop several new interactive education programmes to engage patrons. By giving them access to a digitised copy of an item, the library supports the preservation and prolongs the life of its physical holdings. This article describes two ongoing projects at the KB that aim to aid the preservation of the library's materials and public engagement with them. In the first project, the KB is in the early stages of testing the feasibility of 360° imaging to support virtual access to its special collections. These holdings will become less visible overall if the KB implements plans for a new automated storage and retrieval system (ASRS) to preserve its entire physical collection. In the second project, the KB is using a virtual reality interface for educational purposes; if this effort is successful, it could inspire other libraries to introduce virtual reality. This article represents the first attempt to describe the KB's use of these technologies and to discuss the potential outcomes of these efforts.

The article is structured as follows. It discusses related works and previous research in the 'Background' sections, before detailing the two case studies. The first study explores 360° imaging to support virtual access to the KB's special collections and the second study examines the KB's creation of virtual reality representations of the library's children's pop-up books. The final section offers design guidelines and ideas for future work.

### **Background on library repositories**

The KB collects everything that is published in the Netherlands or concerns the country, which ranges from medieval literature to contemporary publications. This policy means that the KB's collection is continuously growing. The challenge for the KB is to maintain a balance between preserving and offering access to its holdings, both physical and digital. One

difficulty is to provide adequate space and a safe environment for its expanding physical collections. When it is not possible to expand existing library buildings, the solution is either to redesign the current space or to move collections into a super-high-density facility.

Purpose-built high-density facilities usually follow one of two designs: the 'Harvard model', which was designed for manual retrieval, and the ASRS model, where retrieval is performed by a robotic mechanism. The first model was created at Harvard University in 1986 and is now used in libraries all over the world, especially in North America (Weeks and Chepesiuk, 2008). The ASRS model, by contrast, is more often used in industrial settings such as distribution centres for supermarkets. However, the ASRS model has been used in some library collections. For example, the British Library repositories in Boston Spa and the cooperative *Speicherbibliothek* in Büron, Switzerland, both use the ASRS model.

### **Background on the use of virtual reality in libraries**

Like the KB, many libraries strive to make their digitised items available through their websites or other platforms, such as the Microsoft Live Search Books project, the Google Books Library Project or the Open Content Alliance (Payne, 2007). Until recently, however, libraries seldom used augmented, virtual or mixed reality to expand access to their collections. The COVID-19 pandemic, by necessity, has changed the way people access heritage collections, but, before this period, several libraries experimented with these technologies. Especially after 2014, virtual reality, augmented reality, mixed reality, three-dimensional (3-D) modelling and 3-D-capture techniques became increasingly common in higher education, research and teaching (Grayburn et al., 2019; Milgram and Kishino, 1994). It is no coincidence that, in 2014, Google released its Cardboard virtual reality viewer, which made virtual reality widely accessible. In the following years, a series of fully functional virtual reality headsets made it possible to harness virtual reality in new fields, such as architecture, design and the humanities (Figuerola, 2018).

Libraries seldom used virtual, augmented or mixed reality technologies for education projects until recently. For instance, students at the University of Iowa developed a reality sandbox to help them visualise how gravity works (Gravbox, 2018). Also, Maryland's Prince George's County Memorial Library System uses Google's Tilt Brush so that users can paint in 3-D (Dar, 2018).

Also, libraries sometimes provide space and services to help develop projects or collaborate with other institutions, such as universities or private companies. For instance, in 2018, the University of California San Diego Geisel Library's Digital Media Lab offered virtual reality headsets, 3-D printing and digital expert consultation to students and a general audience (Oyelude, 2018).

### **KB's future storage solution for its physical collections (Foekje Boersma)**

The KB's physical collections are currently located in the National Library building in the centre of The Hague. The collections are stored in static stacks in 29 climate-controlled compartments over 9 floors. The current system will pose several challenges in the future. First, there is limited space for the collection to grow. Second, the building needs renovations that will be extremely expensive to make. Third, the use of space for storage in a prime location in the centre of the city is not economically sustainable. Finally, the way patrons use the library is changing; there are markedly fewer requests for physical items, aside from special collections, and there is increased access to digitised materials online.

For these reasons, the KB is exploring the possibility of moving its entire physical collection off-site to a dedicated external facility. Modelling its plans on the cooperative library storage facility in Büron, the KB is considering an automated, super-high-density storage facility with passive climate control. The planned building would passively maintain a safe climate for collections, with the temperatures adjusting with the seasons and the relative humidity stabilised by the dense storage of the hygroscopic collections themselves, which are capable of absorbing and desorbing moisture from the air. The KB's location in a temperate climate makes this plan feasible.

To maximise the benefit of the climate's lower temperatures (10–12°C in winter), the facility should be automated and human activity in the storage area limited. These restrictions also facilitate high-density storage. In order to mitigate fire risk, oxygen levels in the storage area will be kept artificially low. To mitigate flood risk, the plan is to construct the building on a 2-metre-high artificial hill.

ASRSs, where collections are placed in standard plastic or metal containers and organised by size, are unexceptional. However, the KB's plan to also store its special collections in this environment is more novel. Many cultural heritage specialists resist the idea of a medieval manuscript being confined to a plastic container, placed in a high rack and retrieved

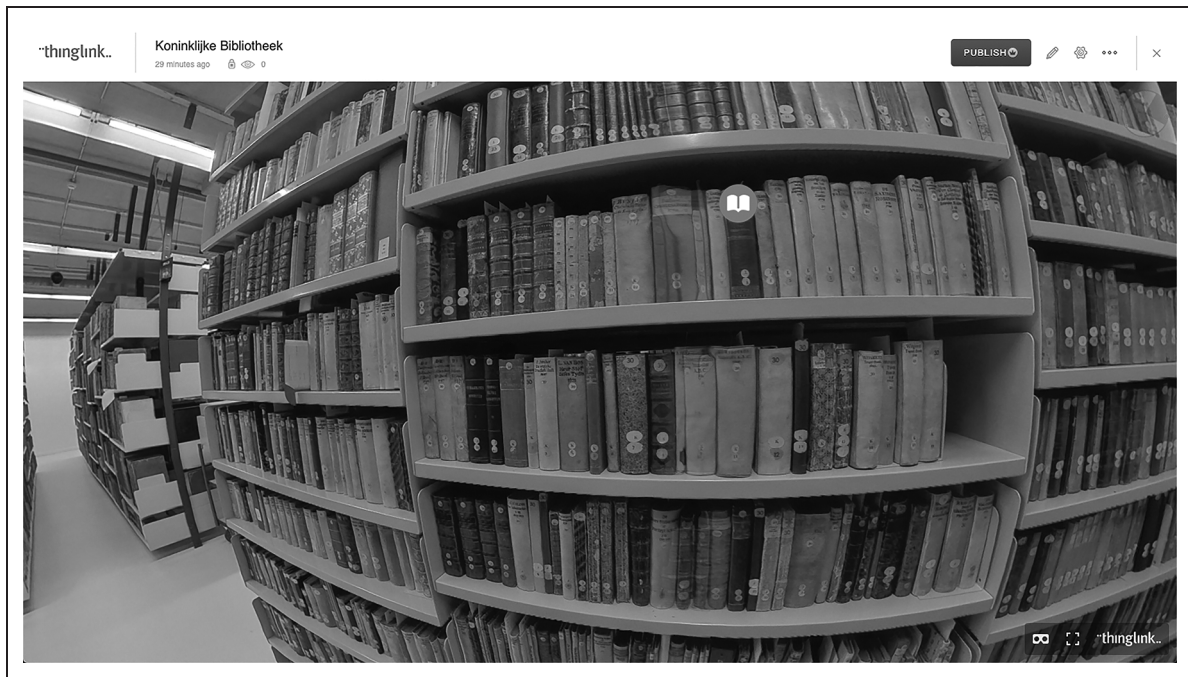
only by an automated system. Nevertheless, based on the risk assessment, climate modelling and other institutions' reports, the new set-up is sensible (American Society of Heating, 2019; Boersma et al., 2014).

It is, however, difficult to let go of the experience of being in the library stacks as they exist now. It is not that these stacks have a special design or aesthetic value – the KB's current building dates to the early 1980s – and access to special collections is restricted to authorised staff. Of course, books can be retrieved using the catalogue, but for collection specialists, curators and conservators alike, being able to see the collection is an important part of their care for these items and can also assist their research. For this reason, the Conservation Department is conducting a survey of the condition of different special collections' materials; this assessment ought to provide an overview that the KB can use to plan its move and for the long-term prioritisation of collection-care activities. The KB is exploring ways in which the visual and tactile aspects of these items can be captured and preserved. Virtual reality offers perhaps the best opportunity to achieve this aim.

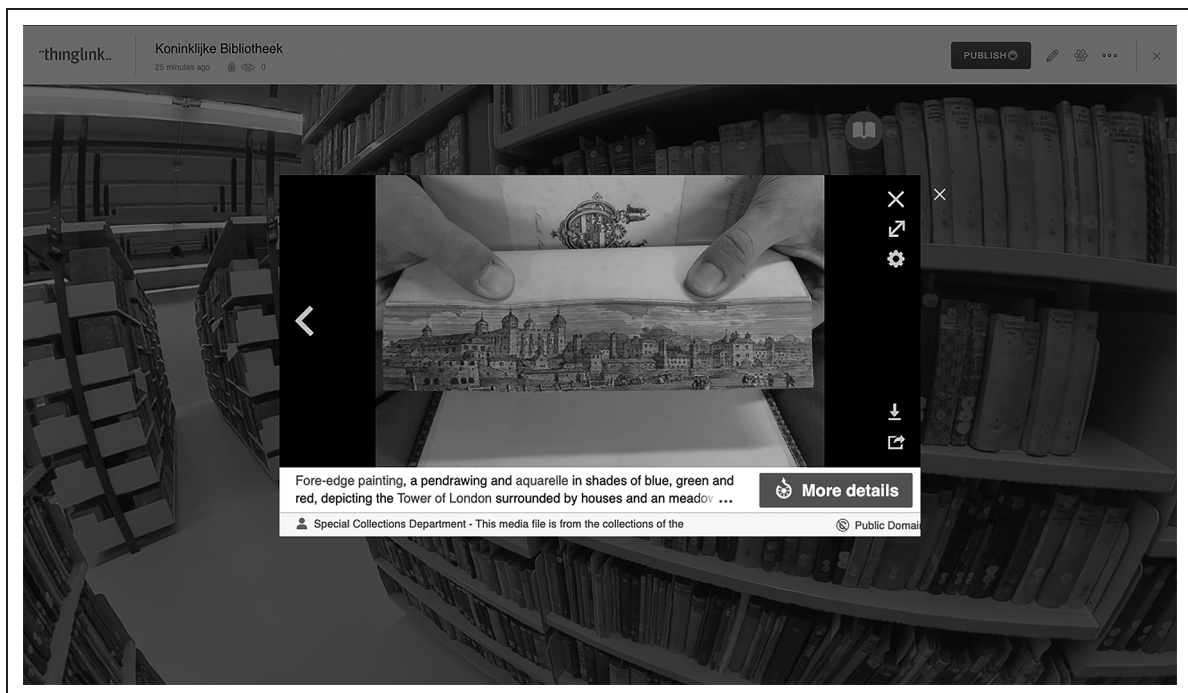
### **The 360° images of the special collections' storage: methods and approaches (Marzia Loddo)**

If the KB chooses an ASRS, it would radically change the way in which it currently manages access to its collections. The care and maintenance of the collections, performed by stack-keepers and conservators, relies on their having access to the stacks. Although access to special collections is restricted to authorised staff, they benefit from access to them for research. All this might change in the future, however. A large part of the collections has already been digitised and users can access the digitised versions online. However, with these changes, the possibility to look at the books in person may largely disappear. In the special collections of the KB, the books are mainly positioned by size and date of entry, rather than by subject. However, for centuries, open shelves have helped researchers find new resources because other relevant books are positioned near those that they know are relevant to their research.

With the DIPOT project, Marzia Loddo aims to preserve high-quality access to the KB's special collections.<sup>1</sup> The current arrangement of the books in storage was captured by using a 3-D camera (Insta360 EVO). The camera was installed on a tripod and placed in different areas of the current stacks. Images were captured through the technology platform ThingLink. Once collected, they were analysed and



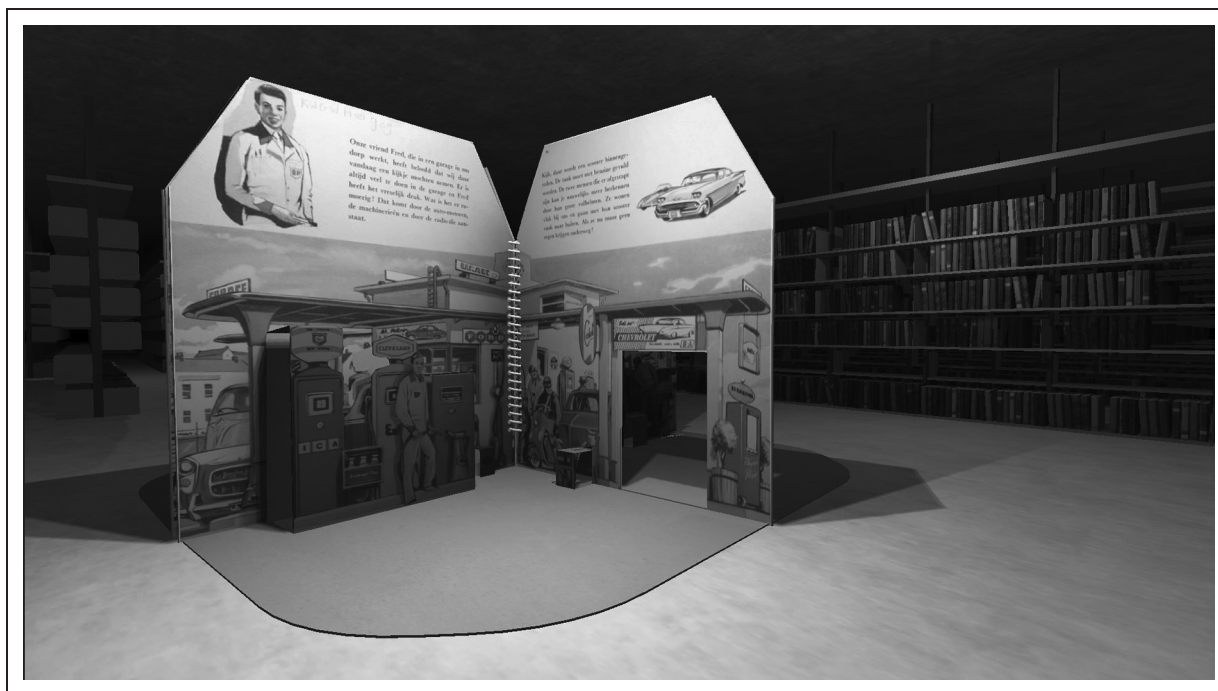
**Figure 1.** The 360° representation of the KB's special collections' storage (Loddo, 2020).



**Figure 2.** The green button – placed on the book in Figure 1 – redirects the user to the digitised copy of the manuscript (Wikimedia Commons, 2018).

equipped with interactive elements (Figure 1). With this tool, the library could, theoretically, connect each book on the 360° image with hyperlinks to the digitised copy, a conservation report, additional images and other materials (Figure 2). Moreover, a user can roam freely in the recorded 360° space, zoom in and out for a different view, and make out the titles on the

shelf. In addition, this system makes it possible to access links that provide information about the author, printer, illustrator or former owners. These links might even connect, through linked open data, the book selected with other online resources (Loddo, 2020). Currently, Marzia Loddo is in the early stages of testing the usefulness of this 360° image with



**Figure 3.** The virtual reality representation of the carousel book 'Garage', with illustrations by N Dear (published between 1950 and 1960), in the virtual library environment Source: KB-Koninklijke Bibliotheek (2020).

several groups of higher education students at the Delft University of Technology. She is also testing 360° representations of other settings, including museums, and plans to compare the 3-D representations with others made using virtual, augmented and mixed reality.

### Experiments with a virtual reality production of novelty children's books: methods and approaches (Martijn Kleppe and Karin Vingerhoets)

One of the special collections of the KB is novelty children's books, such as pop-ups. Novelty books are those whose design is more elaborate than leaves sewn between two flat covers (KB, 2019). The pages may fold out like a concertina or illustrations may pop up. Novelty books are often quite fragile and easily damaged, particularly if they are used by young readers, who are often more enthusiastic than careful while handling books. Visitors can only access novelty books on-site and by request.

To preserve the books, the KB is experimenting with virtual reality production as an alternative to physical access. The library began this project with three novelty books from the 1950s and 1970s – a pop-up book about Noah's ark, a carousel book about a car repair shop, and a fan-folded street scene – and one book from 1863 – a picture book on farm life with movable parts. The copyright of the last book had

expired, but the KB conducted research to identify the illustrators of the other books and traced their heirs to ask permission to use the books for this project. This step took several months and is still ongoing for one of the books.

For the virtual reality production, the library collaborated with Justin Zijlstra and Tijmen Lohmeijer, who specialise in making immersive, interactive experiences. With their help, the KB carefully photographed the books from all possible angles in the library's photographic studio. Zijlstra and Lohmeijer then recreated the books in a virtual environment and mapped the photographed footage onto 3-D models. They added shadows and surrounding bookcases to give the viewer the feeling of being in a real library (Figure 3). They also added sound effects, such as a voice that reads parts of the story and the background noises of a radio and banging hammers in the car repair shop.

Using an Oculus Quest virtual reality headset, users can explore the books in different ways. They can see a representation of their own hands in the virtual environment and use them to open the books, move them and turn on sound effects. Also, moving one's body allows one to move around in the virtual world; users can walk around the virtual books and view them from any angle. The virtual reality experience lets users enjoy the details of the books close up and appreciate the craftsmanship in a whole new way.

## Discussion

This article has investigated two ongoing projects at the KB that involve digital-representation techniques. The first description recounts the early stages of testing 360° imaging to support virtual access to the library's special collections. Currently, a group of students at the Delft University of Technology are testing the system. After this pilot test, the KB intends to extend the use of the 360° application to a wider audience. In this way, curators, book historians, archive professionals, conservators, scholars and the general public can virtually browse the KB's stacks in ways that are impossible in real life, due to restricted access. In addition, this virtual representation will be an invaluable record of what has been collected and how it has changed over time.

The second project has pioneered virtual reality as a means to introduce older books to the general public in an exciting way and help these materials find a new audience. Virtual reality is more realistic and vivid than two-dimensional photography. The KB is currently setting up a user study to understand how different users experience virtual reality and their impressions of its value. The study's outcomes will determine whether the KB uses virtual reality to open up other vulnerable collections to digital access.

Because these two projects are closely related, the authors are considering testing the usability of virtual reality pop-up books in the 3-D-storage environment. Virtual reality contents could be added to the 360° images as an interactive element. This project could also inspire other library staff to introduce virtual reality technologies to new audiences.

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## Note

1. The full name of Marzia Loddo's project is 'DIPOT: Digital Depot' (available at: [dipot.altervista.org](http://dipot.altervista.org)). It is a dynamic 3-D representation of art-collection storage facilities as a learning resource to build critical engagement and improve future design.

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**Marzia Loddo** has worked as an expert in applied arts conservation in several Italian museums. She holds the European title of Doctor of Preservation of Architectural Heritage, awarded by the Polytechnic University of Milan in 2019. In 2020, she published her first monograph, *Storage Facilities for the Collections of Art Museums: A Focus on the Italian Context* (Maggioli Editore), on the topic of art collections storage. Marzia is currently based in the Netherlands where she is a postdoctoral researcher at the Delft University of Technology. She is also an affiliated researcher with the Centre for Global Heritage and Development.

**Foekje Boersma** is head of Collection Care at the KB, National Library of the Netherlands. Prior to joining the library, she worked as the programme manager at the Getty Conservation Institute establishing the Managing Collection Environments Initiative, a multiyear initiative addressing a number of compelling research questions and practical issues pertaining to the control and management of collection environments in museums. In her current role,

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**Martijn Kleppe** is head of the Research Department at the KB, National Library of the Netherlands. Before joining the KB, he worked on several European digital humanities research projects that focused on opening up (audio)visual and textual archives by using techniques from the natural language processing domain, speech recognition and computer vision. At the KB, he now leads the Research Department, which covers topics such as digital preservation, copyright, public library research, data science, and improving the usability and discoverability of digital content by applying artificial intelligence techniques.

**Karin Vingerhoets** is the curator of the children's books collection at the KB, National Library of the Netherlands and a key user of the Dutch/Flemish catalogue of children's books. Before joining the KB, she worked at the library of the Radboud University Nijmegen. Karin has a Bachelor's degree in Art History and a Master's degree in Dutch, with a specialization in youth literature. She started in the KB as a project manager for various projects and currently uses that experience on a project rejuvenating a website about the history of Dutch literature for educational purposes. Karin tweets about her work as a curator from @KBKarinV.



# Applicability of traditional storage methods in Indonesia for today's conservation practice

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## Abstract

This contribution aims to distil the experience from several conservation projects in Java, Indonesia, into a summary of methods in an attempt to arrive at some suggestions for best practice for the preservation of cultural heritage items in a tropical country. The related projects concerned a museum of contemporary art, traditional puppet theatre materials, a museum of traditional art and an archive.

## Keywords

Indonesia, cultural heritage management, principles of library and information science, preservation, conservation, collection development, South East Asia, Asia

## Introduction

This contribution aims to distil the experience from several conservation projects in Java, Indonesia, into a summary of methods in an attempt to arrive at some suggestions for best practice for the preservation of cultural heritage items in a tropical country. The related projects concerned a museum of contemporary art, traditional puppet theatre materials, a museum of traditional art and an archive.

The main focus area was termite control, with humidity and temperature being other major considerations. Attention was also given to ways of avoiding the need for air-conditioning systems, given that they consume a lot of energy, which translates into monetary costs, and the power supply is unstable. This instability of power supply results in the uncontrolled switching on and off of the heating, ventilation and air-conditioning system, which causes rapid temperature changes (up to more than 20°C in a few minutes) and puts stress on the artefacts because the material dries or moistens rapidly and, as a result, contracts with water loss or swells with the increase of humidity. Some museums cannot operate their heating, ventilation and air-conditioning systems in a way that would address this problem due to the associated costs. However, a more important point is that the problem cannot actually be avoided as there is simply no power supply at night.

Having received an invitation from Mrs Kartika Affandi to help with the conservation of her father's art at the Affandi Museum, and having started a cooperative project with the Indonesia Institute of the Arts, Yogyakarta, the author was in a position to obtain funding from the ASEAN–European Academic University Network from 2015 onwards (see ASEAN-European Academic University Network, 2017). The partners in the corresponding projects (see Table 1) were the University of Continuing Education Krems, Vienna University of Technology, Gadjah Mada University, Indonesia Institute of the Arts, and Affandi Museum.

## Cases

In implementing the projects listed in Table 1, we identified the same core questions again and again, which we consider to be the key features for a conservation concept in any collection, be it items of contemporary art or the oldest traditional puppet in Indonesia. Interestingly, we soon found that, contrary to our initial hypothesis that the principal risk was

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**Table 1.** Titles and years of implementation of the ASEAN–European Academic University Network projects carried out to date.

Year	Project title
2016	Development of an integrated concept for the restoration of art and architecture at the Affandi Museum, Yogyakarta
2017	The interrelation between the state of the hosted art and the building performance
2017	Affandi's art and architecture as a part of the tangible and intangible heritage of Indonesia
2018	A sustainable hygiene concept as a mandatory conservation aspect for people, paintings on paper and drawings, and the buildings of the Affandi Museum
2018	The influence of daylight and natural airflow on the architecture of the Affandi Museum
2019	An archive and museum conservation concept for paintings on canvas and paper, notebooks, drawings, glass plates, photographs, plans and films at the Affandi Museum and the archives of the Temple of Borobudur UNESCO World Heritage Site, listed in UNESCO's Memory of the World in 2017 as joint training for establishing a Department of Conservation and Restoration at the Indonesia Institute of the Arts, Yogyakarta
2019	Thermal comfort criteria in Indonesia and Europe
2019	SP24 grants Conservation of <i>wayang beber</i> as a model for a step-by-step conservation approach – preparing first teaching modules for the new Department of Conservation and Restoration of paintings on paper and canvas at the Indonesia Institute of the Arts, Yogyakarta, Phase I
2020	Mobility grant Conservation of <i>wayang beber</i> as a model for a step-by-step conservation approach – preparing first teaching modules for the new Department of Conservation and Restoration of paintings on paper and canvas at the Indonesia Institute of the Arts, Yogyakarta, Phase II

posed by mould, the greatest challenge was actually posed by termites. As our efforts to develop appropriate conservation concepts progressed, we came to perceive the need for an appropriate conservation theory for Indonesia as another essential requirement.

### Affandi Museum

Affandi was one of the most prominent Indonesian painters. His works include oil paintings on canvas, paintings on silk and wood panels, sculptures and works of art on various sorts of paper. These works on paper include pastels, aquarelles, gouache paintings, ink and pencil drawings, lithographs and engravings, as well as his diaries containing sketches and

ideas about his exhibitions and the museum he had built according to his own design. The museum consists of several buildings, called 'galleries' today. 'The first gallery (314,6 m<sup>2</sup>) was built in 1962 and officially opened in 1974' (Affandi Museum, n.d.).

In 2015, when the collaboration started, the three galleries of the Affandi Museum were air-conditioned, with the indoor temperature and humidity in all three halls during the day suitable for the storage of art. Every night the electricity was switched off for safety reasons. This created a daily temperature fluctuation between 35°C at night and 15°C during the day, with the corresponding change of relative humidity. This change occurred within 20 minutes every morning and every evening. It is well known that changes of humidity and temperature of this magnitude put considerable stress on art materials.

The fear of mould attacks, which had led to the installation of the air-conditioning system, was nevertheless justified. To prevent the outbreak of mould and still reduce the stress caused by the humidity changes, the team embarked on a study of traditional conservation methods available in the area and the local ways of mould control. The team started to bring together traditional recipes for the storage of fabric and measures against mould and insect attacks, and explore how houses were built to provide a proper indoor environment for both artefacts and people. In the course of the survey, it was found that insect control could really be achieved with the application of herbs, while mould could be kept at an acceptable level by proper ventilation.

### Insects

Table 2 lists the plants that are traditionally used against insects in Java, as well as their mode of application.

To be able to use the plants in other tropical areas, we needed to know what insects are found in Indonesian collections. Therefore, information on what insects are found in Indonesian museums was brought together from the personal knowledge of the museum staff living and working in Indonesia and from the literature – in particular, the publication by Diar Ria Pramestiti (Fort Vredeborg Museum). The following list provides a summary:

Termite: Fransiska Dian Ekarini (Balei Borobudur Conservasi) identified from the frass *bintang teter pemakan kayu*. Udaya Cabral, an insect expert from the National Library of Sri Lanka, identified this insect from a picture the



**Table 2.** Plants traditionally used against insects in Java and mode of application.

Name of plant in Indonesian	Name of plant in Latin	Name of plant in English	Form of application	Method of application or use	Source of information
Nilam (see Kompas.com, 2008; Nuswantoro, 2015)	<i>Pogostemon cablin</i>	Patchouli	Oil	Ether oil from <i>nilam</i> or some other plant of the <i>Pinace</i> family is used for tending to items made of iron, stone, wood and batik cloth	Ryani Silaban's father in Medan, North Sumatra; <i>nilam</i> was named as a good disinfectant by several other people too
Lerak Kelerak Rerak	<i>Sapindaceae rarak</i> DC <i>Sapindus rarak</i>	<i>Sandindus</i>	Lerak fruit are soaked in warm water and used to wash batik cloth	Batik cloth/woven traditional cloth	Wiwik Sri Wulandari's grandmother from Surakarta, Central Java; <i>lerak</i> was also mentioned as being used for washing by Kartika Affandi and Bekti
Pandan	<i>Pandanus amaryllifolius</i> <i>Pandanus</i> spp (several species)	Pandan	The roots are knotted into a bundle and put in cars, etc.	To chase off roaches	Kartika Affandi
Akar wangi	<i>Chrysopogon zizanioides</i> <i>Vetiveria zizanioides</i>		Used as a dry root	Produces a smell that chases away rats	Kartika Affandi and Dr Suastriwi, Dean of the Indonesia Institute of the Arts
Kelor	<i>Moringa oleifera</i>	Moringa		Unclear what <i>kelor</i> is used for; according to Kartika Affandi, it is used by peasants in villages as a remedy 'against everything'	Kartika Affandi
Sereh Cengkeh	<i>Gymbopogon citratus</i> <i>Syzygium aromaticum</i>	Lemon grass Clove oil	Oil and water extract Oil and water extract	Protection against mosquitos To chase away insects	Kartika Affandi Fransiska Dian Ekarini, Sri Wahzuni and others; it was also used in Vienna in the 1970s by conservators and for toothache
	<i>Nicotiana tabacum</i>	Tobacco	No information given but presumably it is used as an extract in water	No clear information given	Number 11 Standard <sup>a</sup>

(continued)

Table 2. (continued)

Name of plant in Indonesian	Name of plant in Latin	Name of plant in English	Form of application	Method of application or use	Source of information
	<i>Aquilaria malaccensis</i> <sup>b</sup>	Agar wood Aloe wood	No information given in I I Standard but other sources suggest that the application method is smoking (fumigation)	Wood burned to produce smoke (the resin which the tree absorbs in case it is attacked by a certain fungus is also used in Chinese medicine)	Number I I Standard and explanation of its effects by Riedl
	<i>Vetiveria zizanioides</i> (Chahal et al., 2015; see also Mallavarapu et al., 2012; it consists of about 110 different components, in particular: Sesquiterpenen: beta-Vetisporin (1.6%–4.5%), Khusimol (3.4%–13.7%), Vetisetinrol (1.3%–7.8%) und alpha-Vetionon (4.5%–6.3%))	Vetiver (a close relative to lemon grass)	Vetiver ( <i>Chrysopogon zizanioides</i> ) ether oil (Riedl)	Used against fungi and mental illnesses, hysteria, stress, sleeplessness, neuroses, etc. (oil is believed to calm the nerves)	Number I I Standard; see also Chahal et al. (2015) for the fungicide effects of the plant
<i>Minyak zaitun</i> (see Ann McG, 2011; Kamis, 2016)	<i>Olea europaea</i>	Olive oil	Applied to surfaces	Wood	<i>Mutia Bunga</i> , an Internet publication (Chahal et al., 2015; see also Mallavarapu et al., 2012)
	<i>Piper nigrum</i>	Black pepper	Black pepper is put in a plastic bag with small holes in it to chase away rats	Remedy against rats	Selarti Venetsia Saraswati
	<i>Vigna radiata</i>	Mung beans	Mung beans are put in a plastic bag with small holes in it and the bag is placed where you want to have the humidity regulated	To keep humidity under control, which indirectly prevents mould growth	Selarti Venetsia Saraswati

<sup>a</sup> The state regulation to keep collections of natural history (animals and plants) and heritage.

<sup>b</sup> Importation of this wood to Europe is forbidden under the Washington Agreement.

author sent to him as 'dry wood termite' (email, 10 December 2018);<sup>1</sup>  
*Kumbang kayu (Anobium punctatum)*;  
*Rayap kayu kering (Cryptotermes cynocephalus)*;  
*Kumbang bubuk (Lyctus brunneus)*;  
*Rayap tanah* (no Latin name given);  
*Kumbang penggerek (Euophryum confine)*;  
*Ernboius mollis* (looks like teter in the picture (observation by the author));  
*Ngengat pakaian (Tineola bisselliella)*;  
*Kumbang sutera (Tineapellionella)*;  
*Kumbang karpet (Anthrenus verbascii)*;  
*Kumbang bulu (Attegenus pellio)*;  
*Siverfish (Lepisma saccharina)*;  
*Firebrat (Thermobia domestica)*;  
*Drugstore beetle (Stegobium paniceum)*;  
*Kecoa jerman (Blattella germanica)*; it may be added that other sorts of cockroaches were also observed, like the Asian and the American cockroach).

Our research into the methods used by other museums to deal with insects in Yogyakarta has indicated extensive use of Lentrek. The Indonesian government has authorized a standard that addresses the issue of insect control in heritage collections. According to a paper recommended by Diar Ria Pramestiti, this Number 11 Standard ('Undang-Undang, Nomor 11, Tahun 2010, Tentang, Cagar Budaya') suggests using Lentrek 400 EC in addition to some herbal substances. There is also a picture of white balls, most probably a disinfection agent that is used extensively in bathrooms in Indonesia.<sup>2</sup> Using Lentrek 400 EC in combination with 'fogging' is a very common practice nowadays in many museums and collections in Indonesia.<sup>3</sup> In a publication of the Ministry of Agriculture and Rural Development of Vietnam, we find 'chlorpyrifos ethyl' given as a substance name for the brand name Lentrek 400 EC.<sup>4</sup> According to a search for 'clorpyrifos' in the ChemicalBook CAS DataBase List, Lentrek is associated with the following health hazards: symptoms of organophosphate insecticide poisoning, such as cholinesterase inhibition, headache, fatigue, dizziness, blurred vision, weakness, nausea, cramps, diarrhoea, chest discomfort, sweating, miosis, tearing, salivation, vomiting, cyanosis, papilledema and muscle twitching. In advanced cases, convulsions, coma, loss of reflexes and loss of sphincter control may occur. Lentrek can produce mild to moderate eye irritation and transient corneal injury. Undiluted liquid products can cause skin irritation. Prolonged or repeated exposure causes superficial burns. According to our own

research, it does not prevent termite attack for longer than clove oil or *nelam* would.

It can already be said that both methods applied to protect cultural heritage items from insects, rodents and mould in Indonesia pose serious health hazards and must be periodically reapplied. This conclusion is confirmed by information provided to and observations made by the author. The frames of Affandi's drawings had been sprayed with Lentrek three times immediately before the paintings were inserted (in 2015). The frames were checked regularly to see if any new infestation had occurred. In January 2019, termites were found in one of these wooden frames. It was then suggested to apply clove oil or *nelam* oil onto the frames instead of Lentrek. At the moment, we cannot monitor the results of this test, as the museum has been closed since spring 2020 due to COVID regulations.

Museum Negeri Sonobudoyo houses paintings, books, textiles and wooden carvings illustrating the history and crafts of the region.<sup>4</sup> As part of its preservation methods, this museum exhibits its artefacts. This might sound strange at first, because usually conservators try to keep artefacts safe in a storage area. However, in a warm, humid climate, insect attacks in storage areas can develop quickly, remain unobserved and lead to a rapid loss of items. Therefore, the museum cooperates with several other museums in Java in a sort of 'artefact moving exercise'. The individual exhibitions are moved on from one museum to the next after a period of time.

Thanks to the items being moved from one museum to another, galleries are kept under observation. The manipulation of the items might mean some physical stress for them, but this is still less risky than having the artefacts out of sight and out of the museum staff's control. Furthermore, this 'moving' must not be confused with moving a puppet in the framework of a performance. We emphasize here the preservation effect of observation and assessment. As a side effect, the museums continuously offer interesting information to their visitors, but the important point in terms of conservation is that if some items went into storage while others were on display, the stored items would be damaged by insects while unseen by the conservators. Moving the items helps to preserve them, and this 'preservation moving' was one of the interesting new ideas that came up in the Indonesian museum sector in 2018.

The fact that boxed items are more easily attacked by insects because such attacks are not recognized in time was also confirmed by Kartika Affandi, who related that she had stored some puppets in a box and,

on opening it some years later, found that they had been reduced to dust by insects. Therefore, modern boxing as it is used in Europe to create a buffer against rapid climate changes, dust and light exposure might work well in controlled environments but does not really work in a natural environment like that of Indonesia.

However, some kinds of boxes work very well as a means of protection in Indonesia. *Wayang beber* (*wayang* means ‘puppet’ and *beber* means ‘unrolling’) is a puppet theatre that consists of scrolls made of bark-based Indonesian cloth with images illustrating traditional stories painted on them, which are presented while the stories are told and sung, accompanied by musicians. In 2003, *wayang* puppet theatre was designated by UNESCO as one of the Masterpieces of the Oral and Intangible Heritage of Humanity (Hays, 2015). There are three *wayang beber* still in existence: one is in Wonosari, one is in Pacitan and one is in Leiden. They date from between 1500 and 1700. While the two puppet theatres still owned by Indonesian storytellers are kept in a traditional way, the scrolls in Leiden are owned by the National Museum of Ethnology and preserved according to western state-of-the-art methods. Interestingly, the scrolls in Indonesia are more flexible and less heavily restored. The hypothesis explaining their greater flexibility is that it is the result of the higher humidity in Indonesia, which is a better environment for the local plant material. Furthermore, they receive particular attention and traditional care, and have special boxes. These boxes are made of hardwood and have thick walls and tight, heavy lids. The cavity for the scrolls inside the box is small, so that the scrolls – wrapped in cloth – just fit in tightly. On both ends of the scrolls there are cavities for herbs. The herbs are taken out before the performance and burned, with the smoke spreading over the scrolls, and are then replaced with new herbs. There are also peacock feathers in the box and, according to the explanation we were given, insects prefer to attack the feathers and ‘leave the scrolls alone’. On another occasion, we were told that the feathers ‘hold a spell’. In any case, the box holding the scrolls is stored in a room with appropriate airflow, standing on a table, so that water and rodents cannot reach it easily, and the room is kept clean at all times. Proper housekeeping is another important factor to be taken into account in tropical countries. Besides insects, rodents are a serious threat.

### Mould

Airflow was found to be the key condition for preventing mould growth, both for the architecture and the artefacts on display. As we started to get

acquainted with traditional preservation methods in Java, we also wanted to understand the traditional way of building houses with respect to their conservation features.

The temperature and humidity inside traditional buildings are equal to outdoor conditions. This has the advantage of condensation not being such a persistent problem as it is in Europe. Additionally, there is virtually no temperature change between day and night or over the course of the year. The temperature is relatively high but stable, so no artificial climate conditioning is needed. There are traditional wooden doors with wooden carvings, and air enters the house on one side and leaves it on the opposite side. The airflow is known to generally inhibit the growth of mould. Another important feature of the traditional air-conditioning concept is to keep the outer walls of the house cool by a roof which extends far beyond the immediate living (or display) space indoors, thus giving shade to the walls. A third important element is that no plants grow too close to the house because they would hinder the wind passing around the building. Finally, it is considered important that a house has a proper south-to-north position to get the airflow from the strongest and most prevalent winds. This recipe is only true for Yogyakarta, as the wind conditions in other regions of the country are different. Airflow therefore seems to be key to the conservation of both houses and artefacts, and contributes to both human health and human comfort.

Interestingly, we found that Gallery 1 of the Affandi Museum originally, before the 2006 earthquake and before its windows were closed, had proper internal climate control because the room enjoyed a natural airflow. After the earthquake, the windows were filled with bricks, which was considered to give the building more stability, but the measure caused substantial mould problems since the airflow had been stopped.

In contrast, we found that the ‘House of Kartika’ Gallery, which is a sort of village museum in which Kartika Affandi has used old house elements in a new artistic manner to create space for her own paintings, does not work well and is mouldy because the airflow is hindered due to the ‘artistic’ construction of the house, which is wrong climate-wise. The house has a proper main entrance and also an extending roof, but the back wall is very large and the air that enters the exhibition hall on one side cannot exit it on the opposite side.

These two examples – the renovated Gallery 1 of the Affandi Museum and the ‘House of Kartika’ building with its serious mould problems – showed that our assumptions were right. Again, as in the case

**Table 3.** Microorganisms found in the museums in Yogyakarta.

Name of microorganism	Health hazard	Method of identification in the project
<i>Cladosporium</i> , morphologically most similar to <i>Cladosporium tenellum</i>	<i>Cladosporium tenellum</i> – no known health hazard	Microscope slide preparations in glycerol; examination under 400x magnification
<i>Stachybotrys chartarum</i>	Usually considered hazardous	Survey of the place of contamination and glass-plate preparations made by the microbiologist; identification at 400x magnification and in transmitted light
<i>Rhizopus microsporus</i> var. <i>oligosporus</i>	No known health hazard	On paper strips, on cardboard and in cultures on Sabouraud dextrose agar contact plates
<i>Curvularia lunata</i>	Hazardous	On exposed paper strips
<i>Aspergillus niger</i>	Hazardous, allergenic	In cultures on Sabouraud dextrose agar contact plates
<i>Metarhizium anisopliae</i>	Hazardous	In cultures on Sabouraud dextrose agar contact plates
<i>Candida tropicalis</i>	Serious health hazard	In cultures on Sabouraud dextrose agar contact plates

**Table 4.** Substances that are effective against insects and/or mould.

Plant or mix name	Active substance	Effective against
<i>Nicotiana tabacum</i>	Nicotine	Insects
<i>Vetiveria zizanioides</i>	Consists of about 110 different substances, in particular: Sesquiterpenen: beta-Vetisporin (1.6%–4.5%), Khusimol (3.4%–13.7%), Vetisetinerol (1.3%–7.8%) and alpha-Vetinin (4.5%–6.3%)	Mould
<i>Nilam (Pogostemon cablin)</i>	The oil contains camphen, zimtaldehyd, benzaldehyd, pinen, azulen, oxide, sesquiterpene (which play an important role in conservation), monoterpene, guaiacol, patchoulipyridin, patchoulan, eugenol, pachipodol, caryophyllen (which also can be found in clove oil), cardinen, sesquiterpinole and ketone	Bacteria, fungi and insects
<i>Sapindus rarak</i> DC	Oil of fruit shells contains eight different acetylated acyclic sesquiterpen-oligoglykosides plus the Mukoroziosidea (Kim and Kinghorn, 2002) of Type Ia, Iia and IIb	Bacteria, fungi and protozoas
<i>Kelor</i>	Kelor leaf has a high polyphenol content, which is useful as an antioxidant	Bacteria

of insects, in the case of mould we identified the species that might allow us to apply the accumulated knowledge in other cases. A list of the species found in the museums in Yogyakarta, was identified by Harald Riedl and is presented in Table 3.

Harald Riedl was in Yogyakarta in 2019 and worked in the team as a volunteer researcher. His method of observation was visual observation under a microscope, culture breeding and second visual observation. Even though ensuring airflow was identified as the main means of combating mould, we tried to identify the active substances in the plants and understand whether they would work against insects or mould, or both. A list of the substances that Riedl concluded are effective against insects and/or mould is presented in Table 4.

However, apart from the optimal climate, mould and insects also need nutrition for their development. Since the traditional Indonesian meal involves eating food with one's fingers, washing one's hands after a

meal and before handling cultural heritage items becomes more important than in other cultures.

#### *Borobudur archive*

Recently, we learned that there is an important collection of glass slides documenting the preservation of the Borobudur Temple at Gadjah Mada University and at the Balei Borobudur Yogyakarta Archives which is a collection listed as written world heritage as well as at the International Centre for the Study of the Preservation and Restoration of Cultural Property, Rome. The material will be of considerable value for experts in building conservation and therefore must initially be preserved as archive material. Previous ASEAN–European Academic University Network projects have allowed us to build up an appropriate infrastructure in Indonesia to do this. The university chair at the Indonesia Institute of the Arts, established with the help of the ASEAN–European Academic

University Network, is one of the advantages we can now build on. Another advantage is the network and activities of ERC at ZKGS at DBU at DUK (European Research Centre for Book and Paper Conservation-Restoration at Zentrum für Kulturgüterschutz at Department für Bauen und Umwelt at University for Continuing Education, Krems). Finally, the ongoing cooperation with the International Centre for the Study of the Preservation and Restoration of Cultural Property, Rome, is our third advantage. The team at Balei Borobudur Yogyakarta has also confirmed that termites are considered to be a more serious conservation problem than mould in the Indonesian environment.

## Conclusion

It is self-evident that local traditional conservation methods and materials (herbs) should be helpful in preventing the destruction of local artefacts and houses by local species insects and mould. This contribution, however, has aimed to encourage the use of such 'outdated' materials and methods, and bring together information on a very limited area which may be of interest for the community of professional conservators as a pool of facts and ideas they might be able to use in similar cases.

A considerable number of plant and herb names, as well as specific measures aimed at protecting cultural heritage items and human health from microorganisms and insects in Indonesia, were brought together by holding interviews with elders and consulting the literature. Single plant roots, leaves and seeds, as well as mixtures both applied as unprocessed plant elements (*akar wangi* or *pandan*) and oils (*cengkeh*/clove) or water extracts (*sereh*/lemon grass), have been identified. Countless mixtures are used for protecting human health, as well as disinfection. Some of the plants are used for both humans and heritage preservation. Some plants and substances used in Sri Lanka and *neem* from India were included in the tests.

The active substances in the plants were identified from the literature. Some are known for having a disinfectant effect on mould, others on bacteria. Most of the substances are meant to be used on a preventive basis so that infestation does not start. Insects and mould species that are prevalent in Indonesia's wet, humid environment were identified by collecting and identifying them and by consulting the literature for relevant information. The focus in doing this was, however, on species that can harm heritage items or museum buildings in one way or another. The fact that rodents represent a further problem was also kept in mind. It has been found that several plants are used to

keep rats away. The effect of the leaves, fruits and roots as brews or oils was considered. Additionally, approaches to structural design considered effective in terms of conservation were documented for the benefit of the design of future museum buildings.

We did not seek to prove that substances found in natural herbs are less toxic for humans than industry-produced insecticides. Our focus on such substances had to do with the advantages of their greater availability and lower cost. Plants and substances based on them can be applied in rural areas and are affordable for small museums nationwide. Furthermore, it is presumed that local plants work better against local insects. Finally, industry-made insecticides are generally not as rapidly degradable as insecticides made directly out of plants.

While only a few hazardous species of mould were identified (*Stachybotrys*, *Curvularia lunata*, *Aspergillus niger*, *Metarhizium anisopliae*, *Paecilomyces spec.*), termites seem to be the biggest threat for cultural heritage items. This was confirmed in an email communication with Julia Brennan ([julia@caringfortextiles.com](mailto:julia@caringfortextiles.com)) in August 2017, who, citing her own experience, also considered termites as the most serious conservation problem in Rwanda and Australia.

*Nilam* and clove oil could be proven to be effective in getting rid of termites in the case of both heritage items and buildings. Of course, their use requires permanent control, repeated application and good housekeeping, but the same applies to the use of any substances, including industrially produced disinfectants such as *Lentrek*. It could be shown that the effect of *Lentrek* had obviously disappeared within three years and new termite infestation was found in paintings. *Lentrek* was found to be the most widely used modern disinfectant.

Clove poses no health hazards to people, while *nilam* is effective against insects, bacteria and mould. Repeated treatment to combat insects and good housekeeping could be added to the job description of the cleaning staff who are frequently employed in Indonesian museums. In Europe, reapplication might be needed less frequently as the climate is cooler and drier, and thus insect and mould growth is slower.

This research work is seen as the very first step in a promising direction. It is clear that:

- A more extensive search for plants with disinfectant properties would help recover further old knowledge of such plants. Therefore, this kind of search will be seen as a long-time exercise, and a database of such plants and substances will be established.

- Biochemists should be involved in the identification of all active substances in the plants documented.
- Medical experts should be involved to estimate the hazardous doses for humans.

The collection of moulds that can be found on heritage items in Indonesia will be completed and a second attempt to find relevant literature shall be made. The ingredients of the mixtures of unknown substances such as *ratus* will be identified. More tests must be designed and performed in known environments as well as in real-life settings. The main question will be how the heritage material will react with the various substances and for how long they can be applied without harming the material but keeping their positive effects. Long-term tests and the artificial aging of the substances will be carried out. Ginger and other substances that were mentioned as beneficial for human health should be included in the tests, even though such substances have not yet been mentioned in the lists of insecticides and fungi-fighting measures protecting cultural heritage.

It was found that modern boxes, which serve as a buffer against rapid climate changes, dust and light exposure in Europe, are not always appropriate in Java, as termites can destroy boxed items in an unobserved manner. However, the traditional boxing of the *wayang beber* scrolls in special hardwood boxes, along with fumigation with particular herbs, good housekeeping and the particular care of these valuable heritage items, does work well.

While mould can be kept under control with the use of traditional building design, ensuring constant air-flow through the building and over heritage items, termites are killed with boiling water – a method that cannot be applied to works of art on canvas or paper. Clove oil and *nilam* were found to be effective as a preventive measure.

This study of traditional conservation methods also made it clear that European methods are not fully applicable in the Indonesian environment. The integral way in which art and tradition are incorporated in everyday life, and the specific understanding of the processes of retrieval and loss of information about the past require a new and timely Indonesian conservation theory – a topic that must be reserved for another publication.

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### Notes

1. In this email, Mr Cabral mentions a trap he has developed to control termites as a simple non-chemical method.
2. 'IPM: Integrated pest management', by Diar Ria Stya Pramestiti. Provided by Selarti Venetsia Saraswati as a printout on 11 December 2018.
3. An outdoor procedure called 'fogging' takes place, specifically targeting dengue fever mosquitos; however, the fog also contains substances which help fight museum pests. Along with dengue fever mosquitos, flies and cockroaches are killed. The active substances in the fogging are Resigen 1.5/10 OS, produced by Bayer Environmental Science, which consists of Permethrin 97, 5g/l (Permethrin is a Pyrethroide, CAS Number: 52645-53-1); S-bioaletrin, 15g/l (a name for a wider range of substances for fighting pestilent insects); 112 piperonyl butoxide, 5g/l (enhances the potency of certain pesticides such as carbamates, pyrethrins, pyrethroids and rotenone); and LD50 > 9280 mg/kg. Resigen is considered poisonous when humans come into contact with it or swallow it. Depending on the specific purpose, there are two different concentrations in which the substance is applied: (1) so-called 'thermal fogging': 100 ml of Resigen are dissolved in 9900 ml of oil/diesel (1 + 99) to obtain a solution that is ready to

- spray – the application dose is 10 litres of the solution per hectare – and (2) so-called ‘User Volume Label (ULV)’: 50 ml are dissolved in 450 ml of Resigen oil/diesel (1 + 9) to obtain 500 ml of a spraying solution – the application dose is 500 ml of the solution per hectare. See <http://www.environmentalscience.bayer.my/Pest-Management/Products/Resigen>
4. National CFC and Halon Phase-Out Project (P083593) Vietnam Methyl Bromide Phase-out component, Pest Management Plan.
  5. See <http://www.sonobudoyo.com/id> (accessed 25 August 2019).

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# Natural ingredients for a bacteria-free library collection

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## Abstract

Fumigation is widely used for getting rid of pests. This treatment makes use of chemicals. However, if repeated applications are not made, the insects and pests tend to breed again. This treatment also does not take care of the growth of microorganisms that feed on organic substances. India has a warm and humid climate that encourages the growth of microorganisms. Indian tradition makes use of various herbs and spices to preserve reading materials. This study was therefore undertaken to view the effect of locally available herbs and spices on paper. Experiments were carried out in a college laboratory. This was done with the objective of studying the inhibitory action of neem, cinnamon, cloves, pepper and a mixture of all of these herbs and spices.

## Keywords

Library preservation, microbial contamination, natural preservatives

## Introduction

Most of the insect species that are likely to infest paper collections are attracted to paper because of its size and the adhesives and starches that are used, which all provide food for various insects. Many chemical methods are used regularly to control pests such as silverfish, firebrats, psocids (also known as booklice) and cockroaches. However, paper, being organic in nature, can also be a feeding ground for microorganisms. Moreover, packed bookshelves may obstruct airflow and allow airborne microorganisms to settle and grow on books. Countries like India have a warm and humid climate, which encourages the growth of microorganisms that degrade paper.

The control of these microorganisms is a challenging task as they do not respond to the regular cleaning and pest-control methods of a library. The library environment offers optimal conditions for the proliferation of microorganisms, and this contamination not only has adverse effects on the life of books, but can also affect the health of users along with the air quality of the library.

A study was undertaken to identify the microorganisms growing on paper that had been put through

regular biannual pest control. Based on the presence of microorganisms, the action of naturally occurring substances on these microorganisms was studied.

## Need for the study

Various library studies carried out across the world have found the existence of bacteria-contaminated collections, despite all the precautions taken against this (Hempel et al., 2014; Leite et al., 2012; Singh, et al., 2011 and Skora, et al., 2015). Such contamination can also have adverse effects on the health of library users. Hence, the researchers were interested in verifying the bacterial contamination found in a library collection and studying the impact of various natural ingredients on these microorganisms. For this study, commonly occurring substances such as pepper powder, cinnamon powder, neem oil, clove powder and a mixture of all of these were used to study their inhibitory effects.

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**Table 1.** T Test results for Microbial Count

Box number	1	2	3	4	5
Combination of Natural Inhibitors used	Wheat flour + cinnamon powder	Wheat flour + pepper powder	Wheat flour + Neem Oil	Wheat flour + clove powder	Wheat flour + a mixture of all the herbs and spices
p value	.033947	.008919	.249982	.386154	.157923

### Method and observation

The researchers have backgrounds in analytical and medicinal chemistry and organic chemistry, respectively, and were keen to undertake the present study. They sought guidance and support from the Biotechnology Department at the SIES College of Arts, Science and Commerce, which is the parent body of one of the researchers. The college is located in the heart of Mumbai, India, and known as a well-respected institution that has served the ever-growing educational needs of students from the north and central Mumbai suburbs since 1960. The Biotechnology Department was established in 2002 and offers courses for undergraduate, postgraduate and PhD students; it is equipped with a state-of-the-art laboratory and other required facilities (such as Polymerase Chain Reaction Instrument and a spectrophotometer). The Biotechnology Department was used to conduct the tests as the materials and instruments required for this study were readily available. The late Dr Rajalaxmi Amudan, an experienced biotechnologist and faculty member of the SIES College of Arts, Science and Commerce, mentored the experimental study.

All of the books selected for the study were subjected to chemical pest control three times a year. However, the samples collected from these books showed the presence of microorganisms. These microorganisms were identified as belonging to the *Bacillus* species by 16S ribosomal RNA tests. The subsequent step was to try and inhibit the growth of these microorganisms with the available resources. Naturally occurring substances like neem, cinnamon, cloves and pepper are readily available and used in day-to-day life. Further, they are known for their medicinal properties. It was therefore decided to study the inhibitory effects of these substances.

To study the effect of naturally occurring substances like neem, cinnamon, cloves and pepper, books belonging to different accession numbers were selected with the view that older books may have more contamination compared to newly acquired books. A ditch-plate method was used to check the inhibitory action of neem oil, cinnamon powder, clove powder and pepper powder. This method

consisted of preparing a ditch in a sterile nutrient agar plate. The ditch was then filled with the substance mixed in nutrient agar and kept till set. The organisms were streaked evenly across the ditch and incubated for 24 hours at 37°C. The observed zones of inhibition provided the measurable sensitivity of the bacteria to the antimicrobial substance. The entire procedure was done under sterile conditions to prevent contamination.

A microbial inhibitory count for neem oil was performed in order to confirm its inhibitory action by using slants (5 ml) of nutrient broth and neem oil (1 ml to 3 ml). It was observed that 3 ml of neem oil had the maximum inhibitory effect. Further, to confirm inhibitory action, pellets were made of an equal proportion of wheat flour and cinnamon powder, wheat flour and pepper powder, wheat flour and neem oil, wheat flour and clove powder, and wheat flour and a mixture of all of the above. These pellets were put in boxes containing eight books each, and a standard without any inhibitory agent was also maintained. Swabs were taken before placing the pellets in their respective boxes and after 1 day and 23 days. The microbial counts were compared, and it was observed that there was a reduction in growth.

The results of a paired *t* test to test for a significant drop in the number of microorganisms for all five methods are shown in Table 1.

All of the boxes showed a reduction in the number of microorganisms. However, Box 1 and Box 2 – that is, wheat flour + cinnamon powder and wheat flour + pepper powder – showed the greatest reduction in the number of microorganisms over the 1–23-day period. The box without any inhibitory agent showed an increase (matlike appearance) in the number of microorganisms.

### Findings and suggestions

Even though neem, cinnamon, cloves and pepper all exhibited inhibitory properties, neem oil was the most effective. However, a dusting of neem powder on books would leave a residue and stick to the hands of users. Neem oil could therefore be mixed with methanol and placed in small bottles on bookshelves;

being volatile, it would evaporate and inhibit the growth of microorganisms. A mixture of neem oil and methanol in the proportion of 3:2 could be sprayed on shelves or cotton-wool balls dipped in neem oil could be placed on shelves. A further detailed study is required to determine the best method of application.

Components such as cinnamon powder, pepper powder and clove powder, and a mixture of all four herbs and spices, displayed a considerable reduction in microbial activity. Hence, placing pellets made by mixing equal proportions of wheat flour with cinnamon powder, pepper powder, clove powder or a mixture of all four herbs and spices (and water, and then drying them) among book stacks can restrict the growth of microorganisms.

### Declaration of conflicting interests

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## Abstracts

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### Identification and storage of plastics in libraries and archives

تحديد المواد البلاستيكية وتخزينها في المكتبات ودور المحفوظات  
شاننال شتاين، وجيسكا بيس، ولورا ماكان  
مجلة الإفلا، 48–2

الخلاصة:

يُعد التخزين الآمن للمواد البلاستيكية ومعالجتها مشكلة ملحة، غالباً ما يجري تجاهلها في العديد من مجموعات المكتبات والأرشيف. ومن المعروف أنه يصعب العناية بالمواد البلاستيكية نظراً لتلفها بمعدل أسرع من المواد الأخرى في المجموعات الأرشيفية. كما أن منتجات التحلل الضارة الناتجة عما يُطلق عليه البلاستيك “الضار” قد تتلف المواد المحيطة، مثل الصور الفوتوغرافية والأوراق. ويتمثل أحد جوانب المشكلة في وجود كم هائل من أدوات تعريف المواد البلاستيكية، وهو ما قد يكون مرهقاً وشاقاً في آن واحد. أما الجانب الآخر فهو توفير بيانات تخزين مثلى للمواد البلاستيكية التي غالباً ما يتعذر تهيئتها على النحو الموصى به في مؤلفات الحفظ المنشورة، بسبب الاحتياجات المتعلقة بإمكانية الوصول إليها، وضيق المساحة في العديد من المكتبات ودور المحفوظات. وتتناول هذه المقالة مشروعاً يُنفذ حالياً في مكتبات جامعة نيويورك، لتقييم التوصيات القائمة بشأن تحديد المواد البلاستيكية وتخزينها، ويوفر إرشادات لصنع أنواع من أوعية التخزين قابلة للتوسع والقياس، تيسر وصول المستخدم لها.

الكلمات الرئيسية:

الحفظ، والصيانة، وتطوير المجموعات، والمجموعات الأرشيفية، والمجموعات الخاصة، والكتب النادرة، و مواد الرسوم البيانية.

### Curation of manuscripts in the tropical savanna climate of north-eastern India

الاهتمام بالمخطوطات في مناخ السافانا الاستوائي في شمال شرقي الهند

سوديب بهاتاشارجي

مجلة الإفلا، 48–2

الخلاصة:

يتميز مناخ السافانا الاستوائي في شمال شرقي الهند بسمات خاصة نتيجة تقلب طقس المنطقة وموقعها الجغرافي. ويوجد في هذه المنطقة أكثر من 50000 مخطوطة نادرة مخزنة في مختلف مراكز حفظ المخطوطات. وعلى الرغم من أن البعثة الوطنية

للمخطوطات اتخذت مبادرات عديدة للحفاظ على هذه المخطوطات، بما في ذلك رقمنتها فإنه لم يطرأ أي تغيير يُذكر على الحالة المادية للمخطوطات، بل يتعرض معظمها للتلف بطبيعة الحال بسبب ندني مستوى العناية بها. ويمكن، باتخاذ الإجراءات المناسبة، الحد من عملية تلف المخطوطات الناجم عن تأثيرات البيئة والطقس والمناخ. وتتناول هذه المقالة الحالة المادية للمخطوطات، إلى جانب تأثيرات المناخ والطقس في هذه المنطقة. كما تناقش الحاجة إلى إيلاء اهتمام خاص للمخطوطات في هذا الموقع الجغرافي، واتخاذ إجراءات أو تقنيات وقائية بسيطة.

الكلمات الرئيسية:

مخطوطة، والاهتمام، ومناخ السافانا الاستوائي، والمناخ، والطقس، وشمال شرقي الهند

### Preservation storage in a flood damage mitigation effort at the National Library of France

مستودعات التخزين في مكتبة فرنسا الوطنية أثناء الجهود الرامية إلى الحد من أضرار الفيضانات  
سيلين ألين؛ وصوفي جرينو  
مجلة الإفلا، 48–2

الخلاصة:

يكتسي قرار إخلاء مجموعة معرضة للخطر من مكتبة أثناء إنذار الفيضانات أهمية بالغة. وما لم تُدرس كل خطوة دراسة متأنية، فإن التعجل في تنفيذ أي منها قد يؤدي إلى تعريض مجموعات قيمة لمخاطر غير متوقعة. وعلى الرغم من قلة الفيضانات التي تتعرض لها باريس عموماً، فإن قرار الإخلاء الوقائي يجب أن يُتخذ في وقت مناسب، مع الأخذ في الاعتبار الوقت اللازم لإعادة تخزين المجموعة، وواقع التهديد، وضرورة مواصلة تقديم الخدمة. وفي سياق خطة الحماية من الفيضانات، ابتكرت المكتبة الوطنية الفرنسية نموذج الصندوق، الذي يوفر الوقت في حالة حدوث فيضان، ويحول دون وقوع أضرار أثناء الإخلاء. ومن خلال الجمع بين إمكانية الوصول إلى الوثائق وتحقيق متطلبات الأمان، يمكن تنفيذ هذا النموذج في سياقات مختلفة.

الكلمات الرئيسية:

الحفظ، والصيانة، وتنمية المجموعات، وإدارة التراث الثقافي، ومبادئ علم المكتبات والمعلومات، والمجموعات الخاصة، والكتب النادرة

## Dunhuang scrolls: Innovative storage solutions at the British Library

مخطوطات دونهوانغ: حلول تخزين مبتكرة في المكتبة البريطانية  
بولينا كراكا، وماريا موزارت  
مجلة الإفلا، 48-2

الخلاصة:

تضم مجموعة شتاين في المكتبة البريطانية حوالي 14000 لفيفة، وشظايا لفائف، وكتيبات باللغة الصينية عُثر عليها في مجموعة كهوف موعاو البوذية بالقرب من دونهوانغ شمال غرب الصين. وتصف هذه المقالة حلولاً لتخزين المجموعات والوصول إليها في سياق كل من مكتبة أبحاث مزدحمة، ومشروع رقمنة مخطوطات لوتس سوترا الجاري تنفيذه في الوقت الراهن. ويعرض المقال مختلف التحديات التقنية والتنظيمية التي يواجهها أخصائيو الترميم في إعادة التخزين. ونظراً للقيود المتعلقة بمرافق التخزين القائمة، وقصور الميزانية، وقصر المهل الزمنية، يجب على أخصائيي الترميم توفير أوعية تخزين تناسب شكل اللفائف، لا تكون عملية وممانعة للفتك فحسب، وإنما فعالة أيضاً من حيث التكلفة والوقت. ومع أخذ أفضل ممارسات التخزين في الاعتبار، قاموا بتطوير حلول أصلية، وتحقيق التوازن بين متطلبات التخزين المحددة والقيود المفروضة. وتضمن هذه الحلول لأخصائيي الترميم سلامة المجموعة، وتتيح إمكانية الوصول إليها على المدى الطويل، كما ترسي أساس التوحيد القياسي الذي يضمن تجانس النهج المتبعة في المشاريع المستقبلية.

الكلمات الرئيسية:

اللفائف، والتخزين، ودوننهوانغ، وآسيا الوسطى، والحفظ، والورق

## David O Selznick storyboard rehousing project: A case study

مشروع إعادة تخزين قصص ديفيد أوه سيلزنيك المصورة: دراسة  
إفرادية  
جينيفيف بيرس  
مجلة الإفلا، 48-2

الخلاصة:

في 2018، أعاد مركز هاري رانسوم في جامعة تكساس في أوستن تخزين ما يزيد على 300 مخطط قصص مصورة من مجموعة ديفيد أوه سيلزنيك الشهيرة التي تحظى بإقبال كبير. وقد تابع أخصائيو الترميم هذا المشروع منذ بدايته وحتى إجراء المسح، ووضع التصميم، والتنفيذ. ومن خلال إنشاء نموذج تخزين جديد وتحسينه على مدار عام، تمكنت وحدة الترميم من دراسة كيفية تأثير التخزين على المادة، مما أدى إلى نشأة أنظمة وهياكل جديدة تسهل إدارة العملية وسير العمل، وكيفية تأثر المادة بالوعاء الذي تُخزن فيه.

الكلمات الرئيسية:

الترميم، والحفظ، وتطوير المجموعات، وآداب الفنون والعلوم الإنسانية، والمكتبات الأكاديمية، ومقدمو المعلومات، والمجموعات الخاصة، والكتب النادرة.

## Deciding how to decide: Using the digital preservation storage criteria

تحديد كيفية اتخاذ قرار: استخدام معايير مستودع الحفظ الرقمي  
سبيل شايفر؛ ونانسي واي ماكجفرن؛ والد مو زيبراو؛ وأندريا  
جوثالس، وسينثيا سم وو  
مجلة الإفلا، 48-2

الخلاصة:

انبثقت معايير مستودعات الحفظ الرقمي (المشار إليها فيما يلي بالمعايير) عن مناقشة مجتمعية جرت في المؤتمر الدولي الثاني عشر للحفظ الرقمي (iPRES 2015) بشأن تطور الوضع فيما يتعلق بالنهج المتبعة في مستودعات الحفظ الرقمي. اجتمع فريق عمل لوضع إرشادات للمنظمات التي تستخدم مستودعات الحفظ الرقمي أو توفرها. وظهر الإصدار الأول من المعايير في حلقة عمل iPRES 2016، الذي يوجز النتائج الأولية لمجموعة العمل وطلب التعليقات. وتبادل الفريق نسخاً تكرارية على مدار السنوات الثلاث الماضية، استرشدت بتعقيبات المجتمع التي جُمعت من جلسات المؤتمر، والاستعراضات عبر الإنترنت والمسوحات. وتتضمن الاستخدامات المحتملة للمعايير مساعدة المؤسسات على تطوير متطلبات مستودعات الحفظ الرقمي لديها، وتقييم حلول مستودعات الحفظ الرقمي، وزيادة الوعي بها، وتوفير مواد تدريبية لإعلام العاملين وغيرهم، مثل تنظيم ألعاب توضح كيفية موازنة المعايير للاستخدام. وصدر دليل الاستخدام جنباً إلى جنب مع تكرارية العام الحالي للمعايير للمساعدة في تطبيق المعايير. وتحتوي هذه التكرارية للمعايير على 61 معياراً مصنفة إلى فئات: سلامة المحتوى، واعتبارات التكلفة، والمرونة، وأمن المعلومات، والقدرة على التكيف، وقابلية التوسع، والأداء، والدعم، والشفافية. وتتضمن مسودة الإصدار 4، التي لم تصدر بعد، فئة إضافية، هي: أمن النظام. وإضافة إلى تقديم المعايير، وتوفير معلومات أساسية عن تطورها، تسلط هذه المقالة الضوء على مجالات جديدة للتطوير. أولاً، تعرض النتائج الأولية للجهد المستمر لتحديد معايير الحفظ الرقمي الدولية، ومعايير تكنولوجيا المعلومات ذات الصلة. ثانياً، تُناقش تحديات دليل الاستخدام. ودليل الاستخدام هو مكمل للمعايير، إذ يوفر المعلومات السياقية اللازمة لتنفيذ المعايير، ويتضمن أقساماً بشأن اعتبارات مثل إدارة المخاطر، والتكلفة، وفهم الاستقلال، وضمان سلامة الأجزاء الصغيرة. وأخيراً، طرحت أمثلة لاستخدام المعايير في سياقات مختلفة لتشجيع المنظمات على تطبيق المعايير وفقاً لأوضاعها. ويمكن الاطلاع على المعايير، وعلى دليل الاستخدام، وألعاب المعايير، والوثائق ذات الصلة، واستعراضها على الرابط: <https://osf.io/sjc6u/>، وستجري مشاركة الإضافات والتحديثات في المستقبل.

الكلمات الرئيسية:

المعايير، والمقاييس، وإدارة المخاطر، مستودع الحفظ الرقمي، والحفظ الرقمي، والتخزين طويل الأجل، ونظام المعلومات الأرشيفية المفتوح.

## Experimenting with 360° and virtual reality representations as new access strategies to vulnerable physical collections: Two case studies at the KB, National Library of the Netherlands

تجربة عروض الواقع الافتراضي بزواوية 360 درجة - بوصفها استراتيجيات جديدة للوصول إلى المجموعات المعرضة للتلف المادي: دراستان لحالتين إفراديتين في مكتبة هولندا الوطنية (KB) مارزيا لودو، وفويكي بورسما، ومارتين كليب، وكارين فينجرهوتس مجلة الإفلا، 48-2

الخلاصة:

في أواخر التسعينيات من القرن الماضي، أسفرت الثورة التي شهدتها الموارد الإلكترونية عن مشاريع رقمنة واسعة النطاق في خضم الحاجة إلى حفظ المعلومات الرقمية. وقد شاركت مكتبة هولندا الوطنية (KB)، بنشاط في هذه الأنشطة. وهي تقترح الآن طرقاً أفضل للحفاظ على المواد المادية للمكتبة، وتحسين سبل الوصول إليها لأغراض تعليمية. وتصف هذه المقالة مشروعين يجري تنفيذهما للحفاظ والمشاركة العامة. الأول، في مرحله الأولى، يتناول اختبار قابلية تطبيق التصوير بزواوية 360 درجة لدعم الوصول الافتراضي إلى مستودع المجموعات الخاصة. والثاني، هو إنتاج الواقع الافتراضي للأغراض التعليمية، وكتب الأطفال ذات الإطارات المنبثقة. كلا المشروعين يمكن أن يكونا مصدر إلهام لمكتبات أخرى لتقديم تقنيات الواقع الافتراضي، أو التقنيات الثلاثية الأبعاد وتطبيقاتها إلى جمهور جديد. وتصف هذه المقالة كل مشروع منهما، وتوضح الأساليب المستخدمة، وتناقش النتائج المتوقعة.

الكلمات الرئيسية:

إدارة المجموعات، وصور بزواوية 360 درجة، والواقع الافتراضي، والتخزين الآلي، وكتب الأطفال، والحفظ، والترميم.

## Applicability of traditional storage methods in Indonesia for today's conservation practice

إمكانية تطبيق طرق التخزين التقليدية في إندونيسيا على ممارسات الحفظ الراهنة باتريشيا إنجل مجلة الإفلا، 48-2

الخلاصة:

تهدف هذه المقالة إلى استخلاص التجارب من العديد من مشاريع الحفظ في جافا، إندونيسيا، وتلخص الطرق المستخدمة في محاولة للوصول إلى بعض الاقتراحات لأفضل الممارسات للحفاظ على عناصر التراث الثقافي في بلد استوائي. وتتعلق المشاريع المعنية بمتحف للفن المعاصر، ومواد مسرح العرائس التقليدي، ومتحف الفن التقليدي، وأرشيف.

الكلمات الرئيسية:

إندونيسيا، وإدارة التراث الثقافي، ومبادئ علم المكتبات والمعلومات، والحفظ، والترميم، وتطوير المجموعات، وجنوب شرق آسيا، وآسيا.

## Natural ingredients for a bacteria-free library collection

مكونات طبيعية لمجموعة مكتبية خالية من البكتيريا أنتونيت موهان لوبو؛ ومادهوري فيكرام تيكام مجلة الإفلا، 48-2

الخلاصة:

يستخدم التبخير على نطاق واسع للتخلص من الآفات. وينطوي هذا العلاج على استخدام المواد الكيميائية. لكنه إذا لم يُستخدم على نحو متكرر، فإن الحشرات والآفات تتكاثر مرة أخرى. ولا تهتم هذه المعالجة أيضاً بنمو الكائنات الحية الدقيقة التي تتغذى على المواد العضوية. ونظراً لما تتمتع به الهند من مناخ دافئ ورطب يشجع نمو الكائنات الحية الدقيقة تستخدم العادات الهندية أعشاباً وتوابل متنوعة للحفاظ على مواد القراءة. وقد أجريت هذه الدراسة لمعرفة تأثير الأعشاب والتوابل المتوفرة محلياً على الورق. كما أجريت التجارب في معمل إحدى الكليات. وذلك بهدف دراسة الأثر المثبط للنيم والقرفة والقرنفل والفلفل، ولمزيج من كل هذه الأعشاب والتوابل.

الكلمات الرئيسية:

حفظ المكتبات، والتلوث الجرثومي، والمواد الحافظة الطبيعية.

## Identification and storage of plastics in libraries and archives

图书馆和档案馆中塑料制品的识别与存储

Chantal Stein; Jessica Pace; Laura McCann

IFLA Journal, 48-2, 275-281

摘要

在许多图书馆和档案馆中，塑料制品安全存储及处理是一个紧迫的问题，但经常被忽视。众所周知，塑料很难保养，它比其他馆藏文献更容易变质。所谓的“有毒”塑料也会产生有害的降解物，破坏周围的文献，包括照片和纸张。然而，识别塑料制品的各种工具既繁琐又累赘。另一个原因是，由于许多图书馆和档案馆面临的无障碍需求和空间限制，理想的塑料存储环境往往难以实现。本文介绍了纽约大学图书馆目前开展的一个项目，旨在评估现有的识别和存储塑料制品的方法，并为开发可扩展存储形式提供指南。

关键词

保存，保护，馆藏开发，档案收藏，特藏，善本，图形资料

## Curation of manuscripts in the tropical savanna climate of north-eastern India

印度东北部热带草原气候环境下的手稿保护

Sudip Bhattacharjee

IFLA Journal, 48-2, 282-288

## 摘要

印度东北部因该地区的热带草原气候和地理位置特殊而具有独特性。该地区的手稿保存中心收藏了5万多份珍贵手稿。“国家手稿使命”组织采取了多种举措来保护这些手稿，包括数字化。然而，从目前的观察看来，手稿的物理状态没有重大改观。由于护理不当，大多数手稿材质都在自然老化。由于环境、天气和气候的影响造成的材质老化可以通过采取适当的措施来降至最低。本文介绍了该地区手稿的物理状态，以及气候和天气的影响。另外，文章还讨论了在该地区采用简单的预防措施或技术手段对手稿进行特殊护理的必要性。

## 关键词

手稿，保存，热带草原气候，气候，天气，印度东北部

### Preservation storage in a flood damage mitigation effort at the National Library of France

法国国家图书馆防洪减灾工作中的保护性存储

Celine Allain; Sophie Guérinot

*IFLA Journal*, 48–2, 289–292

## 摘要

在洪水警报期间，转移受到威胁的图书馆馆藏是一个重要的决定。如果不提前作好规划，仓促转移可能会让珍贵的藏品面临无法预测的威胁。尽管在巴黎洪水漫延速度较慢，但考虑到搬迁所需的时间、现实的威胁以及持续提供服务的需要，我们必须在适当的时候作出预防性转移的决定。法国国家图书馆根据其防洪计划设计了一个盒子模型，有助于在洪水发生时节省时间，并防止在转移过程中造成馆藏损坏。该模型将文献的获取便利性与安全需求结合起来，可以在不同的环境中应用。

## 关键词

保存，保护，馆藏开发，文化遗产管理，图情规范，特藏，善本

### Dunhuang scrolls: Innovative storage solutions at the British Library

敦煌经卷 英国国家图书馆的创新保存方案

Paulina Kralka; Marya Muzart

*IFLA Journal*, 48–2, 293–306

## 摘要

英国国家图书馆馆藏中有来自中国西北部敦煌莫高窟一个洞穴的大约1.4万件经卷、碎片和小册子。本文介绍了研究型图书馆在工作繁重且正在

开展莲华经手稿数字化项目的背景下，针对馆藏的存储和获取方案，以及图书馆员在转移这批馆藏的过程中遇到的各种技术和组织方面的挑战。受现有存储设施、预算限制和项目时间的约束，图书馆员必须找到适合卷轴格式、实用且足够宽阔，同时也要具有成本效益和时间效益的存储空间。为了实现最佳存储，他们进一步完善了原始方案，平衡了空间要求和限制，从而保证馆藏的长期安全和获取便利，同时也奠定了标准化的基础，有助于确保未来项目方案的统一性。

## 关键词

经卷，保存，敦煌，中亚，保护，纸张

### David O Selznick storyboard rehousing project: A case study

大卫·塞尔兹尼克插图重新安置项目 案例研究

Genevieve Pierce

*IFLA Journal*, 48–2, 307–317

## 摘要

2018年，得克萨斯大学奥斯汀分校哈里·兰塞姆中心将广受欢迎且使用频率较高的大卫·塞尔兹尼克藏品中的300幅电影故事插图进行了迁移。从项目启动到调查和设计构思，再到项目实施，保护人员对整个项目进行了跟踪。通过创建新的存储模型并在一年内逐渐完善，保存小组了解到存储环境对藏品的影响，并在此基础上建立了新的系统和架构，以优化流程管理。

## 关键词

保存，保护，馆藏开发，艺术与人文文献，高校图书馆，信息提供者，特藏，善本

### Deciding how to decide: Using the digital preservation storage criteria

如何作出决策 数字保存存储标准的使用

Sibyl Schaefer; Nancy Y. McGovern; Eld M. O. Zhierau; Andrea Goethals; Cynthia C. M. Wu

*IFLA Journal*, 48–2, 318–331

## 摘要

数字保存存储标准(以下简称标准)成型于第12届国际数字保存会议(iPRES 2015)期间有关数字保存存储方法的发展前景的讨论。会上成立了工作组，为使用或提供数字保存存储的组织制定工作指南。标准第一版在2016年举行的国际数字保存会议上发布，其中简要介绍了工作组的初步成果，并向业界征集反馈意见。在过去三年中，工作组以会议、在线评论和调查中收集到的反馈为依据，不断更新标准版本并进行分享。它可以帮助各机构针对自身情况制定数字保存存储要

求, 评估数字保存存储解决方案, 加强对数字保存存储的关注, 并向从业人员和其他人员提供培训材料(如通过一个游戏来演示如何根据自身需要调整标准) 当前通用版本的标准附带了一份使用指南, 介绍其使用方法 现行版本包含61项内容, 包括内容完整性、成本考虑、灵活性、信息安全、弹性、可扩展性和性能、支持以及透明度 未发布的第四版还包含另一个类别 系统安全 除了介绍标准及其完善过程外, 本文还重点介绍了新的发展领域 首先介绍了将标准与相关国际数字保存和信息技术标准相匹配的初步结果 其次讨论了使用指南的更新情况 使用指南是对标准的补充, 提供了实施标准所需的背景信息, 另外还包含风险管理、成本、独立性理解和确保数字安全等几方面内容 最后, 本文提供了标准在多种情形中的使用案例, 鼓励各机构根据自身情况予以使用 标准、使用指南和相关文件均已公开, 可登录<https://osf.io/sjc6u/>查看, 后续新增内容也将陆续上传

#### 关键词

标准, 风险管理, 数字保存存储, 数字存储, 长期存储, 开放档案信息系统

### **Experimenting with 360° and virtual reality representations as new access strategies to vulnerable physical collections: Two case studies at the KB, National Library of the Netherlands**

使用全景图像和虚拟现实作为访问脆弱物理馆藏的新途径 荷兰国家图书馆的两个案例研究

*Marzia Loddo; Foekje Boersma; Martijn Kleppe; Karin Vingerhoets*

*IFLA Journal, 48-2, 332-338*

#### 摘要

20世纪90年代末, 电子资源的爆炸性增长导致了大规模数字化项目的涌现, 出现了保存数字信息的需求 荷兰国家图书馆一直积极参与这些活动 目前, 该馆提出了更好的方法, 既可以保存实体文献, 也可以提供公开获取, 实现文献的教育用途 本文介绍了两个正在开展的有关保存保护和公众参与的项目 第一个项目仍处于早期阶段, 旨在测试全景图像对于支持在线特藏访问的效果 第二个项目是以教育为目的, 将少儿立体书做成虚拟现实 这两个项目有助于激励其他图书馆向新的受众推出三维或虚拟现实技术及其应用 本文详细介绍了这两个项目, 展示相关技术的使用方法, 并探讨了预期结果

#### 关键词

馆藏管理, 全景图像, 虚拟现实, 自动存储, 少儿图书, 保存, 保护

### **Applicability of traditional storage methods in Indonesia for today's conservation practice**

印度尼西亚传统存储方法在当今保护实践中的适用性

*Patricia Engel*

*IFLA Journal, 48-2, 339-348*

#### 摘要

本文旨在将印度尼西亚爪哇开展的几个保护项目的经验进行归纳提炼, 为热带国家保护文化遗产项目提供最佳实践 相关项目涉及当代艺术博物馆、传统木偶剧院、传统艺术博物馆和档案馆等

#### 关键词

印度尼西亚, 文化遗产管理, 图情规范, 保存, 保护, 馆藏开发, 东南亚, 亚洲

### **Natural ingredients for a bacteria-free library collection**

无菌馆藏保护中使用的天然成分

*Antonette Mohan Lobo; Madhuri Vikram Tikam*

*IFLA Journal, 48-2, 349-351*

#### 摘要

熏蒸法被广泛用于消灭害虫 这种处理方法需要借助化学物质, 如果不反复使用, 昆虫和害虫往往会再次繁殖 这种方法也无法解决以有机物为食的微生物的生长 印度气候温暖湿润, 有利于微生物的生长 印度人传统上利用各种草药和香料来保护阅读材料 因此, 本文的目的是观察当地的草药和香料对纸张的影响 研究人员在一所大学的实验室里进行实验, 研究印楝、肉桂、丁香、胡椒以及所有草药和香料的混合物产生的抑制作用

#### 关键词

图书馆保存, 微生物污染, 天然防腐剂

### **Identification and storage of plastics in libraries and archives**

### **Identification et stockage des plastiques dans les bibliothèques et archives**

*Chantal Stein; Jessica Pace; Laura McCann*

*IFLA Journal, 48-2, 275-281*

#### Résumé:

Stocker et manipuler en toute sécurité des objets en plastique est un problème grandissant et souvent sous-estimé dans de nombreuses collections de



bibliothèques et d'archives. Les plastiques sont connus pour être difficiles à conserver, dans la mesure où ils peuvent se détériorer plus vite que les autres matériaux présents dans les collections d'archives. Les plastiques dits « malléables » peuvent aussi produire des substances dangereuses en se décomposant, endommageant ainsi les matériaux environnants, y compris photos et papiers. D'une part, le problème est qu'il existe une multitude d'outils disponibles pour identifier les plastiques, ce qui peut être à la fois fastidieux et décourageant. D'autre part, les conditions idéales recommandées par les spécialistes pour conserver les plastiques sont souvent difficiles à mettre en place, du fait des besoins d'accès et des contraintes spatiales auxquels de nombreuses bibliothèques et archives sont confrontées. Cet article présente un projet en cours dans les bibliothèques de l'Université de New York, projet qui évalue les recommandations existantes pour identifier et héberger les plastiques et donne des conseils pour mettre en place des types d'hébergement évolutifs permettant l'accès aux utilisateurs.

Mots-clés:

Préservation, conservation, développement des collections, collections d'archives, collections spéciales, livres rares, matériels graphiques

### **Curation of manuscripts in the tropical savanna climate of north-eastern India**

### **Conservation des manuscrits dans le climat tropical de la savane du nord-est de l'Inde**

*Sudip Bhattacharjee*

*IFLA Journal, 48–2, 282–288*

Résumé:

En raison du temps variable et de l'emplacement géographique, le climat tropical de la savane du nord-est de l'Inde a des caractéristiques particulières. Plus de 50 000 manuscrits rares sont entreposés dans différents centres de conservation des manuscrits de cette région. La Mission nationale des Manuscrits a pris de nombreuses initiatives afin de les conserver, y compris leur numérisation. Cependant, aucun changement significatif n'a été constaté en ce qui concerne l'état même des manuscrits. La plupart se détériorent naturellement faute de soins appropriés. Le processus de détérioration des manuscrits dû aux effets de l'environnement, des conditions météo et du climat peuvent être atténués à condition de prendre des mesures adéquates. Cet article aborde l'état dans lequel se trouvent les manuscrits dans cette région ainsi que les

effets du climat et de la météo. Il traite aussi de la nécessité de procurer des soins particuliers à ces manuscrits dans cette région du monde en appliquant de simples mesures ou techniques préventives.

Mots-clés:

Manuscrit, conservation, climat tropical de la savane, climat, météo, nord-est de l'Inde

### **Preservation storage in a flood damage mitigation effort at the National Library of France**

### **Stockage protecteur afin de réduire les dommages en cas d'inondation à la Bibliothèque nationale de France**

*Celine Allain; Sophie Guérinot*

*IFLA Journal, 48–2, 289–292*

Résumé:

En cas d'alerte aux inondations, la décision d'évacuer une collection bibliothécaire en péril est décisive. Si elle n'est pas soigneusement pensée, des mesures prises à la hâte peuvent exposer de précieuses collections à des menaces imprévisibles. Bien que les inondations se développent généralement lentement à Paris, la décision de procéder à une évacuation préventive doit être prise au moment opportun, étant donné le temps nécessaire pour le déménagement, la réalité de la menace et le besoin d'assurer la continuité des services. Dans le contexte de ce plan de protection contre les inondations, la Bibliothèque nationale de France a conçu un modèle de caisson qui permet de gagner du temps en cas d'inondation et d'éviter les dommages en cours d'évacuation. Combinant la possibilité d'accéder aux documents et les contraintes en matière de sécurité, ce modèle peut être utilisé dans différents contextes.

Mots-clés:

Préservation, conservation, développement des collections, gestion du patrimoine culturel, principes de bibliothéconomie, collections spéciales, livres rares

### **Dunhuang scrolls: Innovative storage solutions at the British Library**

### **Les manuscrits de Dunhuang: solutions innovantes de stockage à la British Library**

*Paulina Kralka; Marya Muzart*

*IFLA Journal, 48–2, 293–306*

Résumé:

La collection Stein de la British Library comprend environ 14 000 rouleaux, fragments et recueils en

chinois provenant d'une des grottes du complexe bouddhique de Mogao près de Dunhuang, dans le nord-ouest de la Chine. Cet article décrit les solutions de stockage pour la collection et les possibilités d'y accéder, dans le contexte d'une bibliothèque de recherche très fréquentée et du projet de numérisation en cours des manuscrits du Sûtra du Lotus. L'article présente les différents défis d'ordre technique et organisationnel que pose la relocalisation de la collection aux conservateurs de la bibliothèque. Limités par les équipements existants de stockage, les contraintes budgétaires et les délais serrés du projet, les conservateurs doivent fournir un lieu de stockage adapté au format des rouleaux qui soit pratique et évite de devoir les séparer tout en étant aussi rentable et efficace en termes de temps. Visant à mettre en place les meilleures solutions de stockage, ils ont développé des options originales qui tiennent compte aussi bien des exigences spécifiques en matière de stockage que des contraintes existantes. Ces solutions de stockage permettent aux conservateurs d'assurer à long terme la sécurité de la collection et la possibilité d'y accéder, tout en jetant les bases d'une standardisation afin de pouvoir adopter des approches homogènes lors de futurs projets.

Mots-clés:

Rouleaux, stockage, Dunhuang, Asie centrale, conservation, papier

### **David O Selznick storyboard rehousing project: A case study**

#### **Projet de relocalisation des storyboards de David O. Selznick: une étude de cas**

Genevieve Pierce

*IFLA Journal*, 48–2, 307–317

Résumé:

En 2018, le Centre Harry Ransom de l'Université du Texas à Austin a relocalisé plus de 300 storyboards illustrés de la collection David O. Selznick, une collection populaire et fréquemment consultée. Des spécialistes de la conservation ont suivi ce projet depuis ses débuts, de l'étude préalable et de sa conception jusqu'à sa mise en œuvre. En créant un nouveau modèle d'hébergement et en le raffinant en l'espace d'un an, l'unité chargée de la conservation a pu étudier la façon dont le lieu de stockage influence un objet, ce qui a permis de concevoir de nouveaux systèmes et structures pour faciliter la gestion des processus et des tâches, ainsi que la façon dont un objet est impacté par son lieu de stockage.

Mots-clés:

Préservation, conservation, développement des collections, documentation sur les arts et sciences

humaines, bibliothèques universitaires, fournisseurs d'informations, collections spéciales, livres rares

### **Deciding how to decide: Using the digital preservation storage criteria**

#### **Décider comment prendre une décision: utiliser les critères de stockage pour la préservation numérique**

Sibyl Schaefer; Nancy Y. McGovern; Eld M. O. Zhierau; Andrea Goethals; Cynthia C. M. Wu

*IFLA Journal*, 48–2, 318–331

Résumé:

Les critères de stockage pour la préservation numérique (ci-après les Critères) sont issus d'une discussion commune lors de la 12<sup>e</sup> Conférence internationale consacrée à la préservation numérique (iPRES 2015) et portant sur l'évolution des méthodes de préservation numérique. Un groupe de travail s'est réuni pour développer une ligne directrice à l'intention des organisations qui utilisent ou fournissent des possibilités de stockage pour la préservation numérique. La première version des Critères a été présentée lors d'un atelier à l'iPRES 2016, afin d'exposer les premiers résultats obtenus par le groupe de travail et de susciter des réactions. Ces trois dernières années, le groupe de travail a partagé plusieurs versions différentes, prenant en compte les réactions de la communauté recueillies lors des conférences ainsi que les avis en ligne et une enquête. Les Critères peuvent notamment aider les organisations à déterminer des conditions de stockage pour la préservation numérique, évaluer les solutions en la matière, sensibiliser aux questions relatives à ce stockage et fournir du matériel de formation servant à informer les professionnels et autres, comprenant un jeu pour démontrer comment les Critères peuvent être adaptés à un usage donné. La publication de la dernière version publique en date des Critères était accompagnée d'un Guide d'utilisation pour aider à les appliquer. Cette publication contient 61 critères regroupés en catégories: intégrité du contenu, considérations sur les coûts, flexibilité, sécurité des informations, résilience, modularité et performances, soutien et transparence. La version provisoire 4 non publiée comprend une catégorie supplémentaire: sécurité des systèmes. En plus de présenter les Critères et d'offrir un contexte à propos de leur évolution, cet article aborde de nouveaux domaines de développement. Tout d'abord, il évoque les premiers résultats d'une démarche constante visant à cartographier les Critères en tenant compte des normes internationales de préservation numérique et de technologie informatique.

Ensuite, il traite des mises à jour du Guide d'utilisation. Ce guide complète les Critères en fournissant les informations contextuelles nécessaires pour les mettre en œuvre, et il comprend des chapitres consacrés à des considérations telles que gestion des risques, coûts, comprendre l'indépendance et assurer la protection des bits. Enfin, il donne des exemples d'utilisation des Critères dans différents contextes pour encourager les organisations à les appliquer à leur propre situation. Les Critères, le Guide d'utilisation, le jeu et les documents en rapport sont en accès libre et disponibles pour consultation sur <https://osf.io/sjc6u/>, site sur lequel seront partagées des mises à jour et additions par la suite.

Mots-clés:

Critères, normes, gestion des risques, stockage pour la préservation numérique, stockage numérique, stockage sur le long terme, système d'informations d'archives en accès libre

**Experimenting with 360° and virtual reality representations as new access strategies to vulnerable physical collections: Two case studies at the KB, National Library of the Netherlands**

**Expérimentation avec des représentations à 360° et de réalité virtuelle en tant que nouvelles stratégies d'accès à des collections matérielles vulnérables: deux études de cas à la Bibliothèque royale des Pays-Bas (KB)**

*Marzia Loddo; Foekje Boersma; Martijn Kleppe; Karin Vingerhoets*

*IFLA Journal, 48-2, 332-338*

Résumé:

À la fin des années 90, l'abondance de ressources électroniques a donné naissance à des projets de numérisation à grande échelle, avec la nécessité de préserver les informations numériques. La Bibliothèque royale des Pays-Bas (KB) s'est impliquée activement dans ces projets. Maintenant, elle propose de meilleures méthodes pour aussi bien conserver le patrimoine physique des bibliothèques qu'améliorer l'accès à des fins éducatives. Cet article décrit deux projets en cours portant sur la conservation et l'engagement du public. Le premier, à un stade précoce, consiste à tester la possibilité d'utiliser des images à 360° pour permettre d'accéder visuellement à des collections spéciales stockées. Le second consiste à produire des livres animés pour enfants en réalité virtuelle dans un but éducatif. Ces deux projets

pourraient inspirer les autres bibliothèques à faire connaître les technologies en trois dimensions ou en réalité virtuelle à de nouveaux publics, ainsi que leurs applications. Cet article décrit chaque projet, expose les méthodes utilisées et aborde les résultats attendus.

Mots-clés:  
Gestion des collections, images à 360°, réalité virtuelle, stockage automatisé, livres pour enfants, préservation, conservation

**Applicability of traditional storage methods in Indonesia for today's conservation practice**

**Possibilité d'utiliser des méthodes de stockage traditionnelles en Indonésie dans le cadre des pratiques actuelles de conservation**

*Patricia Engel*

*IFLA Journal, 48-2, 339-348*

Résumé:

Cette contribution fait le point sur les expériences tirées de plusieurs projets de conservation à Java en Indonésie et en résume les méthodes, afin de suggérer quelles peuvent être les meilleures pratiques pour conserver les objets du patrimoine culturel dans un pays tropical. Ces projets concernent un musée d'art contemporain, le matériel d'un théâtre de marionnettes traditionnel, un musée d'art traditionnel et une archive.

Mots-clés:

Indonésie, gestion du patrimoine culturel, principes de bibliothéconomie, préservation, conservation, développement des collections, Asie du Sud-Est, Asie

**Natural ingredients for a bacteria-free library collection**

**Ingrédients naturels pour une collection bibliothécaire exempte de bactéries**

*Antonette Mohan Lobo; Madhuri Vikram Tikam*

*IFLA Journal, 48-2, 349-351*

Résumé:

La fumigation est largement utilisée pour se débarrasser des nuisibles. Ce traitement utilise des produits chimiques. Cependant, si les traitements ne sont pas appliqués de façon répétée, les insectes et nuisibles ont de nouveau tendance à se reproduire. Ce traitement ne tient pas non plus compte de la croissance des microorganismes qui se nourrissent de substances organiques. L'Inde a un climat chaud et humide qui

favorise la croissance des microorganismes. La tradition indienne utilise diverses herbes aromatiques et épices pour conserver les matériels de lecture. Par conséquent, cette étude a été menée pour examiner l'effet sur le papier des herbes aromatiques et des épices disponibles localement. Des expériences ont eu lieu dans un laboratoire universitaire. Elles avaient pour but d'étudier l'action inhibitrice du margousier, de la cannelle, des clous de girofle, du poivre et d'un mélange de toutes ces herbes aromatiques et épices.

Mots-clés:

Conservation bibliothécaire, contamination microbienne, conservateurs naturels

### **Identification and storage of plastics in libraries and archives**

### **Identifizierung und Aufbewahrung von Kunststoffen in Bibliotheken und Archiven**

*Chantal Stein; Jessica Pace; Laura McCann*

*IFLA Journal, 48–2, 275–281*

Zusammenfassung:

Die sichere Aufbewahrung und Handhabung von Kunststoffobjekten stellt in vielen Bibliotheks- und Archivsammlungen ein großes, aber oft übersehenes Problem dar. Es ist bekannt, dass die Aufbewahrung von Kunststoffen äußerst schwierig ist, weil deren Zustand sich viel schneller verschlechtern kann als der anderer Materialien in Archivbeständen. Die sogenannten „malignant plastics“ (= „böartige“, „heimtückische“ Kunststoffe“) können auch schädliche Abbauprodukte erzeugen, die in der Nähe befindliche Materialien wie Fotos und Papiere beschädigen. Ein Teil des Problems ist die Vielzahl der verfügbaren Hilfsmittel zur Identifizierung von Kunststoffen, die sowohl aufwändig als auch abschreckend sein können. Außerdem sind die in der einschlägigen Literatur empfohlenen idealen Aufbewahrungsbedingungen für Kunststoffe aufgrund der Auflagen zur Zugänglichkeit und des Platzmangels in vielen Bibliotheken und Archiven oft schwer zu bieten. In diesem Artikel wird ein aktuelles Projekt der Bibliotheken der New York University vorgestellt, bei dem die bestehenden Empfehlungen für die Identifizierung und Aufbewahrung von Kunststoffen bewertet und Richtlinien für die Erstellung skalierbarer Lagerungsarten bereitgestellt werden, die den Zugriff durch Benutzende verbessern.

Schlüsselbegriffe:

Erhaltung, Konservierung, Sammlungsentwicklung, Archivsammlungen, Sondersammlungen, seltene Bücher, grafische Materialien

### **Curation of manuscripts in the tropical savanna climate of north-eastern India**

### **Aufbewahrung von Manuskripten im tropischen Savannenklime Nordostindiens**

*Sudip Bhattacharjee*

*IFLA Journal, 48–2, 282–288*

Abstrakt:

Das Klima der tropischen Savanne im Nordosten Indiens zeigt aufgrund der unterschiedlichen Wetterbedingungen und der geografischen Lage der Region besondere Merkmale. In den einzelnen Zentren zur Erhaltung von Handschriften in dieser Region werden mehr als 50.000 seltene Handschriften aufbewahrt. Die National Mission for Manuscripts hat zahlreiche Initiativen zur Erhaltung dieser Manuskripte einschließlich der Digitalisierung auf den Weg gebracht. Erhebliche Veränderungen in Bezug auf den physischen Zustand der Manuskripte wurden jedoch nicht festgestellt. Die Qualität der meisten Manuskripte verschlechtert sich auf natürliche Weise durch unsachgemäße Pflege. Dem durch Umwelt-, Witterungs- und Klimaeinflüsse verursachten Qualitätsverlust von Manuskripten kann durch geeignete Maßnahmen entgegengewirkt werden. Dieser Artikel befasst sich mit dem Zustand von Manuskripten in dieser Region sowie mit den Auswirkungen durch Klima und Wetter. Außerdem beschreibt er die Notwendigkeit einer besonderen Pflege der Manuskripte an diesem geografischen Ort anhand einfacher vorbeugender Maßnahmen oder Techniken.

Schlüsselbegriffe:

Manuskript, Kuration, Klima der tropischen Savanne, Klima, Wetter, Nordostindien

### **Preservation storage in a flood damage mitigation effort at the National Library of France**

### **Konservierende Lagerung in der Nationalbibliothek Frankreichs als Schutzmaßnahmen im Rahmen von Hochwasserschäden**

*Celine Allain; Sophie Guérinot*

*IFLA Journal, 48–2, 289–292*

Abstrakt:

Während eines Hochwasseralarms ist die Entscheidung, eine bedrohte Sammlung einer Bibliothek auszulagern, von höchster Bedeutung. Eine voreilige Verlegung kann dazu führen, dass wertvolle Sammlungen unvorhergesehenen Bedrohungen ausgesetzt

werden. Auch wenn der Zeitverlauf bei Überschwemmungen in Paris zumeist in gemäßigttem Tempo verläuft, muss die Entscheidung für eine präventive Auslagerung zum richtigen Zeitpunkt getroffen werden, wobei die dafür benötigte Zeit, die Wahrscheinlichkeit der Bedrohung und die Notwendigkeit der Kontinuität beim Leistungsangebot zu berücksichtigen sind. Im Rahmen ihres Hochwasserschutzplans hat die Nationalbibliothek Frankreichs eine Art Kastenmodell entwickelt, mit dem im Falle einer Überschwemmung Zeit gespart und Schäden bei einer Evakuierung verhindert werden. Bei diesem Modell, das in verschiedenen Kontexten eingesetzt werden kann, werden einerseits die Zugänglichkeit von Dokumenten und andererseits die Sicherheitsanforderungen berücksichtigt.

Schlüsselbegriffe:

Konservierung, Erhaltung, Sammlungsentwicklung, Verwaltung des kulturellen Erbes, Grundsätze der Bibliotheks- und Informationswissenschaft, Sondersammlungen, seltene Bücher

### **Dunhuang scrolls: Innovative storage solutions at the British Library**

#### **Dunhuang-Schriftrollen: Innovative Lösungen zur Aufbewahrung in der British Library**

*Paulina Kralka; Marya Muzart*

*IFLA Journal, 48–2, 293–306*

Abstrakt:

Die Stein-Sammlung der British Library enthält etwa 14.000 Schriftrollen, Fragmente und Dokumente in chinesischer Sprache aus einer Höhle im buddhistischen Mogao-Höhlenkomplex in der Nähe von Dunhuang im Nordwesten Chinas. Dieser Artikel beschreibt Aufbewahrungs- und Zugriffslösungen für die Sammlung im Kontext einer intensiv genutzten Forschungsbibliothek und des derzeit laufenden Digitalisierungsprojekts für das Manuskript des Lotus-Sutra. In dem Artikel werden die verschiedenen technischen und organisatorischen Herausforderungen vorgestellt, die sich den Bibliothekskonservatoren: innen bei der Umlagerung stellen. Im Hinblick auf die Beschränkungen durch die vorhandenen Lagermöglichkeiten, das begrenzte Budget und die knappen Projektfristen müssen die Konservatoren: innen eine Unterbringung schaffen, die dem Format der Schriftrolle angemessen ist, praktisch ist und eine räumliche Trennung verhindert, aber auch kosten- und zeitsparend ist. Unter Berücksichtigung der besten Praktiken zur Aufbewahrung haben sie originelle Lösungen

entwickelt, bei denen die spezifischen Anforderungen und Beschränkungen der Unterbringung berücksichtigt werden. Diese Aufbewahrungslösungen ermöglichen es den Konservatoren: innen, die Sicherheit und Zugänglichkeit der Sammlung langfristig zu gewährleisten und gleichzeitig eine Grundlage für die Standardisierung zu schaffen, die eine einheitliche Vorgehensweise bei künftigen Projekten sicherstellt.

Schlüsselbegriffe:

Schriftrolle, Lagerung, Dunhuang, Zentralasien, Konservierung, Papier

### **David O Selznick storyboard rehousing project: A case study**

#### **Projekt zur Umlagerung der Storyboards von David O. Selznick: Eine Fallstudie**

*Genevieve Pierce*

*IFLA Journal, 48–2, 307–317*

Abstrakt:

Im Jahr 2018 hat das Harry Ransom Center der University of Texas in Austin über 300 illustrierte Storyboards für Filme aus der beliebten und häufig genutzten „David O Selznick Collection“ umgelagert. Die Konservierungstechniker: innen haben dieses Projekt von seiner Entstehung über die Auslegung und Konzeption bis hin zur Ausführung betreut. Durch die Entwicklung eines neuen Aufbewahrungsmodells und dessen stetiger Verbesserung im Laufe eines Jahres konnte die Abteilung für Konservierung die Auswirkungen der Aufbewahrung auf ein Objekt untersuchen, was zu neuen Systemen und Strukturen zur Erleichterung des Prozessmanagements und der Arbeitsabläufe führte, und Informationen darüber bot, wie ein Objekt durch seine Aufbewahrung beeinflusst wird.

Schlüsselbegriffe:

Erhaltung, Konservierung, Sammlungsentwicklung, kunst- und geisteswissenschaftliche Literatur, wissenschaftliche Bibliotheken, Informationsanbieter, Sondersammlungen, seltene Bücher

### **Deciding how to decide: Using the digital preservation storage criteria**

#### **Entscheidungen zur Entscheidungsfindung: Anwendung von Speicherkriterien für die digitale Bestandserhaltung**

*Sibyl Schaefer; Nancy Y. McGovern; Eld M. O. Zhierau; Andrea Goethals; Cynthia C. M. Wu*

*IFLA Journal, 48–2, 318–331*

Abstrakt:

Die Speicherkriterien für die digitale Bestandserhaltung (nachstehend „die Kriterien“) sind aus einer Gemeinschaftsdiskussion auf der 12. Internationalen Konferenz für digitale Bestandserhaltung (iPRES 2015) über die sich entwickelnde Landschaft der Speicherkonzepte für die digitale Aufbewahrung hervorgegangen. Eine Arbeitsgruppe wurde eingerichtet, um einen Leitfaden für Organisationen zu entwickeln, die Speicher für die digitale Bestandserhaltung nutzen oder bereitstellen. Die erste Fassung dieser Kriterien wurde auf einem iPRES-Workshop 2016 vorgestellt, auf dem die vorläufigen Ergebnisse der Arbeitsgruppe vorgestellt und um Feedback gebeten wurden. Die Arbeitsgruppe hat in den letzten drei Jahren verschiedene Fassungen präsentiert, die durch das Feedback aus der Gemeinschaft, das in Konferenzsitzungen, Online-Reviews und einer Umfrage gesammelt wurde, beeinflusst wurden. Zu den möglichen Verwendungszwecken der Kriterien gehören die Unterstützung von Organisationen bei der Entwicklung von Anforderungen für die Datenspeicherung zur digitalen Bestandserhaltung, die Bewertung der diesbezüglichen Lösungen, die Sensibilisierung über diese Form der Bestandserhaltung und die Bereitstellung von Schulungsmaterial zur Information von Fachleuten und anderen, einschließlich eines Spiels, um aufzuzeigen, wie die Kriterien in der Praxis angepasst werden können. Mit der Veröffentlichung der aktuellen Fassung dieser Kriterien wurde ein Leitfaden zu deren Anwendung veröffentlicht. Diese Ausgabe enthält 61 Kriterien, die in diese Kategorien unterteilt sind: Integrität der Inhalte, Kostenerwägungen, Flexibilität, Informationssicherheit, Ausfallsicherheit, Skalierbarkeit und Leistung, Unterstützung und Transparenz. Der unveröffentlichte Entwurf, Fassung 4, enthält eine zusätzliche Kategorie: Systemsicherheit. In diesem Artikel werden nicht nur die Kriterien vorgestellt und Hintergründe zu ihrer Entwicklung erläutert, sondern auch neue Entwicklungsbereiche aufgezeigt. Zunächst werden die vorläufigen Ergebnisse der laufenden Bemühungen um eine Zuordnung der Kriterien zu den einschlägigen internationalen Normen für digitale Bestandserhaltung und Informationstechnologie vorgestellt. Im Anschluss werden Aktualisierungen des Anwendungsleitfadens erörtert. Dieser Leitfaden ist eine Ergänzung zu den Kriterien, die die für deren Umsetzung erforderlichen Kontextinformationen bietet und Abschnitte zu wesentlichen Aspekten wie Risikomanagement, Kosten, Verständnis der Unabhängigkeit und Gewährleistung der Bit-Verschlüsselung enthält. Schließlich werden Beispiele für die Anwendung der Kriterien in verschiedenen Kontexten angeführt, um Organisationen anzuregen,

die Kriterien in ihrer eigenen Situation anzuwenden. Die Kriterien, der Anwendungsleitfaden, das Kriterienspiel und die zugehörigen Dokumente sind frei zugänglich und können unter <https://osf.io/sjc6u/> abgerufen werden; dort werden auch in Zukunft Ergänzungen und Aktualisierungen veröffentlicht.

Schlüsselbegriffe:

Kriterien, Normen, Risikomanagement, Speicherung zur digitalen Bestandserhaltung, digitale Speicherung, Langzeitspeicherung, Open Archival Information System (OAIS), dynamisches erweiterungsfähiges Archivinformationssystem

### **Experimenting with 360° and virtual reality representations as new access strategies to vulnerable physical collections: Two case studies at the KB, National Library of the Netherlands**

### **Experimente mit 360°- und Virtual-Reality-Darstellungen als neue Zugangsstrategien für gefährdete physische Sammlungen: zwei Fallstudien an der Königlichen Bibliothek der Niederlande**

*Marzia Loddo; Foekje Boersma; Martijn Kleppe; Karin Vingerhoets*

*IFLA Journal, 48–2, 332–338*

Abstrakt:

In den späten 1990er-Jahren führte die stürmische Zunahme elektronischer Ressourcen in Verbindung mit der Notwendigkeit zur Bestandserhaltung digitaler Informationen zu groß angelegten Digitalisierungsprojekten. Die Königliche Bibliothek der Niederlande hat sich aktiv an diesen Aktivitäten beteiligt, sodass sie jetzt bessere Möglichkeiten vorschlägt, um sowohl die physischen Bibliotheksbestände zu erhalten als auch ihre Zugänglichkeit für Bildungszwecke zu verbessern. In diesem Artikel werden zwei laufende Projekte beschrieben, bei denen es um Bestandserhaltung und öffentliches Engagement geht. Ein Projekt, das sich noch in der Anfangsphase befindet, beinhaltet Test hinsichtlich der Anwendbarkeit von 360°-Bildern zur Unterstützung des virtuellen Zugangs zu den Beständen der Sondersammlungen. Das zweite Projekt umfasst die Erstellung sogenannter Pop-up-Kinderbücher in virtueller Realität zu Bildungszwecken. Beide Projekte könnten andere Bibliotheken dazu inspirieren, dreidimensionale oder Virtual-Reality-Technologien und ihre Anwendungen für neue Zielgruppen zu erschließen. In diesem Artikel werden die einzelnen Projekte beschrieben, die

verwendeten Methoden aufgezeigt und die erwarteten Ergebnisse dargelegt.

Schlüsselbegriffe:

Samlungsmanagement, 360°-Bilder, virtuelle Realität, automatisierte Lagerung, Kinderbücher, Bestandserhaltung, Konservierung

### **Applicability of traditional storage methods in Indonesia for today's conservation practice**

#### **Anwendbarkeit traditioneller Lagerungsmethoden in Indonesien für die heutige Konservierungspraxis**

*Patricia Engel*

*IFLA Journal, 48–2, 339–348*

Abstrakt:

In diesem Beitrag sollen die Erfahrungen aus mehreren Konservierungsprojekten auf Java (Indonesien) in einer Zusammenfassung der Methoden zusammengefasst werden, um einige Vorschläge im Rahmen bewährter Verfahren zur Erhaltung von Kulturgütern in einem tropischen Land vorzulegen. Bei den diesbezüglichen Projekten betraf es ein Museum für zeitgenössische Kunst, Materialien aus dem Puppenvolkstheater, ein Museum für traditionelle Kunst und ein Archiv.

Schlüsselbegriffe:

Indonesien, Umgang mit dem kulturellen Erbe, Grundsätze der Bibliotheks- und Informationswissenschaft, Konservierung, Bestandserhaltung, Sammlungsentwicklung, Südostasien, Asien

### **Natural ingredients for a bacteria-free library collection**

#### **Natürliche Aspekte für eine bakterienfreie Bibliothekssammlung**

*Antonette Mohan Lobo; Madhuri Vikram Tikam*

*IFLA Journal, 48–2, 349–351*

Abstrakt:

Ein weit verbreitetes Mittel zur Bekämpfung von Schädlingen ist die Ausräucherung, bei der Chemikalien eingesetzt werden. Wenn die Anwendung jedoch nicht regelmäßig wiederholt wird, können sich Insekten und Schädlinge wieder vermehren. Bei dieser Behandlung wird ferner das Wachstum von Mikroorganismen, die sich von organischen Stoffen ernähren, nicht berücksichtigt. In Indien herrscht ein warmes und feuchtes Klima, das das Wachstum von Mikroorganismen begünstigt. In der indischen Tradition werden verschiedene Kräuter und Gewürze verwendet,

um Bücher und andere Dokumente zu konservieren. Diese Studie wurde daher durchgeführt, um die Wirkung lokal verfügbarer Kräuter und Gewürze auf Papier zu untersuchen. Die Experimente wurden in einem Hochschullabor durchgeführt, um die diesbezüglich gewünschte Wirkung von Neem, Zimt, Nelken, Pfeffer und einer Mischung aus all diesen Kräutern und Gewürzen zu untersuchen.

Schlüsselbegriffe:

Bibliothekskonservierung, mikrobielle Kontamination, natürliche Konservierungsmittel

### **Identification and storage of plastics in libraries and archives**

#### **Идентификация и хранение пластмасс в библиотеках и архивах**

*Chantal Stein; Jessica Pace; Laura McCann*

*Шанталь Стайн; Джессика Пейс; Лора Макканн*

*IFLA Journal, 48–2, 275–281*

Аннотация:

Во многих библиотечных и архивных коллекциях безопасное хранение и обращение с пластиковыми предметами представляет собой насущную и часто упускаемую из виду проблему. За пластмассами, как известно, ухаживать трудно, так как они могут выходить из строя быстрее, чем другие материалы в архивных коллекциях. Так называемые “злосортные” пластмассы также могут выделять вредные продукты разложения, которые повреждают окружающие материалы, включая фотографии и бумаги. Количество доступных инструментов для идентификации пластмасс также может расцениваться как часть проблемы, вследствие их громоздкости и сложности конструкций. Еще одна проблема заключается в том, что идеальные условия хранения пластмасс, рекомендованные в литературе по консервации, часто трудно достижимы. Это вызывается сложностями в их доступности и нехваткой места, с чем сталкиваются многие библиотеки и архивы. В этой статье представлен текущий проект в библиотеках Нью-Йоркского университета. Проект посвящён оценке существующих рекомендаций по идентификации и размещению пластмасс, а также в нем приводятся рекомендации по созданию масштабируемых типов корпусов, поддерживающих доступ пользователей.

Ключевые слова:

сохранение, консервация, развитие коллекции, архивные коллекции, специальные коллекции, редкие книги, графические материалы

## Curation of manuscripts in the tropical savanna climate of north-eastern India

Хранитель рукописей в тропическом саванном климате северо-восточной Индии

*Sudip Bhattacharjee*

*Судип Бхаттачарджи*

*IFLA Journal, 48–2, 282–288*

Аннотация:

Климат тропической саванны на северо-востоке Индии имеет особые черты, обусловленные альтернативными погодными условиями и географическим положением региона. В этом регионе в различных центрах хранения рукописей хранится более 50 000 редких рукописей. Национальная миссия по рукописям предприняла множество инициатив по их сохранению, включая оцифровку. Однако никаких существенных изменений, связанных с физическим состоянием рукописей, замечено не было. Большинство рукописей подвергаются порче естественным образом из-за неправильного ухода. Процесс ухудшения качества рукописей из-за воздействия окружающей среды, погоды и климата может быть сведен к минимуму путем принятия соответствующих мер. В данной статье обсуждается состояние физического состояния рукописей в этом регионе, а также влияние климата и погоды. В статье также обсуждается необходимость особого ухода за рукописями в этом географическом местоположении с помощью простых профилактических мер или особых техник.

Ключевые слова:

Рукопись, кураторство, климат тропической саванны, климат, погода, северо-восточная Индия

## Preservation storage in a flood damage mitigation effort at the National Library of France

Сохранность хранилищ в рамках усилий по смягчению последствий наводнения в Национальной библиотеке Франции

*Celine Allain; Sophie Guérinot*

*Селин Аллейн; Софи Герино*

*Journal, 48–2, 289–292*

Аннотация:

Чрезвычайно важным является решение об эвакуации находящейся под угрозой коллекции библиотеки во время предупреждения о наводнении. Если не продумать все тщательно, поспешно

выполненные действия могут подвергнуть ценные коллекции непредвиденным угрозам. Хотя наводнения в Париже обычно развиваются медленно, решение о превентивной эвакуации должно приниматься в подходящий момент, учитывая время, необходимое для перемещения, реальность угрозы и необходимость обеспечения непрерывности обслуживания. В контексте своего плана защиты от наводнений Национальная библиотека Франции разработала коробчатую модель, которая способствует экономии времени в случае наводнения и предотвращает повреждение во время эвакуации. Сочетая доступность документов с требованиями безопасности, эта модель может быть введена в действие в различных контекстах.

Ключевые слова:

сохранение, консервация, развитие коллекций, управление культурным наследием, принципы библиотечно-информационной науки, специальные коллекции, редкие книги

## Dunhuang scrolls: Innovative storage solutions at the British Library

Свитки Дуньхуана: Инновационные решения для хранения в Британской библиотеке

*Paulina Kralka; Marya Muzart*

*Паулина Кралка; Мария Муцарт*

*IFLA Journal, 48–2, 293–306*

Аннотация:

Коллекция Стейна в Британской библиотеке содержит около 14 000 свитков, фрагментов и брошюр на китайском языке из пещеры в буддийском комплексе пещер Могао близ Дуньхуана на северо-западе Китая. В этой статье описываются способы хранения и виды доступа к коллекции в контексте загруженной исследовательской библиотеки и продолжающегося в настоящее время проекта оцифровки рукописей Сутры Лотоса. В статье представлены различные технические и организационные проблемы, с которыми в период переезда приходится сталкиваться хранителям библиотеки. Ограниченные существующими складскими помещениями, бюджетными ограничениями и сжатыми сроками реализации проекта, хранители должны предоставить помещение, соответствующее формату свитка, практичное и предотвращающее разделение, но также эффективное с точки зрения затрат и времени. Учитывая лучшие практики хранения, они разработали оригинальные решения, учитывающие конкретные требования к хранилищу, а также ограничения. Принятие данных



решений для хранения позволяют хранителям обеспечить долгосрочную безопасность и доступность коллекции, при этом закладывается основа стандартизации, которая будет обеспечивать единый подход и для будущих проектов.

Ключевые слова:

Свиток, хранение, Дуньхуан, Центральная Азия, консервация, бумага

### **David O Selznick storyboard rehousing project: A case study**

**Проект по переезду раскадровки Дэвида О Селзника: тематическое исследование**

*Genevieve Pierce*

*Женевьева Пирс*

*IFLA Journal, 48–2, 307–317*

Аннотация:

В 2018 году Центр Гарри Рэнсома при Техасском университете в Остине разместил более 300 иллюстрированных раскадровок фильмов из популярной и часто используемой коллекции Дэвида О Селзника. Специалисты по хранению отслеживали этот проект с момента его создания до разработки концепции и дизайна и вплоть до его реализации. Создав новую модель помещения для хранения и усовершенствовав ее в течение года, Отдел хранения смог изучить, как помещение влияет на объект, что привело к созданию новых систем и структур для облегчения управления различными процессами, а также на сам рабочий процесс, а также на то, как на объект влияет место его размещения.

Ключевые слова:

Сохранение, консервация, развитие коллекций, художественная и гуманитарная литература, академические библиотеки, поставщики информации, специальные коллекции, редкие книги

### **Deciding how to decide: Using the digital preservation storage criteria**

**Решение о том, как принять решение: использование критериев хранения в цифровом формате**

*Sibyl Schaefer; Nancy Y. McGovern; Eld M. O. Zhierau; Andrea Goethals; Cynthia C. M. Wu*

*Сибил Шефер; Нэнси И. Макговерн; Эльд М.О. Жиерау; Андреа Геталс; Синтия СМ Ву*

*IFLA Journal, 48–2, 318–331*

Аннотация:

Критерии хранения в цифровом формате (далее - Критерии) стали результатом обсуждения данных вопросов сообществом на 12-й Международной конференции по цифровому сохранению (iPRES 2015), посвященной меняющемуся виду подходов к хранению в цифровом формате. Рабочая группа была созвана для разработки руководства для организаций, которые либо используют, либо предоставляют цифровое хранилище для хранения материалов. Первая версия Критериев была представлена на семинаре iPRES 2016, в ней были изложены предварительные результаты рабочей группы, а также запрошена обратная связь. За последние три года рабочая группа поделилась итеративными версиями, основанными на отзывах сообщества, которые были собраны в ходе конференций, онлайн-обзоров и опросов. Возможные области применения Критериев включают оказание помощи организациям в ходе разработки требований к хранилищу цифровых данных, оценку решений для хранения цифровых данных, повышение осведомленности о хранении цифровых данных и предоставление учебных материалов для информирования практиков и других лиц, включая игру, чтобы продемонстрировать, как критерии могут быть адаптированы для использования. Руководство по использованию прилагается к выпуску текущей общедоступной версии Критериев с целью помощи в применении этих Критериев. В этой итерации Критериев содержится 61 критерий, которые сгруппированы по категориям: Целостность контента, Соображения стоимости, Гибкость, Информационная безопасность, Устойчивость, Масштабируемость и Производительность, Поддержка и Прозрачность. Неизданный черновик, версия 4, включает дополнительную категорию: Безопасность системы. В дополнение к введению Критериев и предоставлению справочной информации об их эволюции, в этой статье освещаются новые области развития. Во-первых, представлены предварительные результаты продолжающихся усилий по сопоставлению Критериев с соответствующими международными стандартами сохранения цифровых данных и информационных технологий. Во-вторых, обсуждаются обновления Руководства по использованию. Руководство по использованию является дополнением к Критериям и предоставляет собой контекстуальную информацию, необходимую для реализации Критериев, а также включает разделы, посвященные таким выводам, как управление рисками, стоимость, понимание независимости и обеспечение безопасности бит.

Далее приводятся примеры использования Критериев в различных контекстах с целью заинтересовать организации применять Критерии к своей собственной ситуации. Критерии, Руководство по использованию, игра с критериями и соответствующие документы открыты и доступны для ознакомления по ссылке <https://osf.io/sjcbu/>, там же будут публиковаться будущие дополнения и обновления.

Ключевые слова:

Критерии, стандарты, управление рисками, хранение в цифровом виде, цифровое хранилище, долгосрочное хранение, Открытая архивная информационная система

### **Experimenting with 360° and virtual reality representations as new access strategies to vulnerable physical collections: Two case studies at the KB, National Library of the Netherlands**

**Эксперименты с представлениями 360° и виртуальной реальностью в качестве новых стратегий доступа к уязвимым физическим коллекциям: Два тематических исследования в КБ, Национальной библиотеке Нидерландов**

*Marzia Lodudo; Foekje Boersma; Martijn Kleppe; Karin Vingerhoets*

*Марция Лоддо; Фукье Бурсма; Мартейн Клеппе; Карин Вингерхуц*

*IFLA Journal, 48–2, 332–338*

Аннотация:

В конце 1990-х годов бурный рост электронных ресурсов привел к масштабным проектам оцифровки в условиях необходимости сохранения цифровой информации. КБ, Национальная библиотека Нидерландов, активно участвовала в этих мероприятиях. В настоящее время библиотека предлагает лучшие способы как сохранения физических библиотечных материалов, так и улучшения их доступности для образовательных целей. В этой статье описываются два текущих проекта, связанных с сохранением и привлечением общественности. Один из них, на ранних стадиях, заключается в проверке использования 360-градусной визуализации для поддержания виртуального доступа к хранилищу специальных коллекций. Второй - это создание виртуальной реальности детских книг рор-уп в образовательных целях. Оба проекта могли бы вдохновить другие библиотеки на внедрение технологий трехмерной или виртуальной реальности

и их приложений для новых аудиторий. В этой статье описывается каждый проект, показаны используемые методы и обсуждаются ожидаемые результаты.

Ключевые слова:

Управление коллекцией, изображения 360°, виртуальная реальность, автоматизированное хранение, детские книги, сохранение, консервация

### **Applicability of traditional storage methods in Indonesia for today's conservation practice**

**Применимость традиционных методов хранения в Индонезии к современной практике консервации**

*Patricia Engel*

*Патриция Энгел*

*IFLA Journal, 48–2, 339–348*

Аннотация:

В данной работе приводится краткое изложение обобщенного опыта нескольких проектов по охране природы на Яве, Индонезия. Данная статья является обобщением методов в попытке выработать предложения по наилучшей практике сохранения объектов культурного наследия в тропической стране. Соответствующие проекты имели отношение к музею современного искусства, материалам традиционного кукольного театра, музею традиционного искусства и архива. Ключевые слова:

Индонезия, управление культурным наследием, принципы библиотечно-информационной науки, сохранение, консервация, развитие коллекции, Юго-Восточная Азия, Азия

### **Natural ingredients for a bacteria-free library collection**

**Натуральные ингредиенты для библиотечной коллекции без бактерий**

*Antonette Mohan Lobo; Madhuri Vikram Tikam*

*Антонетт Мохан Лобо; Мадхури Викрам Тикам*

*IFLA Journal, 48–2, 349–351*

Аннотация:

Фумигация широко используется для избавления от вредителей. При данной обработке используются химические вещества. Однако, если не проводить повторных обработок, насекомые и вредители, как правило, снова размножаются. Эта обработка не решает проблему роста микроорганизмов, которые питаются органическими

веществами. В Индии теплый и влажный климат, который способствует росту микроорганизмов. Индийская традиция использует различные травы и специи для сохранения материалов для чтения. Поэтому это исследование было предпринято для того, чтобы оценить влияние местных трав и специй на бумагу. Эксперименты проводились в лаборатории колледжа. Это было сделано с целью изучения ингибирующего действия нима, корицы, гвоздики, перца и смеси всех этих трав и специй.

Ключевые слова:

библиотечная консервация, микробное загрязнение, натуральные консерванты

### **Identification and storage of plastics in libraries and archives**

### **Identificación y almacenamiento de plásticos en bibliotecas y archivos**

*Chantal Stein; Jessica Pace; Laura McCann*

*IFLA Journal, 48–2, 275–281*

Abstract:

El almacenamiento y la manipulación seguros de objetos de plástico constituyen un problema urgente y a menudo ignorado en muchos fondos bibliográficos y de archivo. El mantenimiento de los plásticos resulta bastante complejo, ya que se pueden deteriorar con mayor rapidez que otros materiales en los fondos de archivo. Los denominados plásticos «malignos» también pueden producir productos de descomposición perjudiciales que dañan los materiales circundantes, incluso las fotografías y los documentos. Una parte del problema la conforma la infinidad de herramientas disponibles para la identificación de los plásticos, un hecho que puede resultar complejo y abrumador. Otra parte del problema es que los entornos de almacenamiento ideales para los plásticos recomendados en la bibliografía que trata sobre la preservación suelen ser difíciles de conseguir debido a las necesidades de accesibilidad y las limitaciones de espacio que afrontan muchas bibliotecas y archivos. En este artículo se presenta un proyecto que se está llevando a cabo en las bibliotecas universitarias de Nueva York para evaluar las recomendaciones actuales en materia de identificación y alojamiento de plásticos, y se proporcionan directrices para crear tipos de alojamientos ampliables que favorezcan el acceso de los usuarios.

Palabras clave:

Preservación, conservación, desarrollo de colecciones, fondos de archivo, colecciones especiales, libros raros, materiales gráficos

### **Curation of manuscripts in the tropical savanna climate of north-eastern India**

### **Conservación de manuscritos en el clima de la sabana tropical en la India nororiental**

*Sudip Bhattacharjee*

*IFLA Journal, 48–2, 282–288*

Resumen:

El clima de la sabana tropical de la India nororiental tiene unas características especiales debido a la meteorología alternativa y la ubicación geográfica de la región. Existen más de 50 000 manuscritos raros almacenados en diversos centros de conservación de manuscritos de esta región. La National Mission for Manuscripts ha emprendido numerosas iniciativas para preservar estos manuscritos, entre ellas la digitalización. Sin embargo, no se han observado cambios significativos en relación con el estado físico de los manuscritos. Muchos de ellos se están deteriorando de forma natural debido a unos cuidados inapropiados. El proceso de deterioro de los manuscritos debido a los efectos del medio ambiente y las condiciones meteorológicas y climáticas pueden minimizarse mediante la adopción de las medidas adecuadas. En este artículo se trata el estado de físico de los manuscritos de la región, junto con los efectos del clima y la meteorología. También se comenta la necesidad de cuidados especiales de los manuscritos en esta ubicación geográfica mediante la aplicación de técnicas o medidas preventivas sencillas.

Palabras clave:

Manuscrito, conservación, clima de la sabana tropical, clima, meteorología, India nororiental

### **Preservation storage in a flood damage mitigation effort at the National Library of France**

### **Almacenamiento para la preservación en una iniciativa de mitigación de los daños provocados por inundaciones en la Biblioteca Nacional de Francia**

*Celine Allain; Sophie Guérinot*

*IFLA Journal, 48–2, 289–292*

Resumen:

Durante una alerta por inundaciones, la decisión de evacuar los fondos bibliográficos de una biblioteca es importante. Si no se planifica cuidadosamente, cualquier movimiento en falso puede exponer valiosas colecciones a amenazas imprevistas. Aunque, por lo general, las inundaciones en París son lentas, la

decisión de realizar una evacuación preventiva debe adoptarse en el momento apropiado, teniendo en cuenta el tiempo necesario para la reubicación, la realidad de la amenaza y la necesidad de la continuidad del servicio. En el contexto de su plan de protección contra las inundaciones, la Biblioteca Nacional de Francia ha concebido un modelo de caja que contribuye a ahorrar tiempo en caso de inundación y previene daños durante una evacuación. Gracias a su combinación de accesibilidad a los documentos y requisitos de seguridad, este modelo puede aplicarse en diversos contextos.

Palabras clave:

Preservación, conservación, desarrollo de colecciones, gestión del patrimonio cultural, principios de biblioteconomía y documentación, colecciones especiales, libros raros

### **Dunhuang scrolls: Innovative storage solutions at the British Library**

#### **Los pergaminos de Dunhuang: soluciones de almacenamiento innovadoras en la British Library**

*Paulina Kralka; Marya Muzart*

*IFLA Journal, 48–2, 293–306*

Resumen:

La colección Stein de la British Library se compone de alrededor de 14 000 pergaminos, fragmentos y librillos escritos en chino procedentes de una cueva del complejo de cuevas budistas de Mogao, cercano a Dunhuang, en el noroeste de China. En este artículo se describen las soluciones de almacenamiento y acceso concebidas para la colección en el contexto de una concurrida biblioteca de investigación y el proyecto de digitalización de manuscritos Lotus Sutra en curso. Se presentan los numerosos retos técnicos y organizativos que su reubicación plantea para los conservadores de la biblioteca. Los conservadores, que sufren limitaciones relacionadas con las instalaciones de almacenamiento, el presupuesto y el tiempo, deben proporcionar un alojamiento que sea práctico y adecuado para el formato de pergamino e impida la disociación, pero que a su vez sea rentable y no requiera mucho tiempo. Sobre la base de las buenas prácticas de almacenamiento, han desarrollado soluciones originales, equilibrando los requisitos de alojamiento específicos y las limitaciones existentes. Estas soluciones de almacenamiento permiten a los conservadores garantizar la seguridad a largo plazo y la accesibilidad a la colección, sentando a la vez las bases de la normalización que garantizarán una homogeneidad de enfoques para los proyectos futuros.

Palabras clave:

Pergamino, almacenamiento, Dunhuang, Asia Central, conservación, documento

### **David O Selznick storyboard rehousing project: A case study**

#### **El proyecto de realojamiento de los guiones gráficos de David O Selznick: un estudio de caso**

*Genevieve Pierce*

*IFLA Journal, 48–2, 307–317*

Resumen:

En 2018, el Harry Ransom Center de la Universidad de Texas en Austin realojó más de 300 guiones cinematográficos ilustrados de la popular colección David O Selznick, muy utilizada. Los técnicos de conservación realizaron un seguimiento de este proyecto desde su inicio, el estudio y la concepción del diseño, y a lo largo de toda su ejecución. Mediante la creación de un modelo de alojamiento y su perfeccionamiento a lo largo de todo un año, la Unidad de Conservación logró discernir el modo en que el alojamiento afecta a un objeto, lo que dio lugar a nuevos sistemas y estructuras para facilitar la gestión de los procesos y el flujo de trabajo.

Palabras clave:

Preservación, conservación, desarrollo de colecciones, artes y humanidades, literatura, bibliotecas académicas, proveedores de información, colecciones especiales, libros raros

### **Deciding how to decide: Using the digital preservation storage criteria**

#### **Decidiendo cómo decidir: uso de los criterios de almacenamiento con fines de preservación digital**

*Sibyl Schaefer; Nancy Y. McGovern; Eld M. O. Zhierau; Andrea Goethals; Cynthia C. M. Wu*

*IFLA Journal, 48–2, 318–331*

Resumen:

Los Criterios de Almacenamiento con fines de Preservación Digital (en adelante, «los Criterios») nacieron de un debate comunitario mantenido en la XII Conferencia Internacional sobre la Preservación Digital (iPRES 2015) sobre la evolución del panorama de enfoques de almacenamiento con fines de preservación digital. Se creó un grupo de trabajo cuya misión era desarrollar orientaciones para las organizaciones que usan o proporcionan almacenamiento con

fines de preservación digital. La primera versión de los Criterios se presentó en un seminario de iPRES 2016 y en ella se describían los resultados preliminares del grupo de trabajo y se solicitaban comentarios. El grupo de trabajo ha compartido versiones reiteradas durante los tres últimos años, que se han alimentado de los comentarios recopilados en sesiones de conferencia, revisiones en línea y una encuesta. Entre los posibles usos de los Criterios destacan los siguientes: ayudar a las organizaciones a desarrollar requisitos para su almacenamiento con fines de preservación digital, evaluar soluciones de almacenamiento con fines de preservación digital, concienciar sobre el almacenamiento con fines de preservación digital y proporcionar materiales de formación para educar a profesionales y otras personas, en los que se incluye un juego para demostrar cómo podrían adaptarse los Criterios. Una Guía de Usuario acompañó la publicación de la versión actual de los Criterios para ayudar en su aplicación. Esta versión de los Criterios contiene 61 criterios agrupados en las siguientes categorías: integridad de los contenidos, consideraciones de costes, flexibilidad, seguridad de la información, resiliencia, escalabilidad y rendimiento, asistencia y transparencia. En el borrador no publicado de la versión 4 se añade una categoría más: seguridad de los sistemas. En este artículo se presentan los Criterios y se contextualiza su evolución, además de ponerse de relieve nuevos ámbitos de desarrollo. En primer lugar, se presentan los resultados preliminares de una iniciativa en curso para armonizar los Criterios con normas internacionales pertinentes en materia de preservación digital y tecnología de la información. En segundo lugar, se comentan las actualizaciones de la Guía de Uso. La Guía de Uso es un suplemento de los Criterios que proporciona información contextual necesaria para aplicar los Criterios, y contiene secciones sobre consideraciones como la gestión de riesgos, el coste, la independencia y la seguridad de los bits. Por último, se ofrecen ejemplos de uso de los Criterios en diversos contextos para animar a las organizaciones a aplicar los Criterios teniendo en cuenta su propia situación. Los Criterios, la Guía de Uso, el juego y los documentos conexos son públicos y están disponibles en <https://osf.io/sjc6u/>, donde se compartirán futuras adiciones y actualizaciones.

Palabras clave:

Criterios, normas, gestión de riesgos, almacenamiento con fines de preservación digital, almacenamiento digital, almacenamiento a largo plazo, Open Archival Information System

### **Experimenting with 360° and virtual reality representations as new access strategies to vulnerable physical collections: Two case studies at the KB, National Library of the Netherlands**

### **Experimentación con representaciones de realidad virtual y 360° como nuevas estrategias de acceso a colecciones físicas vulnerables: dos estudios de caso en la KB, la Biblioteca Nacional de los Países Bajos**

*Marzia Loddo; Foekje Boersma; Martijn Kleppe; Karin Vingerhoets*

*IFLA Journal, 48-2, 332-338*

Resumen:

A finales de la década de los noventa, el auge de los recursos electrónicos dio lugar a proyectos de digitalización a gran escala en medio de la necesidad de preservación de la información digital. La KB, Biblioteca Nacional de los Países Bajos, ha participado activamente en estas actividades. Ahora, está proponiendo mejores formas de preservar los materiales bibliográficos físicos y mejorar su accesibilidad con fines educativos. En este artículo se describen dos proyectos en curso que implican preservación y participación pública. Uno de ellos, en sus primeras fases, es poner a prueba la aplicabilidad de las imágenes 360° para respaldar el acceso virtual a colecciones especiales. El segundo es la producción de realidad virtual, con fines educativos, de libros infantiles con desplegables. Ambos proyectos podrían inspirar a otras bibliotecas para introducir tecnologías tridimensionales o de realidad virtual, y sus aplicaciones para un público nuevo. En este artículo se describe cada proyecto, se muestran los métodos utilizados y se comentan los resultados previstos.

Palabras clave:

Gestión de fondos bibliográficos, imágenes 360°, realidad virtual, almacenamiento automatizado, libros infantiles, preservación, conservación

### **Applicability of traditional storage methods in Indonesia for today's conservation practice**

### **Aplicabilidad de los métodos de almacenamiento tradicionales en Indonesia para la práctica de conservación actual**

*Patricia Engel*

*IFLA Journal, 48-2, 339-348*

**Resumen:**

Esta contribución tiene por objeto condensar la experiencia de varios proyectos de conservación en Java (Indonesia) en un resumen de métodos, con el objeto de obtener algunas sugerencias de mejores prácticas para la preservación de objetos del patrimonio cultural en un país tropical. Los proyectos conexos tenían que ver con un museo de arte contemporáneo, materiales de un teatro de marionetas tradicional, un museo de arte tradicional y un archivo.

**Palabras clave:**

Indonesia, gestión del patrimonio cultural, principios de biblioteconomía y documentación, preservación, conservación, desarrollo de colecciones, Asia Sudoriental, Asia

**Natural ingredients for a bacteria-free library collection****Ingredientes naturales para lograr fondos bibliográficos libres de bacterias**

*Antonette Mohan Lobo; Madhuri Vikram Tikam*

*IFLA Journal, 48-2, 349-351*

**Resumen:**

La fumigación es una técnica ampliamente utilizada para erradicar plagas. Este tratamiento emplea sustancias químicas. Sin embargo, si no se repiten las aplicaciones, los insectos y las plagas vuelven a reproducirse. Además, este tratamiento promueve el desarrollo de microorganismos que se alimentan de sustancias orgánicas. La India tiene un clima cálido y húmedo que favorece el desarrollo de microorganismos. La tradición india emplea diversas hierbas y especias para conservar los materiales de lectura. Este estudio se llevó a cabo para observar el efecto de las hierbas y especias locales sobre el papel. Se llevaron a cabo experimentos en el laboratorio de una universidad para estudiar la acción inhibidora del neem, la canela, el clavo, la pimienta y una mezcla de todas estas hierbas y especias.

**Palabras clave:**

Conservación de fondos bibliográficos, contaminación microbiana, conservantes naturales