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LIBRARY USE AT THE NATIONAL MUSEUM OF AMERICAN HISTORY, BEHRING CENTER, NATIONAL MUSEUM OF NATURAL HISTORY, AND SMITHSONIAN INSTITUTION SERVICE CENTER

A study prepared by the
Smithsonian Office of Policy and Analysis for
Smithsonian Institution Libraries and
Smithsonian Office of Facilities Engineering and Operations

PHOTOS*: Cover*, Fishes Divisional Library stacks, Natural Museum of Natural History Library, OP&A files ♦ *p. iv*, from Agostino Ramelli, *Le Diverse et Artificiose Machine*, 1588*,* Reading machine, 76-14435, p., 317, plate 188, Smithsonian Institution Libraries collections, from The Galaxy of Images ♦ *p.7 (top)*, National Museum of Natural History Library, mezzanine work space, OP&A files; *(middle)*, Ceramics and Glass Divisional Library, National Museum of American History Library, OP&A files; *(bottom)*, Domestic Life Divisional Library, National Museum of American History Library, OP&A files ♦ *p. 55 (top)*, National Museum of American History Library, main reading room, OP&A files; *(bottom)*, Anthropology Divisional Library, National Museum of Natural History Library, OP&A files ♦ *p. 79 (top)*, Textiles Divisional Library, National Museum of American History Library, OP&A files; *(bottom),* National Museum of Natural History stacks, OP&A files ♦ *p. 95*, from Amelia Blanford Edwards, *A Thousand Miles Up the Nile*, 1890, cover, SIL 28-43-01, Smithsonian Institution Libraries collections, from The Galaxy of Images

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PREFACE

Libraries have played and will continue to play an important part in meeting the needs of Smithsonian researchers and serving the interests of people all over the world. Research, education, and myriad other programs at the Smithsonian cannot prosper without a substantial investment in its libraries. Hopefully, this effort by the Office of Policy and Analysis will contribute to one of the Smithsonian's most important goals: through informed decision making, support a resource that helps people connect by opening doors to the past and future.

This study could not have been undertaken without the support of the Office of Facilities Engineering and Operations and Smithsonian Institution Libraries. I thank them. Both organizations have helped to shape this study and open windows to inquiry. I also wish to thank the many interviewees from the National Museum of American History, Behring Center and the National Museum of Natural History, who patiently explained their connections to and use of the libraries. I am very grateful to contributors from external organizations who shared their views and reflected on the future of libraries. Jennifer Page's comprehensive research skills and ability provided insights that extended the depth and breadth of this study. Finally, I would like to thank Whitney Watriss, whose skills in interviewing people, analyzing data, and writing reports contributed greatly.

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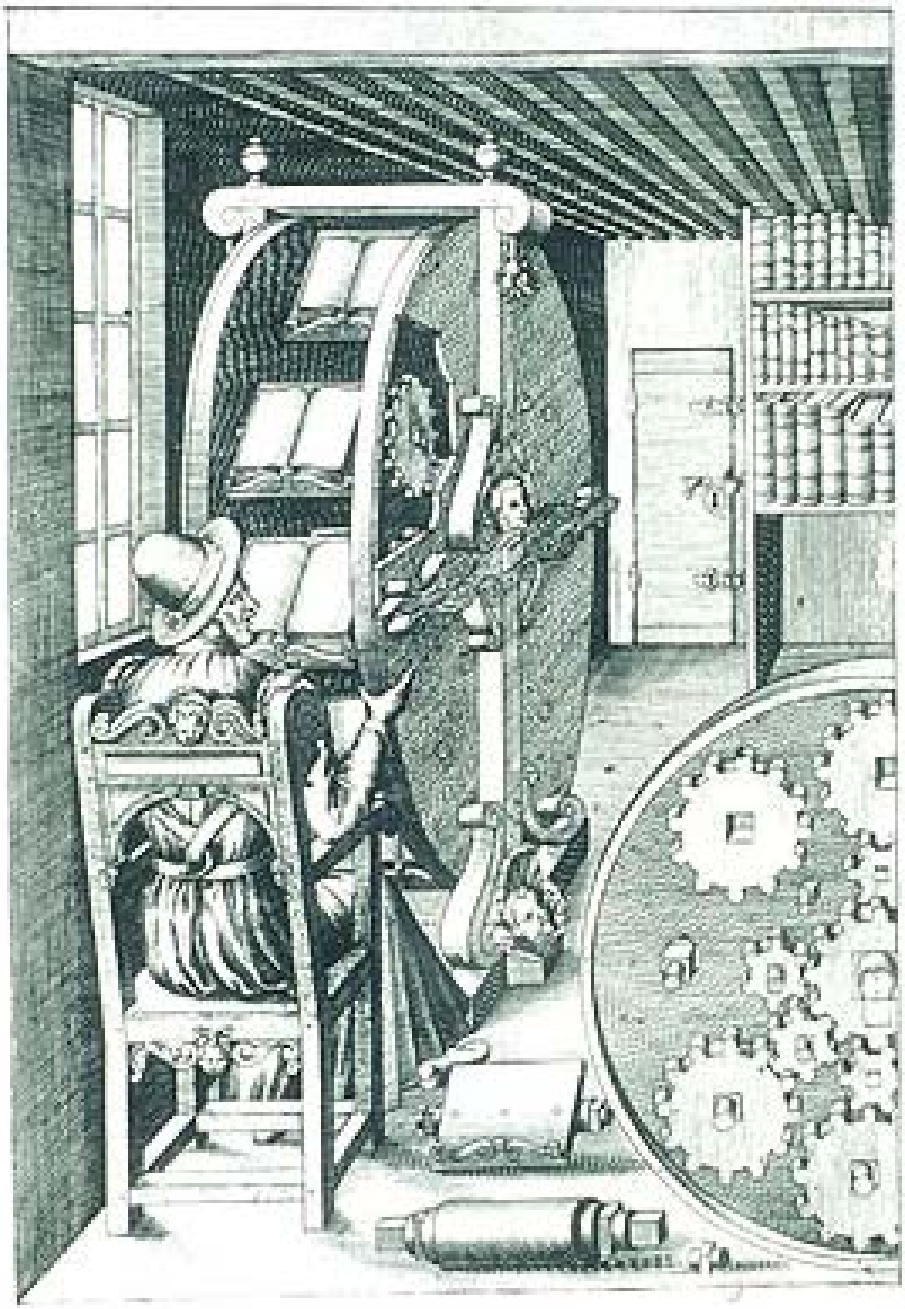

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EXECUTIVE SUMMARY

This study by the Office of Policy and Analysis (OP&A) addresses use of the libraries in the National Museum of American History, Behring Center (NMAH), National Museum of Natural History's (NMNH) Natural History Building (NHB), and Smithsonian Institution Service Center (SISC), as well as trends 20 years out. The purpose is to provide input into the master space planning for libraries overall being conducted by the Smithsonian Institution Libraries (SIL) and for the Smithsonian Office of Facilities Operations and Engineering's (OFEO) master planning for the renovation of the two museums and replacement of SISC.

What Interviewees Said

Library Use

The predominant users of the NMAH and NMNH libraries are curators/scientists and collections management personnel; outside researchers and graduate students are other important user groups. Users universally agree that the library collections are one of three ***inseparable*** pillars of superior academic research, alongside staff and collections. Researchers at both museums primarily use the main branch library and one or two divisional/departmental libraries, with a small number using multiple divisional/ departmental libraries. Frequency of use varies, often based on the stage of a project.

Despite the poor quality of many library spaces, there were few complaints. Researchers make little use of work spaces in the libraries because of the proximity to their offices and 24/7 access, two characteristics they value *highly*. Users would like more shelving

and less cramped stacks, with places to rest materials being reviewed and even to sit. Also important are adequate photocopiers, including color and scan/ email (PDF creation function).

Materials Used

NMAH researchers tend to use print books in their entirety more than journals, although they read electronic and print journals for current research information. NMNH researchers make extensive use of journals, both electronic and print, current and historical, and of reprints; they tend to use only parts of books, except in the case of anthropologists.

Most NMAH and NMNH researchers expressed a *very strong* preference for working with hard/print copy as opposed to electronic files. Reasons include ease of reading; transportability; ability to mark up the text; and issues with electronic materials, particularly low quality, limited durability, and unpredictable crashes of computers and networks. However, researchers typically conduct searches electronically from their desks and value the easy, 24/7 access to the Internet, ability to search texts electronically, and multimedia capability of electronic files. Non-user interviewees noted that most technological issues have been resolved or are near resolution. The exception is the technology to ensure long-term preservation of electronic files.

There is consensus that electronic materials—from both publishers and digitization of library collections—are the direction of the future. At NMNH, the Biodiversity Heritage Library (BHL) project could result in digitization of a large part of the NMNH biodiversity collections. A secondary benefit might be the possibility of transferring digitized print originals to offsite shelving/storage. At the same time, print materials are not going away any time soon. Thus, the libraries will continue to hold a mix of print and

electronic materials over the next 20 years. To maintain the value to research and the reputation of the library collections, they will need to continue growing in both formats.

Consolidation of Dispersed Library Spaces

The majority of users overwhelmingly opposed consolidation of the dispersed library spaces. Consolidation would hinder library use and reduce productivity. A handful of users, however, and all library staff and museum management strongly supported consolidation. Anticipated benefits were easier access to materials, facilitation of interdisciplinary research, and more efficient library operations and use of resources. Consolidation would allow the libraries to take advantage of time-honored technologies such as compact shelving and new technologies that better serve users and library operations. The experience of other research libraries with consolidation supports these points.

Offsite Shelving/Storage

Users expressed strong opposition to offsite shelving/storage as a way to address the shortage of space: it would mean unacceptable delays in obtaining needed materials, be it from time spent traveling to the facility or waiting for deliveries. And who can know what materials to move offsite? Non-users saw additional offsite shelving/storage as inevitable. It could still afford researchers timely access to materials through regular deliveries. For both groups, timely means next business day delivery of physical materials and very near-term (within hours) delivery of materials in electronic format.

Selected Best Practices and Future Trends in Library Space

Most of the secondary literature on library space addresses public libraries or university research libraries, both of which serve audiences and needs dissimilar to those at NMAH and NMNH. In any event, inherent limitations of the physical space of NMAH, NMNH, and SISC greatly limit, if not preclude, the implementation of best practices. The study therefore focused on innovative services for users and application of new technologies that might affect the physical space of the libraries.

Ongoing Need for Physical Libraries

The consensus is that the demand for physical libraries that offer hybrid collections of print and digital materials will not diminish. The preference for working with print/hard copy and browsing shelves of books will continue, even as availability and use of electronic materials expands rapidly. More electronic materials will not significantly reduce the space required to house collections. One factor likely to influence library space is the need to provide specialized technologies, such as multiple screen computers that permit simultaneous viewing of multiple books and articles.

User-focused Design

The Touchdown Suites of the Johns Hopkins University's Welch Medical Library are an example of the *mobile library model*, whose goal is to take information, libraries, and librarians out to faculty, staff, students, researchers, and patients. In addition to extensive electronic materials accessible anywhere with an Internet/intranet connection, small, 400-square foot (sq. ft.) library spaces—Touchdown Suites—are located across the university's campus. They offer such services as meeting and instruction spaces, access to computers, grant writing assistance, assistance in accessing information, and a customized research website.

A growing number of libraries are asking for designs that offer *flexible space tailored to user needs and readily adaptable to change*. The Berry-Baker Library at Dartmouth College, for example, employs a centralized "learning commons" or "knowledge commons" designed for access and connectivity, socializing and networking, collective learning and research, and exhibition and cultural uses. The Seattle Public Library accommodates unpredictable growth in collections with an innovative "Book Spiral": configured like a four-story parking garage, it can be expanded and contracted easily.

Collaborative Offsite Shelving/Storage

A number of research libraries have addressed rising costs and space requirements with shared high-density, environmentally controlled offsite shelving/storage facilities. They offer cost savings in construction, staffing, resource use, and preservation. The best are large, open structures with high ceilings and rows of shelving. The Research Collections and Preservation Consortium (ReCAP) facility in Princeton, NJ, is, for example, 210 feet long, 70 feet wide, and 38 feet high. Organizing materials by size in boxes maximizes the shelving capacity. All these facilities offer timely delivery of materials in electronic or physical format. The most efficient facilities use robotics to retrieve the boxes of materials.

Observations on the Future of the NMAH and NMNH Library Spaces and Offsite Shelving/Storage

OP&A believes that physical libraries will continue to be a critical resource for research by both internal and external users at NMAH and NMNH, and that SIL is a necessary partner in the Smithsonian's pursuit of excellence in research. As such, libraries need to be fully integrated into master planning for both museum buildings.

An Uncertain Framework for Master Planning

OP&A observes a lack of clarity around four points that are essential to effective master planning and determination of the amount and nature of library space over the next 20 years. (1) What will be the balance between research and public programming and other museum functions at NMAH and NMNH? (2) In what directions will research at the museums move, and what will be the predominant role of curators/scientists—public programs or academic research? (3) What should NMAH and NMNH library holdings look like 20 years out in order to support research? **(**4) What importance should the museums attach to the role of libraries in supporting excellence in research?

Desirable Characteristics of Library Space

User-oriented library space would offer: 24/7 access to the stacks; central display of new acquisitions and seating for reviewing them; copiers, including color and scan/email; a limited number of computer terminals; WiFi or laptop hookups; and adjacent shelving for divisional print materials, especially reprints and related card catalogs. Users would benefit from greater and easier access to, and retrieval of, information via a range of up-to-date electronic media and tools.

Dispersed Versus Consolidated Library Spaces

Although sensitive to the strongly expressed desire of users to have libraries near their offices, OP&A sees benefits to consolidation. Most important, it may offer the only way to modernize the libraries and bring them up to code, and to provide the flexibility needed to accommodate future advances in technologies and use of space. Upgrading current spaces is for the most part impossible from either an engineering or cost perspective. Consolidation is consistent with the increasing availability of electronic materials and the growth in interdisciplinary research. It would permit SIL to provide better services,

deploy its scarce resources more effectively, exercise better control over the collections, and improve environmental conditions for the collections.

While supporting consolidation, OP&A cannot say exactly what it should look like. There is not enough information on the costs and benefits of alternatives or a clear "business case" for one alternative over another. The master plan for NMNH as of June 2006 calls for consolidation of some library spaces on the first floor but is vague about the other library spaces. That said, OP&A's "gut" sense is that consolidation into an expanded main library and single east and west wing sub-libraries (plus the Cullman Library) merits consideration. The NMAH master plan calls for a consolidated library, exclusive of Dibner, centrally located on the 5th floor. This approach seems reasonable, given the planned location of research offices and collections on the 4th and 5th floors.

The Composition of NMAH and NMNH Library Collections 20 Years out and the Space Implications

The NMAH and NMNH library collections will continue to offer both print and electronic materials. At least current rates of growth of the collections will be necessary to support high quality research and sustain the global reputation of the collections. The NMNH library is likely to offer more electronic materials, particularly journals and current publications, and the BHL project could result in more of existing collections becoming available electronically. Print materials will likely continue to predominate at NMAH. External projects to digitize collections in public and university libraries in the United States may result in electronic access to materials that also appear in NMAH's collections.

Offsite Library Shelving/Storage

There is a clear need for offsite shelving/storage. Under the master plans for both NMNH and NMAH, it appears that net library space will be less than at present, which is

already insufficient, while the collections will continue to grow. Increased availability of electronic materials, including through the BHL, will not reduce the amount of space needed to house the collections, although it may allow some print materials to be moved offsite. The development of shared library repositories might, however, allow SIL to dispose of some holdings that duplicate those held in the repositories, but realization of this option is uncertain.

From the perspective of users, the key prerequisite of an offsite facility is rapid, easy access to materials, possible in three ways. One is onsite use of materials, which requires: a one-way travel time of no more than 30 minutes and a shuttle service and/or convenient public transportation; and suitable workspace, similar to what a researcher would find in the main library. The second is at least daily delivery of physical items to the NMAH or NMNH libraries. The third is delivery of electronic versions of print materials within one or two hours of a request, which presumes a scanning and electronic delivery system.

With the need for more offsite shelving/storage a given, OP&A believes a very strong business case can be made for investing in a new design-built, high-density, environmentally controlled facility. It makes the most sense from a long-term perspective for reasons of cost, functionality, preservation of collections, and maximum flexibility to accommodate growth in collections and changes in library technology and user needs. Construction of a high-density facility can be done in two years or less. The Smithsonian's experience with the alternative of leasing and retrofitting an existing building has not been entirely satisfactory: typically, functionality has been compromised, the costs per square foot are high over the long term, and at the end of the lease there is no tangible asset to show for the expenditures. A final point is that construction of a new facility would likely offer opportunities to leverage resources through partnerships with other organizations needing offsite shelving/storage.

Collaborative Arrangements

Libraries offer a number of opportunities for partnerships among Smithsonian and external libraries through which scarce resources can be leveraged. Examples include shared digitization facilities and conservation laboratories, collaborative acquisitions, joint library repositories, and, as noted, shared offsite shelving/storage. OP&A believes SIL and OFEO should explore all opportunities for consortial arrangements, particularly, in the near term, for a high-density offsite shelving/storage facility and joint repositories.

Systematic and Coordinated Master Planning of Smithsonian Library Spaces

OP&A understands the need to move quickly to develop long-term master plans for NMAH and NMNH and for replacing SISC. At the same time, it is concerned that this sense of immediacy will lead the Smithsonian to lose sight of the fact that the NMAH and NMNH libraries are part of the larger Smithsonian libraries system, of the Institution as a whole, and of the research library community outside the Smithsonian. In focusing narrowly on immediate needs, decision makers may ignore potential opportunities for long-term economies of scale, leveraging of resources, and effective operation of the entire library system. For example, do other units, such as Smithsonian Archives, have needs that could be met with a high-density, environmentally controlled offsite shelving/storage facility? Is a digitization or conservation facility that serves multiple units at that Smithsonian better than a unit-specific one, and is it best located in the offsite shelving/storage facility? The fragmented approach to library space planning seen to date is not, in OP&A's opinion, likely to produce modern library spaces fully able to meet the short- or long-term needs of users and efficient library operations. The Smithsonian will be better served by taking a long-term, Institution-wide—if not broader—view of how to fashion library space so as to best serve the Institution.

Along with systematic and coordinated master planning, OP&A believes there is a need to strengthen communication among the key players—SIL, museum managers, and OFEO project executives/managers—who need to be involved in master planning the NMAH and NMNH library spaces and an offsite shelving/storage facility.

Recommendations

- Develop a clear baseline for library use and space needs 20 years out at NMAH and NMNH as the starting point for planning. The baseline should include the balance between research and public programming and other museum functions at NMAH and NMNH; future directions for those functions; library holdings needed to support those functions; the current and likely future state of library technology; and modern technologies that affect the retrieval of information, digital content, and pedagogical concepts.

- Conduct systematic studies of the costs and benefits of alternative library consolidation schemes at NMNH, e.g., a single consolidated library and a central branch and a sub-branch in the east and west wings, related to departments located in each. (The OP&A study team assumes the Cullman Library will remain as is.)

- Design libraries that provide:
  - 24/7 access to circulating materials to permit browsing and accommodate irregular work hours, with limited seating and shelves on which to rest materials being reviewed
  - Space for displaying new acquisitions, with nearby seating
  - An adequate number of copiers, including color and scan/email
  - Infrastructure to support both library and personal computers, including WiFi
  - Adjacent shelving for divisional print materials

- Flexibility in design to accommodate new technologies and different patterns of use

- Strengthen communication among the key players—SIL, museum management, and OFEO project executives/managers—who need to be involved in master planning the NMAH and NMNH library spaces and an offsite shelving/storage facility.

- Assuming a permanent, long-term need for offsite shelving at NMNH and NMAH (and at other Smithsonian libraries).
  - Develop a system-wide plan that addresses the off-site shelving needs of libraries throughout the Smithsonian to take advantage of opportunities to leverage costs and enhance the efficiency of retrieval and shelving. The plan should also address the potential to incorporate other functions that have similar facility needs, such as archives, and that multiple libraries use regularly, such as digitization and conservation units.
  - Ensure that the solution to offsite shelving provides users with rapid, easy access to materials, including electronically, and develop a performance standard against with to plan for and measure user access.
  - Conduct systematic feasibility studies of alternative ways to provide offsite shelving. The studies should include life-cycle costs and user requirements, and address at least the following offsite shelving options: construction of a new, high density, environmentally controlled facility, a shared new or existing facility with one or more other organizations, renovation of an existing building, and leasing of existing building or facility that is built to order.

- Prepare a master plan for all of the Smithsonian libraries that addresses them as an entire system and explores in detail the potential opportunities for long-term economies of scale, leveraging of resources, and effective operation of the entire library system, and that looks at the needs that other collections,

such as archival, film, and photography, have in common with library collections. Master planning should include:

- A study of the use of all Smithsonian library spaces (the study of the library spaces at NMAH, NMNH, and 1111 North Capitol Street has been completed, and a study of the art libraries is underway); and
- An assessment of possible collaborative arrangements that might improve the efficiency and reduce the space requirements of libraries, such as shared digitization facilities and conservation laboratories, collaborative acquisitions, joint library repositories, and off-site shelving (see below). The assessment would include potential relationships within the Smithsonian, including SERC, STRI and SAO, and the regional and global library communities, both public and private.

- Ensure that each library is fully integrated into the master planning for its museum, research center, or other unit that it serves.

INTRODUCTION

In March 2006 the Smithsonian Institution Libraries (SIL) requested that the Office of Facilities Engineering and Operations (OFEO) develop a master space plan for its facilities Smithsonian-wide. Of immediate interest was planning for the library spaces in the National Museum of American History, Behring Center (NMAH), National Museum of Natural History's (NMNH) Natural History Building (NHB), and the Smithsonian Institution Service Center (SISC) at 1111 North Capitol Street. The first two are scheduled for renovation in the immediate future, and the lease on SISC may terminate in 2008. OFEO, which was already involved in master planning for the renovation of the two museums and in replacing SISC, contracted with the Smithsonian Office of Policy and Analysis (OP&A) to conduct a study of use of the libraries in the two museums and SISC.

The purpose of the study is to provide input that SIL can use in developing a master plan for its library spaces and that OFEO can apply in developing master plans for the renovation of NMAH and NMNH and replacement of SISC. The study emphasizes both the present and the future—what current use of the libraries looks like and what the Smithsonian needs from its libraries in order to support research 20-years out, the timeframe of the NMAH and NMNH master plans for the renovation.

More specifically, the study looks at

- Why and how different types of researchers—internal and external, younger and older—use the three library facilities, what they think of the current space, what changes they see coming in their fields of research that might affect what they want from library space, and what they most want from library space.

- What users think about proposals to consolidate the dispersed library spaces at their museums and about offsite shelving/storage for library collections.

To provide context for what Smithsonian users said and to understand better how research libraries are evolving, OP&A also looked to expert opinions outside the Smithsonian on the future development of research libraries and the space implications.

Overview of the Smithsonian Library Spaces Covered in the Study

This study addressed library spaces in NMAH, NMNH, SISC, and the Museum Support Center (MSC) Library in Suitland, MD.[1] The two museums have several "categories" of library space:

- A main branch library, whose holdings include basic and heavily used reference works, general materials on the subject matter covered by the museum, and cross-disciplinary materials, and which houses administrative spaces for staff, circulation, retrieval of inter-library loans (ILLs) and other items, etc., shelves for display of new acquisitions, and reading areas

- Special collections, including the rare book libraries and, at NMAH, the trade literature

- Divisional/departmental "sub"-libraries, located near related staff offices and object/specimen collections. OP&A is not certain of the exact number of these library spaces, but there appear to be 14 at NMAH and 21 at NMNH. The confusion arises because of holdings retained in researchers' offices, which might be either materials checked out to the researcher or a "sub"-divisional/ departmental library.

[1] Although originally not part of the study, OP&A added the MSC Library because it has collections used by the Molecular Biology Laboratory, which will be moving to the NHB.

- NMNH is home to the Museum Studies and Research Library (MS&RL).

The MSC Library primarily holds materials that support the work of the Museum Conservation Institute, but it also houses journals and monographs relating to molecular biology. At the time of the study, it was unclear if those materials will accompany the molecular biology laboratory when it relocates to NHB.

Methodology

The study proceeded in four stages: start-up; data collection; data analysis and development of findings and observations; and report preparation. OP&A sought data from three sources—interviews, review of secondary literature, and visits to selected non-Smithsonian libraries:

- Interviews were conducted with (see also the list in Appendix A)
  - Internal and external researchers who made regular use of one or more libraries at NMAH, NMNH, and SISC. Internal researchers included curators/scientists, museum specialists, research assistants, collections management staff, fellows, and volunteers. External researchers included academicians and graduate students from U.S. and foreign universities and other organizations.[2]
  - Experts in library management from public and private libraries, library associations, and funding organizations
  - Graduate students in the fields of natural history and American history, as "surrogates" for the next generation of Smithsonian researchers
  - SIL staff, including librarians at NMAH, NMNH, SISC, and MSC, and SIL management
  - NMNH and NMAH management

[2] Because the number of people from the general public who enter the libraries is very small, and their use typically does not involve academic research or collections management, OP&A did not include them in this study.

- OFEO project managers/executives for NMAH, NMNH, and SISC, and staff in the Office of Facilities Master Planning

- The review of secondary literature focused on materials relating to research libraries and library space of the future, and on best practices in library space (see Appendix B, Bibliography). Almost all the literature on research libraries dealt with academic libraries at universities and colleges and had limited application to the libraries in NMAH and NMNH, as the museums do not have a comparable educational function and user profile.

- Site visits were made to selected external libraries.

Following the data collection, OP&A reviewed all the data and identified the information that it found most relevant to master planning of library space at NMNH and NMAH and replacement of the library space at SISC. What follows in the Findings reflects the main, generalized points that emerged from the study. There are, of course, exceptions to every generalization.

The OP&A work plan for this study specifies the delivery of conclusions and recommendations. Over the course of the study, however, it became apparent that the wiser course was to offer observations rather than conclusions. The observations would raise the questions, considerations, and further analyses that ought to underlie master planning of Smithsonian library spaces. The reasons for this change of course were several:

- OP&A found an absence of answers to very fundamental questions needed to define clearly the framework within which a master plan should evolve. For example, what will the research programs at NMAH and NMNH look like 20 years from now?

- Conclusions need to be based on analysis of detailed information from multiple perspectives, not just those of users.

- Uncertainty characterizes key areas of the master planning environment for the NMAH and NMNH libraries, such as when viable, trustworthy technologies will be available for the long-term preservation of digital materials and how much funding will be available for the Biodiversity Heritage Library initiative and over what timeframe.[3] Dealing with such uncertainties calls for a set of "if this-then that" scenarios and educated predictions about their likelihood, tasks that are beyond the scope of this study. In addition, OP&A believes that these uncertainties are likely to be resolved in the near term, while renovation of the bulk of the NMAH and NMNH library spaces is at least 10 years away.

- Finally, trade-off and cost-benefit analyses of different alternatives are required in order to identify the best course of action, analyses that again are beyond the scope of this study.

In light of these considerations, OP&A believed that any conclusions it might develop from this study would be inherently shaky and perhaps misleading. Thus, OP&A has confined itself to identifying crucial aspects of usage essential for master planning of library spaces and offsite shelving/storage and key questions that need to be addressed. It has also provided a set of recommendations, some of which are specific to NMAH, NMNH, and 1111 North Capitol Street, and others that relate to the general process of master planning for Smithsonian libraries.

Organization of the Report

This report consists of three main parts: Findings, Observations, and Recommendations.

It begins with the Findings, presented in four sections. The first addresses what researchers said about their use of the NMAH, NMNH, and SISC library spaces and what

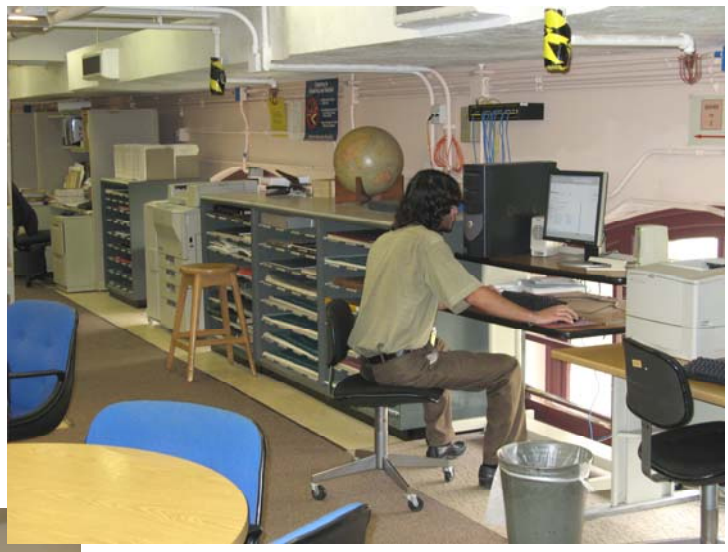
[3] The Findings part of this report discusses the uncertainties in predicting the nature of research library space in general 20 years out.

is important to them; what they think about consolidation of the library spaces at NMAH and NMNH; and what they think about offsite library space. The subsequent section summarizes the comments of non-users.[4] Selected best practices in library space and what the future of research library space might be 20 years out are reviewed in the third section. The Findings conclude with a summary of key aspects of the research library environment in the future that have space implications.

The second part of the report contains OP&A's observations. It begins by discussing some core uncertainties within NMAH and NMNH that affect master planning of the library spaces. It then addresses key issues in the future of library space at NMAH, NMNH, and offsite: desirable characteristics of library space; dispersed versus consolidated library spaces; the composition of library collections 20 years out and the space implications; offsite library shelving/storage; and some additional space-related considerations. The section concludes with a discussion of the need for master planning of the NMAH, NMNH, and SISC library spaces within the broader framework of the SIL branch library system, the Institution as a whole, and the regional, and perhaps national, network of research libraries.

The third part of the report contains the recommendations.

[4] The term "non-users" refers here to individuals whom OP&A interviewed for their management or library operations perspectives; most, if not all, are also library users.



PART A.
FINDINGS

WHAT USERS SAID ABOUT LIBRARY USE

This section summarizes information gathered from interviewees who use the libraries. It reflects those points made most frequently and does not include comments made by only one or two people unless so stated. The comments are broken out as follows: the who, why, and how of library use; opinions about the quality of existing library space; opinions about consolidation of the dispersed divisional/departmental libraries; and thoughts on offsite shelving/storage.

The Who, Why, and How of Library Use

The Who

There is no accurate count of visitors to the NMAH and NMNH libraries, but interviewees suggest that most internal researchers use one or more of them to greater and lesser degrees. Users can be broken into the following categories:

- *Internal NMAH and NMNH staff*. The predominant users are curators/ scientists and collections management personnel. Moreover, many curators/scientists and collections management staff have at least one person working with them (e.g., research assistants, fellows, volunteers, and interns) who also use the libraries. Reference staff/information specialists are small in numbers but frequent users of libraries. Less frequent visitors are education, exhibition, public programs, and public affairs staff.

- *External users*. The primary external users are professional researchers (e.g., from universities, non-profit organizations, and law firms) and graduate students. Together they number about 9,000 patrons a year. Although they constitute a small percentage of users, they bring significant benefits.
    - The work of external users is important to the advancement of knowledge in their disciplines, and they often provide important outside perspectives to Smithsonian researchers and insight into what is happening at universities and elsewhere. This interaction is particularly important given the scarcity of new hires, particularly of younger curators/scientists, at NMAH and NMNH.
    - Allowing external researchers access to the library collections is a key way in which the Smithsonian fulfills its public service mandate. Without the materials available here, many of which are unique to the Smithsonian or are only available in print form, the work of these external researchers would be incomplete.
    - For some local graduate students—and universities—the library collections are an irreplaceable resource.
    - Allowing outside researchers to use NMAH and NMNH library collections in turn facilitates Smithsonian access to library and other materials at their organizations.
    - Joint research projects have developed as a result of interactions that took place in the libraries between external and internal researchers.

The Why

Researchers at the two museums see the libraries as one of three ***inseparable*** pillars of superior academic research, along with staff and collections (an opinion mirrored in the secondary literature). Universities market themselves in part through the strength of their libraries. Similarly, the NMAH and NMNH library collections are widely viewed as a strength of the Smithsonian that underpins "the increase of knowledge."

Researchers use the libraries to access print materials needed for academic research and publications, including fact-, citation, and reference-checking; to review new acquisitions and current journals to keep abreast of research projects and results elsewhere; for collections management; and for public program development, especially exhibitions and educational offerings. Library staff use the collections to answer reference requests from researchers and the general public. At the MSC, some researchers find the library a quiet, conducive place to sit and think. The libraries often serve as venues for informal get-togethers of internal and external researchers, who share ideas, discuss work, and keep abreast; often, these encounters are serendipitous, arising when someone walks by the library and sees another researcher inside. When asked if the staff cafeteria or conference rooms are substitute venues, most thought not. Those types of non-library spaces have a different, non-academic feel, do not lend themselves to spontaneous encounters, and do not offer access to reference materials when questions arise during discussions. Sometimes these informal get-togethers occur over lunch in the libraries. This collegial function was particularly important to divisions such as anthropology. The libraries were also sometimes used for formal divisional/departmental meetings because of the scarcity of dedicated divisional/departmental meeting space.

The How

Materials accessed. NMAH researchers (humanists and social scientists) tend to use print books in their entirety more than journals, although they use journals to keep up on current information. The researchers make little use of e-books: their availability is limited, and reading off a screen for protracted periods is stressful. These usage patterns mirror what the secondary literature says about the research habits of humanists and social scientists generally. Other popular materials in the NMAH branch library are the special trade literature collection and the old runs of journals (the latter are mostly shelved at SISC). Researchers at NMAH tend to check out and hold significant library materials in their offices for long periods (sometimes several years), to the extent that the librarians said there would be a crisis if all the material were returned, as there is no place to shelve it.

NMNH researchers make extensive use of current and historical journals and reprints. They use to entire books less frequently, but may require some specific part of a book. One exception is anthropologists, who mentioned using both categories of materials extensively. Many researchers, particularly taxonomists, make heavy use of historical materials, especially journals and reprints, but those in the mineral sciences and newer disciplines such as molecular biology said they use primarily recent (e.g., not older than 20 years) e-journals and other materials. This pattern of use by natural history scientists is also similar to what is described in the secondary literature. Many NMNH researchers maintain significant personal libraries in their offices (and even more materials in home libraries); these often include the key reference works they might need on a frequent basis.

Library spaces used. Interviewees at both museums primarily use the main branch library and one or two divisional/departmental libraries, with a small number using multiple divisional/departmental libraries. Access to library materials typically begins at the researchers' desks via electronic searches of the library catalog or the Internet, followed by a visit to one or more divisional/departmental libraries to retrieve specific materials not available electronically. Many staff commonly visit the main branch libraries to review new acquisitions, request or retrieve intra- or inter-library loans, and consult with librarians. Finally, a large of number of researchers at NMNH talked of using the reprint collections and related card catalogs that belong to and are maintained by the departments/divisions. Although not part of the library collections, they are housed in the library spaces.

NMNH researchers checking references or citations often do so onsite during a quick visit to their divisional/departmental library, or they take the materials to their offices for brief periods and then return them. They said that generally they need materials other than key reference works for only short periods—anywhere from minutes up to an hour or two. Few people said they check materials out for any length of time. Often researchers copy a few pages or an article at the library or divisional/departmental copier and work off the hard copy in their offices. A few researchers spoke of taking library

materials to use alongside objects/specimens they were examining, and then returning them. Unlike at NMAH, NMNH researchers tend not to check materials out for long periods.[5]

Researchers at both NMAH and NMNH mentioned going to their main branch library at least weekly, some even daily, to check for and review new acquisitions of journals and books.

Use of library resources other than collections. Most researchers make little use of work spaces in the library, except for a few external researchers (typically, most are given use of office space). The long work tables suffice when researchers need a surface on which to leave personal things temporarily, review materials pulled from the stacks, eat lunch, and hold formal or informal meetings. When in the stacks, users put materials on any available surface—sometimes the floor—while reviewing them.

Most interviewees use the copiers in the library or, when not available, take the materials to a divisional/departmental copier. External researchers make particularly heavy use of copiers. Most interviewees were not aware of the availability of the copiers that create and transmit PDF files; those who were had used them and liked that capability. A handful of people, mostly at NMAH, make use of microfilm/fiche readers, mostly for viewing old newspapers.

There is only occasional use of the computer terminals in the libraries, mainly to search the catalog; typically researchers do electronic searches from their own computers. Only external researchers seem to use their own laptops in the library.

[5] OP&A did not get good explanations from interviewees of the reasons for these differing patterns. Putting the pieces together, OP&A surmises that it has to do with the differences in the materials used (entire books at NMAH, which do not get recalled very often, versus articles or limited portions of books, which can easily be copied, at NMNH), and the need to refer to the resource materials regularly over several years at NMAH versus the shorter term time requirements of checking references and citations at NMNH. Many NMAH curators spend a lot of time working on public programs, some of which, e.g., exhibitions, are many years in development. In contrast, most NMNH scientists are not heavily involved in public programming and have to publish three articles a year, the implication being shorter term use of library materials.

Time spent in the libraries. The frequency with which researchers use the libraries and the time they spend in them is wide-ranging and unpredictable. One factor is the stage of a project. Use is more intense at the beginning, when users browse the shelves of the divisional/departmental and main libraries to gather background materials, often visiting daily. There is similar intense use at the end of a project and in the final stages of preparing a publication, as the researcher checks facts, references, quotes, etc. On both occasions, researchers spoke of making multiple, in-and-out visits each day.

Most researchers indicated that they do not spend much time in the library per visit. At the low end, they are there for only the minutes required to locate a specific item and check a reference or citation, but some researchers report making such visits multiple times a day. Researchers also make quick forays to use general reference and cross-disciplinary materials and retrieve ILLs. At the start of a project, however, researchers may spend up to an hour or so in the library, browsing the stacks and reviewing materials. Some regularly spend that amount of time looking at new acquisitions. At the far end of the time spectrum were external researchers, who reported spending several hours up to several full days in a library.

Use of print versus electronic materials. Most researchers at both NMAH and NMNH expressed a *very strong* preference for working with print/hard copy as opposed to electronic files. That is, even if they accessed something electronically and downloaded it to their computers, they would then print a copy and work off of it. The reasons given include:

- Ease of reading print/hard copy
- Ability to take print/hard copy anywhere
- Strong cultural value placed on books
    - Many curators/scientists are bibliophiles

- Curators/scientists are in the business of working with "tangible stuff," and books are inherently more attractive than electronic documents

Another reason researchers prefer print /hard copy is what they see as the limitations of electronic materials.[6] Some are technological in nature:

- Lack of access when the computer network is down
- Uncertainty about the reliability of long-term maintenance and preservation, especially given rapid changes in technology platforms and the short lifetime of current media for storing electronic materials
- Poor quality of electronic materials (e.g., clarity of text and graphics/images, inability to see the true colors of graphics and images)
- Unwieldy size of files that contain extensive graphics/images
- Inability to browse for related materials
- Inability to annotate/highlight electronic files
- Mistrust of the integrity of electronic files
  - It is hard to determine the quality of material found on the Internet
  - People can tamper with electronic materials; they do not have the authority of print materials, which the author and publisher control
  - It is hard to know if the material retrieved is the latest version
- Extensive skills are needed to locate and access electronic materials

[6] The objections of users are spelled out in detail here as general acceptance of electronic library holdings depends in part on overcoming or addressing these concerns, or convincing people they are not real problems. The opinions of non-user interviewees on some of these same issues are discussed in the section, "What Non-users Said."

- Reading off a monitor for protracted periods, especially with long documents such as books, causes eye strain

Other concerns are:

- In the case of digitized materials, the scan of the print item may not be comprehensive, e.g., does not include the covers, annotations by earlier scientists, and the date of publication, or only one version/edition of the item is scanned, even though other versions/editions contain important differences.

- There is a fear that digitization will lead the library to dispose of original print materials.

- Electronic access means a loss of the social contact that occurs in the libraries.

- Publishers of e-resources will stop publishing print versions and neglect preservation of the electronic files, leading to permanent loss of the material.

On the other hand, researchers noted a number of things they like about electronic materials:

- The convenience of 24/7 access anywhere, even in the field (most believe that access from the field will become increasingly possible and facilitate their research enormously)

- The capability to identify and download materials from their desks

- The ability to search the text of documents, including books

- The print-on-demand option made available by some publishers (print versions of digital books can be printed and bound singly or in small lots and sent to the requester, all with a quick turnaround)

- The capability to handle multimedia formats, such as film clips, 3D and music, and increased interactivity

- Features such as on-screen magnification and Internet links

Attitudes toward electronic materials were often linked to age—older researchers grew up with books and came to computers late in life, whereas younger researchers have grown up with computers from a very young age. Older curators/scientists tend to have less confidence in electronic materials and to view extensive use as undesirable and unlikely. Many criticize the younger generation for being too wedded to the Internet ("if it's not on the Internet, it doesn't exist for them"), not knowing how to use libraries, and not making use of print materials. Younger researchers and graduate students say they are very comfortable with electronic resources and trust the technology, while recognizing the limitations. They have strong Internet search skills and tend to search the Internet first when trying to identify useful materials. They think they are well able to determine the quality of materials they find. At the same time, they recognize the need for libraries and do use them and print materials as needed.

The Quality of the Library Spaces

Current Space

Interviewees place a *very high* value on the proximity of library holdings to their offices and object/specimen collections. Also highly valued is the 24/7 access they have to the divisional/departmental libraries (many referred to how difficult it is to use the Library of Congress since it closed the stacks). Although most divisional/departmental libraries are not staffed full-time, interviewees expressed complete satisfaction with the level of access they have to librarians, who respond readily when needed.[7]

[7] OP&A wants to take this occasion to note the effusive praise it heard for the librarians, who were frequently described as models of how staff of a service organization ought to be.

There were very few complaints about the quality of the library spaces. Even though the complaints were few in number, they are worth noting because they offer some insight into what users value in library space:

- *Copiers.* Interviewees spoke of occasional waits to use the copiers in the libraries, and of a need for color as well as black and white copiers.[8]

- *Shelving.* Interviewees noted a lack of pullout shelves/places in the stacks on which to rest materials being reviewed. They also expressed concern about the lack of shelving to accommodate collections growth—let alone existing collections, which in some libraries are packed densely on the shelves. They noted that overly high shelves and tight aisles make access difficult.

- *Seating.* Some interviewees commented that there is no seating in the stacks and occasionally too little seating in the main libraries' reading areas.

- *Other points*
  - At NMAH, the absence of a soundproof space in the library for listening to recordings (cited by one division), and the severe space constraints and bad lighting in the trade literature area
  - At NMNH, the split of the mineral science library collections between two floors
  - At SISC, the excessive travel time to reach the facility

Consolidation of the Departmental/Divisional Libraries

Consolidation of the dispersed library spaces in NMAH and NMNH has been proposed over the years. Various configurations have been suggested, including:

[8] Although not a space issue, interviewees complained a lot about broken copiers and microfilm/fiche readers.

- At NMAH, consolidation of the main and 14± divisional/office libraries[9] into a single library on the fifth floor, with the Dibner rare book library kept as is

- At NMNH,
  - Consolidation of the 21± library spaces into 3± library spaces plus the Cullman rare book library
  - Consolidation of all spaces into a single library plus the Cullman rare book library

Users have, over those same years, strongly opposed any consolidation. They view the current configuration as optimal: the divisional/departmental libraries are near their offices and object/specimen collections and allow 24/7 access to the stacks. This contributes greatly to productivity and efficient workflow. Researchers stressed the importance of having the division/department's own print materials, including reprints, housed alongside the SIL materials. Consolidation would increase the distance to the libraries, thereby: decreasing productivity at a time of greater workloads and publication requirements; resulting in some things not getting done (for example, responding to outside inquiries if resources take too much time to access); and leading to hoarding of library materials in researchers' offices. Divisions/departments might build up their own, often duplicative, library collections. The rate of loss of collections, which researchers understood to be one argument for consolidation, is easily remedied with existing technologies, such as a key card access system and identification of non-circulating materials. Users at NMNH said that the loss rate there is low. Other concerns are: the potential loss of communal space in the divisional/departmental libraries; the possibility that consolidation would be used as an excuse to reduce library staff; and possible overcrowding if users are concentrated in a small number or just one location.

A handful of interviewees supported consolidation. The primary expected benefits were:

- Improved ability to access materials housed in researchers' offices, a point that they also considered to be a matter of equity in access.

[9] OP&A heard different numbers of library spaces for both NMAH and NMNH, hence the "±."

- Less time spent finding materials from different disciplines. The time-saving would be particularly beneficial for external researchers.

These interviewees also pointed out that good researchers will go where they need to in order to produce high-quality work.

Offsite Shelving/Storage

Interviewees expressed similar opposition to offsite shelving and storage:

- It takes too much time out of the work day to get to an offsite facility, particularly for a brief visit.

- It takes too long to get requested material from offsite facilities. The maximum acceptable turnaround time is next day delivery; sooner is better.

- It is impossible to know what to move offsite; the fact that something has not been used in years does not mean it is not important. When you need something, you need it now, not days later.

- Having materials offsite diminishes the capacity to answer inquiries from external researchers and the public.

To be in any way acceptable, an offsite shelving/storage facility would need to be in the District of Columbia, or in very close proximity, to permit easy visits and rapid delivery of requested materials. However, interviewees said both SISC and Suitland took too long to reach. The facility would need to be served by a *frequent* shuttle service. Finally, the facility would have to provide good work space—comfortable chairs, tables, good lighting, copying and scanning equipment/service, stations for the library's computers, and WiFi and/or hookups for laptops.

WHAT NON-USERS SAID

Non-users provided a management or library operations perspective on three areas: the future of print versus electronic materials at the Smithsonian, including digitization of SIL print materials; consolidation of the departmental/divisional libraries; and the need for offsite shelving/storage. Librarians also spoke about problems with existing library space.

Future of Print Versus Electronic Materials

There is consensus that electronic materials are the direction of the future. More and more journals are going electronic; some are now available only in that format, and others are moving in that direction. SIL has been shifting its acquisition budget toward electronic journals and is subscribing to fewer print journals. The number of born-digital materials is increasing for reasons of cost and access; sometimes they are coupled with a print-on-demand option, which some experts believe may become more common. The user-friendliness of electronic materials is continually improving, consistent with widespread recognition of the importance of easy-to-use finding aids and other tools to maximize the usefulness and acceptance of electronic library materials. New technologies, such as software that can do interactive data analysis and configuration, will make electronic materials even more desirable. Evidence shows that acceptance of electronic materials grows with time and familiarity. In fact, as interviewees pointed out, researchers already make extensive use of electronic journals and other materials they are able to access from the Internet. The next generations of scientists will likely be far more accepting of electronic materials and very adept at locating and using them.

Non-user interviewees responded to some of the concerns researchers expressed about electronic materials. They noted that most of the technological issues, e.g., the low resolution of the digital version, the need for complete digitization of print materials, and the unwieldy size of electronic files with images/graphics, have already been resolved or are near to resolution. The one exception is the technology to ensure long-term preservation of electronic files, but there is optimism that even this problem will be resolved satisfactorily in the next 10-15 years. In any event, SIL is committed to maintaining print materials, even those that have been digitized, a policy that most libraries in the world follow. That is, libraries do not see digitization as a path to disposal of print materials. At best, a secondary benefit is that some print materials could be moved from the scarce, prime library space on the Mall to an offsite facility.

Interviewees likewise thought that most other concerns raised by users are more perceived than real. For example, researchers have to assess the quality of materials whether print or electronic, and do so effectively. In the case of electronic materials, provenance can be used to establish authority.

There was strong agreement that even though electronic materials are the direction of the future, print materials are not going away soon, if ever. Print originals of digitized materials need to be retained both as back-up to the digital version and because some researchers need to see the print original. SIL and others at the museums see a need to restore a better balance between acquisition of books and journals. The number of print publications continues to grow, although some may be available only through print-on-demand. Not all materials are likely to be digitized: some are obscure and little used and do not merit the investment in digitization. Many materials at both museums are still under copyright restrictions that may preclude digitization. Finally, print materials are becoming a research area in their own right and must be saved as object collections, to be studied for their historical and evidential value.

Digitization at NMAH and NMNH

SIL has been digitizing materials in its collections since 1994, although the process has been somewhat ad hoc, given the scarcity of funds. It has developed criteria for determining what the digitization priorities are and has had modest success in raising funds for them. It has an internal imaging center at SISC, although currently it contracts out over 90 percent of its digitization and does not foresee a need to expand its imaging center. It is committed to continued digitization, as it recognizes the value of electronic materials to research at the Smithsonian and globally.

Three factors primarily limit SIL's ability to proceed with digitization as it wants. One is the availability of soft money. Even when it is available, it may be earmarked for digitization projects that are not among SIL's main priorities. And SIL, as with other organizations, runs up against intellectual property right and copyright issues.

Digitization at NMNH

The Biodiversity Heritage Library (BHL) is the main digitization initiative that SIL is currently undertaking at NMNH, in concert with the museum.[10] The intent of this initiative is to digitize all print materials in the biodiversity library collections of a consortium of the Smithsonian and nine other libraries in the United States and United Kingdom. The goals of the project are to increase global access to the materials, improve their usefulness through full text search functionality, and promote the long-term preservation of the print materials by greatly reducing their use and by allowing them to be stored under optimal conditions. The BHL initiative is a high priority of both SIL and NMNH, and it has generated interest within Congress and extensive support globally.

[10] SIL has been asked why the Library of Congress, which has a large natural history collection that came from the Smithsonian and which owns many of the same post-1850 materials found in the NMNH library, should not hold the collections. The Library of Congress and the NMNH library have different missions and serve very different audiences. NMAH and NMNH researchers require ongoing, ready access to research resources, and the hours of operations and limited accessibility of materials at the Library of Congress are inconsistent with those needs. The NMNH and NMAH libraries, in contrast, view themselves as a partner of researchers, tailoring their services to best support the work of the researchers.

With respect to the library collections in the NMNH branch library, the initiative aims to digitize all print materials relating to biodiversity—primarily the biology and physical anthropology collections and the rare materials in the Cullman library—up to 1923. Depending on the resolution of the copyright issues, the project could cover materials through 1970 or beyond. It is unlikely the project will include the mineral sciences and cultural anthropology collections. If sufficient funding is available, the biodiversity collections of other Smithsonian libraries, such as those at the Smithsonian Tropical Research Institute and Smithsonian Environmental Research Center, could be included in the project.

The approach the initiative will take to digitization should address the concerns that researchers expressed about digitized materials. They will be available at high resolution so that even graphics and images will be fully usable, and the text will be searchable (something not possible with the print versions). All editions/versions of an item will be digitized comprehensively. There is a long-term access and preservation plan, according to which digital materials will be stored by trusted third parties, with built-in redundancy. In addition, SIL will establish a repository at which to maintain Smithsonian-generated electronic materials. The Online Computer Library Center (OCLC) is already analyzing the holdings of members of the consortium to identify duplication; it was to complete the task in late summer/early fall of this year. The consortium has discussed setting up three scanning centers with a capacity to digitize 800,000-1 million pages a month. One could be located within NHB. Internet Archives will handle the digitizing under contract.

Space savings with respect to shelving is not a goal of the BHL. However, a potential secondary benefit is that a significant portion of the NMNH library print collections that have been digitized could be moved into offsite shelving/storage. Those materials would still be available in a timely manner comparable to that at other leading research libraries.

The consortium partners are optimistic that funding will be forthcoming for the BHL in the near term; sponsors have expressed strong interest, and a grant proposal is being prepared to submit to them. Assuming the proposal is fully funded, SIL hopes to complete the project in three to five years.

SIL has also been digitizing the anthropology library collections at NMNH on a small scale: to date less than 1 percent has been digitized. Here, too, progress is dependent on soft money, which has been raised for specific projects.

Digitization at NMAH

Extensive digitization of the NMAH library collections is not considered likely. There are few champions or interested funders for extensive digitization. A primary reason is that most of the NMAH library collection is not unique. For example, it contains a large number of books that are duplicated in library collections elsewhere (and, being published after 1923, face problematic copyright and intellectual property issues). The exceptions are the special trade literature collections, the rare books in Dibner, and the old journals housed at SISC. Digitization of the trade literature is a particularly high priority: the 500,000 rare and very fragile items in the collection are self-destructing because of acid in the paper, and they may not last more than 50 years. SIL is talking with private funding sources about supporting the digitization and preservation of this collection. A final point is that the Google and other major library book digitization projects likely will cover holdings at other museums that are the same as NMAH's.

The Quality of the Library Spaces

SIL staff noted of a number of issues with the library spaces in both NMAH and NMNH:

- Many are out of compliance with both safety and Americans with Disabilities Act (ADA) codes. For example, the shelves are too close to the sprinklers in the ceiling, and the aisles are too narrow for access by a person in a wheelchair. By law, if any alteration is made to code-deficient library spaces, they will need to become code-compliant. For a number of reasons, it is neither possible nor cost-effective to bring the spaces up to code, and they

therefore cannot be modified. For the same reasons, it is impossible to modernize the spaces to take advantage of current technologies and stay abreast of emerging ones.

- The dispersion of spaces relative to the number of librarians makes it impossible to staff the divisional/departmental libraries full-time. Besides not being able to serve patrons as well as SIL wants, part-time staffing means less control over the collections.

- Some of the libraries, particularly at NMAH, are now completely at capacity, which cannot be increased through expansion of the available floor space or use of compact shelving. The NMAH library already houses more than half its collections offsite at SISC. This lack of space is of concern not only with respect to existing collections, but also for collections growth. Librarians are clear that SIL needs to continue developing its collections to maintain their world-class quality, adapt to changes in the research agenda at the museums, and continue providing what researchers need to do their work. A near-term issue is how to handle the likely donations of print materials by curators/scientists as they retire.

Consolidation of the Departmental/Divisional Libraries

Non-user interviewees believed that consolidation would yield significant benefits:

- SIL could deploy its librarians more efficiently and effectively, providing better services to users and exercising more accountability over the collections. Certainly, the time staff spend trying to locate materials held in researchers' offices would fall dramatically.

- Consolidation may offer the only opportunity to modernize the libraries. Access to different space might allow SIL to use compact shelving and to

develop the infrastructure required to take greater advantage of library technologies that enhance operations and user services.

- Access by other users to materials that have been checked out would improve, as they could be located more readily.

- Researchers engaged in interdisciplinary work and external researchers would be able to use the library collections more easily and efficiently.

Interviewees thought that SIL's dispersed configuration is the exception to the norm at most research libraries. Even with consolidation, it would be possible to afford 24/7 access to some holdings, using technology such as a badge key access and checkout system. Interviewees did not believe that consolidation would reduce productivity or quality. The need for collegial/communal space can be better addressed by providing suitable non-library spaces.

Offsite Shelving/Storage

Interviewees saw an absolute need for more shelving capacity immediately and into the future to better shelve existing collections and permit growth. Moreover, interviewees anticipated that the renovations at the two museums would result in a net loss in space available to the libraries. Bringing the spaces up to code will require wider aisles and lower shelving that will mean a loss in capacity that the use of compact shelving may not counterbalance. A consultant who studied NMNH's library spaces in 1996 reached this same conclusion under a number of scenarios. (Cohen, 1996) Given that additional space is very unlikely to be available on the Mall, it is clear it will have to be located offsite.

Non-users (along with outside experts and the secondary literature) largely agree on the criteria that an offsite shelving/storage facility would need to meet. In addition to the

sine qua non of strict environmental controls that provide maximum protection for the collections, from the users' perspective two criteria are key:

- Assuming the facility affords onsite use of materials, there needs to be easy access to the facility and good work spaces, specifically, tables and comfortable seating, adequate lighting, WiFi/laptop hookups, and temperature control.

- A location that permits timely retrieval and delivery of requested materials to the Mall.

Libraries Within the NMAH and NMNH Renovation Master Plans

The NMAH master plan deals with all the library spaces other than Dibner by consolidating them into one central location on the fifth floor. Collections and curatorial offices would be located on the fourth and fifth floors, although it is expected that some collections would move offsite.

The NMNH master plan that OP&A saw in June 2006 addressed library space only on the first floor of NHB. When OP&A asked interviewees at NMNH about what they understood the plans for consolidation to be, it received different responses, ranging from consolidation into a single library to some smaller number of spaces than at present.

In the case of both museums, renovation of the bulk of the library space would not take place until the later stages of the master plan—that is, at least 10 years out—and even that timing will depend on the availability of funding. Interviewees stated that the master plans for both museums are likely to be revised before then.

SELECTED BEST PRACTICES AND FUTURE TRENDS IN LIBRARY SPACE

Selected Best Practices in Library Space

No library system elsewhere is comparable to the Smithsonian Institution Libraries, and specifically to the NMAH and NMNH libraries. Almost all the secondary literature on library space addresses public libraries or university research libraries, both of which serve audiences and needs that are dissimilar, for the most part, to those at the NMAH and NMNH libraries. Moreover, the ad hoc manner in which the SIL library spaces have evolved, and the inherent limitations of the NMAH and NMNH buildings, have made the application of best practices extremely difficult, if not impossible.

As such, this section focuses on selected best practices in the context of innovative services for users and application of new technologies that may influence the design and use of the physical space of the libraries. It reviews selected recent initiatives and models that address some of the problems with which NMAH and NMNH libraries need to deal.

Mobile Library Model

Johns Hopkins University's Welch Medical Library has begun to use, with much success, an outreach services program called Touchdown Suites. (Oliver, 2005) The goal is to take information, libraries, and librarians out to faculty, staff, students, researchers, and patients, as opposed to the traditional model of users visiting the library to obtain information. The program consists of a network of materials in electronic format accessible anywhere there is an Internet/intranet connection, and small, 400-sq. ft. library

spaces—the Touchdown Suites—located across the university's campus. The term "Touchdown" was chosen to convey a sense of mobility: librarians "touch down" to meet briefly with users. The Suites offer computer access and small-group instruction spaces located near faculty and staff. The library evaluates user needs regularly, and collaboration between the science and information technology (IT) departments ensures that online access portals are working well to meet users' needs. Materials still in print format are undergoing digital conversion.

Four Touchdown Suites are currently in use, with three more under development. The format and nature of the services vary, depending on subject discipline and user needs, but all share a common goal of facilitating interaction between librarians and users. The four are:

- *Hopkins Population Center Touchdown*: it provides information services and outreach to faculty, along with meeting and instruction space and computer access.

- *Basic Research Touchdown:* located in the basic science research building, it provides information services to faculty, students, and staff with cross-disciplinary needs (serving such disciplines as physiology, molecular biology and genetics, cell biology, and anatomy). Services include: office hours for reference and training; grant writing services; customized training courses; and a customized research website.

- *Oncology Patient Information Touchdown:* library services are designed to meet the information needs of patients. One librarian works with faculty and staff; another works directly with patients.

- *Oncology Training Touchdown:* it offers training in applicable oncology information resources, use of software and Internet applications, and research writing skills for faculty and staff.

Architecture and Design in Library Space

Library space is getting more and more attention in light of the rapid changes in user needs and technology and the continuing constraints on space and budgets. Architects are finding that a growing number of libraries are asking for flexible and accommodating space. In addition, it is anticipated that the design of library space will continue to move away from an emphasis on library operations and toward a focus on meeting user needs and on providing built-in flexibility to adapt to change. Four examples of new ways of using space are described below.

- *The Berry-Baker Library at Dartmouth College.* Many academic libraries and some larger public libraries have been using a centralized information commons model, also called "learning commons" or "knowledge commons." It involves a centralized space designed for access and connectivity, socializing and networking, collective learning and research, and exhibition and cultural uses. The space in the Berry-Baker Library at Dartmouth College is designed for user communication and learning needs, with flexibility that allows the library to adapt to rapid changes in technology. (Freeman, 2005)

- *The Middlebury College Library.* The design for this library, which opened in 2004, focused on creating a "social gathering center," with meeting rooms, classrooms, faculty offices, a 50-year allotment for book storage, and digital media spaces. (Frischer, 2005)

- *Seattle Public Library.* Completed in 2004, this library boasts a groundbreaking, award-winning design that sought to address three questions. Among them was how to accommodate an unpredictable rate of growth of up to one million books. (Kenney, 2005) The solution was an innovative "Book Spiral": much like a parking garage, it is four levels high and can be expanded and contracted easily.[11]

[11] For information on the architectural design of the Seattle Public Library, see http://www.arcspace.com/architects/koolhaas/Seattle/.

- *British Library furniture design initiative*. The national British Library has been working with furniture companies to design furniture tailored specifically to user needs in library work spaces. For example, the furniture comes with a power supply, cabinets in which to lock personal property and laptops while away for a time, and ready access to library resources, such as catalogs and technology.

Offsite Shelving/Storage Projects

Another initiative aimed at addressing continually rising costs and space requirements is offsite shelving/storage facilities, some of which are owned and operated by two or more libraries. The best of these facilities are high density with carefully controlled environments. Generally, the buildings are open structures with high ceilings and shelving—e.g., high-bay shelving that can be reached only with a mechanical lift-truck or robots, or two- or three-level mezzanine shelving (such as used at the University of California Berkeley.) At the Research Collections and Preservation Consortium (ReCAP) facility in Princeton, NJ, each high-density library shelving module is approximately 210 feet long, 70 feet wide, and 38 feet high, for 14,588 sq. ft. (Research Collections and Preservation Consortium, n.d.) Collections in high-density facilities are shelved by size in boxes, rather than by call number, to maximize shelving capacity. The most efficient of these facilities use robots to retrieve boxes of materials, which are delivered to a human being for scanning or delivery to a user. One possible disadvantage of shelving by size is that reorganization to accommodate major changes in the collections can be difficult, time-consuming, and costly. The offsite facilities that have proven most successful have been based on careful evaluation of the needs of the collections, the users, and budget considerations. From the user's perspective, the success of a high density offsite shelving/storage facility depends on there being a user-friendly, convenient process for requesting and accessing materials.[12]

[12] These offsite facilities offer cost savings in construction, labor, and conservation (see, for example, the cost savings reported in Yale University, 2000). The cost aspects of this type of shelving/storage facility are discussed in a later section.

Three recently built high-density offsite shelving/storage facilities are:

- *The Five College Library Depository.* In response to critical shortages of space, members of the Five College, Inc. consortium in Massachusetts—Amherst, Hampshire, Mount Holyoke, and Smith Colleges and the University of Massachusetts at Amherst—developed the Five College Library Depository, a shared, high-density depository totaling 10,000 sq. ft., located at Amherst College. Housing lesser-used print collections, the depository offers:
  - User-friendly request and retrieval of materials. Requests are made through the Request Item function of the Five College Catalog or through a linked web request form. Books are delivered daily to all locations. Journals, magazines, periodicals, and serials are available in four formats: scanned image, photocopy, PDF file (from the scanned image), and fax. E-mail delivery of PDF files is a further option.
  - Onsite use of all depository materials in the Reading Room by appointment. Patrons are not permitted to browse the storage area.
  - Cooperative, shared collections management. (Bridegam, 2001, and http://www.fivecolleges.edu/sites/depository/)

- *The Research Collections and Preservation Consortium (ReCAP).* Columbia University, Princeton University, and The New York Public Library jointly own and operate the Research Collections and Preservation Consortium (ReCAP) high-density, environmentally-controlled shelving facility, at which the three partners store low-use items.[13] ReCAP, which is housed at Princeton University, has several noteworthy features:
  - A user-friendly request procedure via a link in the catalogs to an online request form
  - Next business day delivery of physical items via a courier service, and immediate delivery of electronic documents such as journal articles and single chapters of books, to all three campuses

[13] For more information on ReCAP, visit http://recap1.princeton.edu/about/general.html.

- A sophisticated, state-of-the-art inventory control system
- A modular design that allows easy expansion through the construction of additional modules as needed (there is space for 15 modules with a total area of 218,820 sq. ft. and capacity to shelve 37.5 million items).
- An onsite reading room, available by appointment

- *The British Library*. The library has an offsite facility some 200 miles north of London where about 50 percent of its collections are stored. It offers virtually immediate electronic delivery of scanned materials, and next morning delivery of physical items requested by 5:00 pm the previous day, six days a week. The library is currently constructing a second high-density offsite shelving/storage facility. It will be a state-of-the-art high bay building extending 70 feet floor to ceiling, with 300 kilometers of double-depth shelving to hold two rows of boxes of materials. The temperature will be maintained at about 45^{o} F; humidity will be 15 percent. Oxygen levels will be so low that no fire protection system will be needed. Requests will be possible online. Robots will retrieve boxes from the shelves and deliver them to a human picker. The picker will retrieve the requested item from box, scan it at an adjacent scanner, and return the item to the box, and the robot will replace the box on the shelf.

An offsite shelving/storage initiative being developed and tested by the Milton S. Eisenhower Library at Johns Hopkins University is *Comprehensive Access to Print Material (CAPM)*. The Eisenhower library already has a high-density offsite facility within an hour of Baltimore that provides near-immediate delivery of electronic materials and twice-daily delivery of physical items. The goal of the CAPM project is to offer a retrieval and real-time remote browsing capability as well. The plan is to use robots to retrieve individual items from storage boxes, rather than an entire box, and deliver the items to a location where they can be scanned robotically. The user can then browse the item and either request delivery of the scanned file or have the item returned to the shelf robotically. The retrieval speed for browsing will increase over time as newly scanned materials are added to the system and re-used. The technology for retrieving individual

items from storage bins has been tested successfully in a laboratory environment. The technology for the robotic scanning station is being explored. It is anticipated that labor costs would be far lower at this type of fully automated facility than at the typical semi-automated one. At one point it seemed that something like CAPM would be the holy grail of offsite shelving/storage facilities. However, major digitization initiatives such as the Google Library Book project have thrown into question whether there will be a need or demand for its capabilities.

Trends and Issues Affecting Library Space

The Physical Library

Even as the roles and technologies of libraries change, the consensus is that the demand for physical libraries that offer onsite use will continue. Bennett observed that, for many librarians, "their strong preference for the present is to maintain collections on open, browsable shelving." (Bennett, 2003) He quoted Steven M. Foote, an architect with extensive library experience, who said, in a 1997 article,[14] that

> architects and librarians agree that print collections will continue to dominate libraries, that flexible shelving is essential and that compact shelving will be a feature of every library, that adjacencies must be fluid, and that floor-to-ceiling heights must be generous. (Ibid.)

A group of 26 library directors surveyed in the 1990s did not anticipate that electronic publications will relieve the pressure on shelving space for monographs "either now or in the foreseeable future." However, most acknowledged that electronic journals relieved shelf space allotted for back issues of print journals. (Ibid.) For example, a study at the Tri-College Library Consortium[15] concluded that the space savings from the shift from print to digital journals was substantial: Swarthmore's science library canceled 48 print

[14] See "An Architect's Perspective on Contemporary Academic Library Design," *Bulletin of the Medical Library Association* 11 (1997): 351.
[15] The members of the Pennsylvania Tri-College Library Consortium are Bryn Mawr, Haverford, and Swarthmore colleges.

titles in 2002 and gained 340 linear feet (LF) of available space. (Luther, et al., 2003) Access to 15,000 electronic journal back issues (assuming reliable access) would free an estimated 1,666 LF. However, many experts believe the data on the space benefits of digitization are insufficient to reach conclusions. Studies at the University of California and University of Michigan should yield further data in a few years.

Roles

Just as space requirements are changing, the roles of the library are also changing, creating challenges and opportunities for libraries, librarians, and users. Listed below are some of the predominant predictions for the next 10-20 years:

- Libraries will continue to hold and make available hybrid collections of print and digital materials, the current model for most libraries. Highly specialized libraries, such as for law and medicine, may be able to convert to all-digital collections, but this is not likely for most research libraries. One reason is that less-used print materials and copyrighted books will probably not be digitized, and humanists and social scientists will continue to make heavy use of print monographs in their research. A further reason is that digitization is expected to remain costly for the next 10-20 years, as electronic preservation and migration issues still need to be resolved.

- Research libraries will continue to shift from a focus on the quantity of information made available to the quality of information management and presentation. (Frischer, 2005) They will offer organization of information, information access and services, and an environment designed for learning and social and cultural needs.

- Libraries will shift to a role of "learning laboratories." (Freeman, 2005)

- Provision of access to specialized technology, such as multiple screen computers that permit simultaneous viewing of multiple books and articles, will become a major role of libraries and affect their physical attributes.

Print and Electronic Resources: Trends and Issues in Scholarly Research and Use

The future of print versus e-books. There has been much discussion of the future of print books, especially in research libraries. Although intellectual discourse is moving away from print to networked digital media, studies show that many researchers prefer to use print books and to browse shelves of books (especially true for the humanities and social sciences). A 2003 study of research habits at the Tri-College Library Consortiumfound that students and faculty placed a high value on browsing the stacks as a means of discovering information. Further, faculty members valued local ownership of materials and were concerned about libraries weeding out materials from their collections. (Luther, et al., 2003) A 2003 OCLC report also noted the continuing value of some traditional information formats. (OCLC, 2003) Even where materials have been digitized, libraries currently retain the print version as back-up, given the uncertainties over the preservation of digital materials, and also because some researchers need the original print item. The ratio of print to electronic materials will vary from library to library, dictated to some extent by the preferences of the main user groups and their disciplines.

Use of e-books is still limited, and it is unclear whether they will replace print books to any extent. Even when e-books are available, users often take advantage of the print-on-demand option if available. OCLC's 2003 report indicates that the publishing industry will move increasingly to print-on-demand and that this option bears watching. The future of e-books is partly dependent on the extent to which consumers and researchers accept e-book readers, which in part depends on what features are offered. Based on one study at three university libraries that made two different types of e-book readers available to students, the younger generation of researchers is more likely to use e-books,

along with other digital resources. Students found they liked the e-book readers once they had the opportunity to use them. Desirable features included the ability to: search; underline and highlight passages; annotate the text; take notes; an embedded dictionary look-up feature; and PDA-related functions (audio input and output features, calculator, and a separate notepad). (Bell, McCoy, and Peters, 2002) A 2004 analysis by Littman and Connaway of the circulation of print and e-books at Duke University Libraries found substantial e-book usage, leading to the conclusion that development of e-book collections was justified for academic research. (Littman and Connaway, 2004) However, more comparative studies between the two formats are needed, especially when e-book readers become more sophisticated and widely-used.

The future of electronic versus print journals. As user interfaces and features become more sophisticated, more and more users are turning to electronic journals for research. Many publishers have shifted to electronic format only or to a combination of print and electronic, with some publishers offering the print-on-demand option. It is noteworthy that the most prestigious—that is, "must have"—journals in particular are moving to electronic-only. The 2003 OCLC study found that the annual rate of production of electronic-only formats is growing faster than that of paper-only.

Many studies of users have been carried out in the hopes of predicting usage trends. A 2003 study by Tenopir found that university faculty and students preferred electronic resources and often used the library from their desktops. Tenopir concluded, "There is some evidence that younger users are more enthusiastic adopters of electronic resources than are older users. Younger users rely on electronic resources more heavily and rate themselves more expert in using them than do older users." (Tenopir, p. 45)

Within this overall preference for electronic versus print journals, Schottlaender's study found noticeable differences across disciplines. Faculty members and other professionals in the fields of mathematics, science, and medicine emerged as the heaviest and most enthusiastic users of digital resources and electronic journals, with an average of 34 digital uses to 1 print use. Among the disciplines where usage ranked lowest were the

arts, humanities, and social sciences—approximately 10 digital uses to 1 print use—leading to the conclusion that users in these fields relied more on books than was true for other fields. (Schottlaender, et al., 2004) Dalton and Charnigo's study of the information-seeking habits of historians showed that these researchers still liked to browse book shelves, rarely used e-journals, visited physical library space regularly (as evidenced by their heavy usage of WorldCat), and preferred print monographs. Although historians used electronic bibliographic databases to find information, they preferred print formats for reading. (Dalton and Charnigo, 2004)

Despite the trend toward electronic journals, two key issues remain unresolved. One is the uncertainty over the long-term preservation of electronic journals (see, for example, OCLC, 2003). The other is the lack of guidelines for e-journal quality, which need to be established.

Digitization of Print Materials

As digitized collections continue to grow, experts have noted a number of actual or potential advantages that can raise acceptance and use of these materials, as well as some issues that will continue to make print materials desirable.

- Advantages
  - More library materials become easily accessible on a global scale.
  - Electronic access to materials yields time savings for researchers.
  - The searchability of digitized materials enhances usability compared with print materials.
  - An institution's profile becomes more prominent as the digital library becomes known and used. A well-designed digital library can be an effective marketing tool, especially if it attracts users from across the nation or globe.
  - Less physical use of materials enhances preservation, particularly important in the case of rare or fragile items.

- If the long-term preservation of digital materials can be assured, disposal of digitized print materials may become possible and reduce the space requirements for physical library collections.

- Among the issues that need to be addressed are:
  - Long-term digital preservation has not been assured. Laura Campbell at the Library of Congress, for example, stressed the need for further research to prevent wide-scale loss of data. (Campbell, 2002)
  - Too often the quality of images is insufficient to meet the needs of researchers, but provision of high-quality images is costly. A similar problem is the rate of error with Optical Character Recognition (OCR) technology: it works well with clear text but is prone to errors in the case of hard-to-read handwritten items.
  - Current copyright laws are a significant obstacle to digitization, limiting what can be digitized and often making it prohibitively expensive.
  - Current digital formats may not be readable on future machines and require costly, regular migration to new platforms.
  - Universal metadata and preservation guidelines need to be clarified and accepted.
  - The selection of collections for digitization is a challenge.[16]
  - Libraries must have an assured revenue stream for maintenance and preservation to cover the life-cycle costs of electronic materials; too often only the start-up costs are considered.

Developments in Technologies

The rapidity with which existing technologies evolve and new ones emerge has become an axiom in the library world. Although not all the technologies described below have

[16] The Harvard Model is considered to offer the most comprehensive and flexible guidelines for selecting collections for digitization (see Hazen, Horrell, and Merrill-Oldham, 1998, and Brancolini, 2000).

space implications, they are presented here to illustrate the range and speed of change that confronts libraries.

- E-book devices are, as noted, becoming more sophisticated and user-friendly. Features include handheld screens, often the size of a book, search capabilities, and editing software that allows for annotation and highlighting and for multimedia functionality.

- Radio Frequency Identification Devices (RFID) can be placed in books and other materials to address security issues such as tracking. Tracking facilitates access to materials by allowing librarians and users to locate items within and outside the library. This may prove useful when researchers need an item located in someone's office. A vision for the future is to use RFIDs in high-density storage facilities to assess environmental conditions regularly and alert staff to problems, such as the presence of water.

- Growing discontent with catalogs and the need to go beyond inventory control systems have encouraged innovation. Personalized, "intelligent" web portals are beginning to replace traditional library catalogs. These portals allow users to connect seamlessly to other library catalogs and databases from their computers. Personalization of web portals allows easy access to information tailored to individual needs. For example, at the University of Illinois in Chicago, the *MyLibrary* website customizes the content it displays for individual users, based on their use patterns and information queries, and highlights resources they use most often. Often called "Recommender Systems," these interactive online library catalogs are modeled after Amazon.com or Yahoo.com, which automatically recommend books and display information based on users' preferences, checkout history, and web surfing habits. Web 2.0, another technology, is predicted to become more widespread in libraries. Michael Stephens with ALA TechSource defines Web 2.0 as "the next version of the World Wide Web, consisting of digital tools that allow users to create, change, and publish dynamic content."

(Stephens, 2005) Examples of Web 2.0 are: Weblogs (blogs); RSS,[17] which allows users to subscribe to their favorite websites and receive automated updates, for example, news feeds, based on criteria they specify; instant messaging; wikis (sites such as Wikipedia where anyone can add or edit content); and tagging (attaching a keyword or term used to classify content and provide links to related materials, a feature found on sites like Flickr.com). OCLC's WorldCat Library catalog is an example of Web 2.0: the site allows librarians worldwide to add and update collection information and post reviews or notes on items. Open source software, or non-proprietary software, offers programmers the ability freely to read, modify, and redistribute source codes or programming codes. As a result, the software "evolves," as people adapt it to better meet the needs of their organizations. (Kochtanek and Matthews, 2002) This emerging option is worth watching, especially for libraries looking to share resources and alleviate costs, because open source software carries no licensing fees and can be freely shared with others. Locally, the Washington Research Library Consortium (WRLC) uses open-source repository software as the basis for the ALADN Research Commons.[18]

- Search capabilities are becoming more sophisticated. Google and Google Scholar search the "Deep Web,"[19] which includes materials that are not accessible with popular search engines. Such materials include content in searchable databases, non-textual files, and dynamically-generated web pages (pages generated based on user input). Traditional search engines and library catalogs are not so inclusive. (Morgan, 2006)

- Metadata standards and technologies are still being developed.

[17] RSS is variously spelled out as Really Simple Syndication, Rich Site Summary, or RDF (Resource Description Framework) Site Summary.
[18] For more information on WRLC's ALADN Research Commons, visit http://aladinrc.wrlc.org/index.jsp and http://www.cni.org/tfms/2006a.spring/abstracts/PB-cheverie-aladin.html.
[19] For more information on the Deep Web, see http://www.lib.berkeley.edu/TeachingLib/Guides/Internet/InvisibleWeb.html.

- Issues with the migration of e-materials as technology platforms change are prompting IT developers to design platforms that can adapt to and read any digital format and software version. These are works in progress, and the outcome is uncertain. The prediction is that the technologies will go through many changes and developments before a trusted standard is widely available.

- Automation robotic technology looks very promising, according to many experts and user studies on existing projects. Stanford University is, for example, scanning its book collection using a robot from 4DigitalBooks; the device automatically turns pages while it scans. As noted, the Milton S. Eisenhower Library at Johns Hopkins University has been developing and testing a robotic retrieval and remote real-time browsing system (CAPM).

Cost Considerations

Cost considerations relate to library space in two main ways: the extent to which libraries can make use of electronic materials in their collections; and how libraries can best meet their always growing need for space for physical collections and delivery of services to users.

Costs, acquisitions, and scholarly publishing. Many experts are uncertain about the future of electronic scholarly publishing. Costs may rise further before dropping over the next 10-15 years, and in response, libraries, other users, and non-commercial publishers will continue to look for alternative, less costly ways to produce and disseminate scholarly works. A number of alternative dissemination products and cost models are already being used, with greater and lesser degrees of success. Some models have been around for many years and are well-known, such as SPARC, Highwire Press, and JSTOR; others are just beginning to gain recognition. Some of the leading alternative models and trends are summarized below.

- *Open access*: charges paid by the author and other sources of revenue replace subscription fees. This approach remains hotly debated. Some experts contend that libraries will end up paying even more than today, and many open access projects have yet to break even. The Public Library of Science (PLoS) lost $1 million in 2005 and has had to up the author charges; nevertheless, it is launching PLoSOne, similar to the Los Alamos archive of physics papers, which offers discussion and commenting features for scientists and researchers. BioMed Central (UK) also has yet to break even, although its articles are frequently cited. Other open access projects or initiatives are worth watching. A piece of legislation now pending in Congress, the Federal Research Public Access Act of 2006 (S.2695), aims to improve taxpayer access to federally funded research by requiring that every federal agency with an annual research budget of more than $100 million make its research publicly accessible within six months of publication. Given that the U.S. government funds an estimated 50 percent of university research, this legislation would offer substantial benefits to libraries, researchers, scientific dissemination, and the public. As of September 19, 2006, 125 higher education institutions were backing the bill,[20] as well as National Institutes of Health (NIH), consumer groups, and many major library organizations. Because of the amount of support the bill is receiving, opinions are leaning towards its passage. The Spanish Panace@ is a successful open access journal for medical translators, with no author, user access, and subscription fees; much of the participation is voluntary, and donations cover the costs of web space rental, copyediting, typesetting, and page layout. Its approach may prove a useful model for smaller organizations with limited funding; however, its long-term sustainability remains to be seen. (Arroyo, et al., 2005) In short, more research is needed before the open access business model in its various forms can be widely recommended.

[20] See http://www.arl.org/sparc/advocacy/frpaa/institutions.html for a list of the higher education institutions backing the bill.

- *Tiered or differential pricing.* In her article "Tiered Pricing," Karla Hahn defines it as "differential charges for both paper and electronic subscriptions to a journal based on the categorization of the subscribing institution. Smaller institutions are assessed a lower subscription price than larger institutions." (Hahn, 2005, p. 151) Hahn believes that smaller institutions will benefit, but larger institutions may get hit with significant price increases. In contrast, David Stern believes this approach may be a fairer and more customized way to distribute the costs of scholarly publishing. (Stern, 2005)

- *Consortia/partnership arrangements.* In many cases, collaborative acquisition and storage of library materials have proven effective means through which libraries can manage costs and create shelf space. Consortia can exert leverage in license negotiations and get products at lower cost than individual libraries can. The University of California has a long tradition of collaboration in collection building and resource sharing and is considered to be at the cutting-edge of consortium models. The Carolina Consortium, consisting of libraries from 38 schools, is another example; it has been able to expand electronic resources and save money by sharing thousands of journal subscriptions while saving money. Tim Bucknall states:

> In many ways, the Carolina Consortium has implications for libraries nationwide. Its success shows that institutions with shared interests can band together on short notice to create ad hoc consortia for specific needs. Moreover, even libraries with differing missions and backgrounds can gain considerably expanded journal access at little extra cost by working together… Suddenly, a large collection of major academic journals that would typically be accessible only at elite research institutions can be accessed online from small colleges. (Bucknall, 2005, p. 4)

Some librarians interviewed for this study are concerned that library consortia may result in a loss of depth in library collections and an increase in the similarity of their holdings. The reasoning is that as acquisition budgets decline, libraries will jointly shift their acquisitions to the most important,

general, and/or widely used items and away from specialized materials. However, key findings from the Tri-College Library Consortium study suggest the opposite: consortial arrangements minimize duplication of materials and thus allow libraries to save money that can be used for specialty items. (Luther, et al., 2003)

Many librarians who have participated in consortial arrangements have found that implementation of the consortium has been difficult due to the different organizational structures of member libraries. Communications and decision making among the members of a consortium can be labor-intensive and cumbersome, especially for those smaller consortia that often rely on volunteer efforts.

Digitization costs. The trend is toward outsourcing the digitization of less fragile items in a library's collections, because, as studies have shown, the costs are substantially cheaper. According to one source, a Chinese scanning company, Superstar, charges $10/book, versus $30/book in the West. (Kelly, 2006) However, in the case of fragile and rare items, which require very strict environmental controls and careful handling, libraries prefer to do the scanning in-house to avoid damage and loss. A sometimes overlooked factor in digitization projects is provision of a revenue stream to cover the life-cycle costs, such as long-term storage and preservation, IT management, hardware maintenance, migration, and staffing; project budgets need to include these costs. In particular, until a reliable migration platform is available, libraries and institutions need to factor in migration costs lest the digital media files become unreadable on future systems.

Offsite shelving/storage. High density offsite shelving/storage facilities have, as noted, proven to be cost-effective. Often they are sited at a location where land is cheaper and more available, and construction costs tend to be less than those of a traditional storage facility or new library building. A 2006 report by Kohl and Sanville highlights the comparative costs of two offsite high-density facilities in the late 1990s. The facility

built by Orbis, a coalition of academic libraries in Oregon and Washington, had a construction cost per volume of $3.75, compared with $13.39 for traditional campus library construction. Yale University stated that its high-density facility is "one tenth as expensive as traditional library open stacks housing."[21] High-density shelving/storage facilities offer other cost savings: the strict environmental controls minimize the conservation requirements for materials and allow journals to be stored unbound; there are energy savings; and at facilities using robots, the labor savings can be significant. (See also Nitecki and Kendrick, 2001)

Highlights from a cost analysis for the CAPM project done in 2001 offer a general idea of what various elements of a high-density facility might run, exclusive of construction costs. (Lorie, 2005)

Fixed costs based on a 10-year analysis (based on 2001 prices)	
Robot	$50,000-$100,000
Page turner	$5,000-$50,000; range covers costs for additional turners
Scanner(s)	$15,000-$45,000
2 computers—dependent on computers at existing institutions	$10,000 each
Book containers	$432,000 for $1 cartons $1,296,000 for $3 cartons
Set-up and operating costs	
Labor costs, including operation and maintenance	$432,000, based on $12/hr rate
Page turner maintenance	$2,500/year, equivalent to medium-sized copier
Scanner maintenance	$4,500/year per scanner
Robot maintenance	$2,500/year, equivalent to medium-sized copier
Loss of storage capacity due to insertion of book spacers for robot	Dependent on lease rate and usage of facility; JHU estimated $11,800 annual cost for CAPM use in Moravia Park
Variable operations and maintenance costs	
Electricity	$652/year

[21] Kohl and Sanville cite, as the source of the figures for Yale's facility, "Remote Storage in Research Libraries: A Microhistory," by D. Block, in *Library Resources and Technical Services* 44 (4)(October 2000): 184-89. Also see Yale University (2000).

The total estimated costs, as of 2001, for implementing and operating CAPM at other institutions are:

Costs	Fully Automated CAPM	Partially Automated CAPM
Low	$1,435,000	$1,516,000
High	$2,660,000	$2,603,000

The total estimated costs separated into fixed and variable categories are:

Costs		Fully Automated CAPM	Partially Automated CAPM
Low	**Fixed**	$826,000	$832,000
	Variable	$609,000	$684,000
High	**Fixed**	$1,958,000	$1,919,000
	Variable	$702,000	$684,000

In addition to the cost analysis, the University of Colorado's Department of Economics studied what users might pay for materials from CAPM: "Based on preliminary analysis, as of 2001, a reasonable estimate of the average willingness to pay per semester for a basic CAPM system is approximately $63." (Flores, 2001)

SUMMING UP:
EXTERNAL RESEARCH LIBRARIES IN THE FUTURE

The Continuing Importance of the Physical Research Library

Libraries will remain a critical pillar of academic research, and their holdings will need to continue growing. An average rate of growth is impossible to project, but none of the museum/national libraries covered in this study is projecting less than a continuation of current rates of growth. Two variables whose future is difficult to predict could significantly affect the rate of growth of physical collections:

- The extent to which publishers make journals and monographs available only in electronic form, and

- The extent to which libraries engage in collaborative acquisitions and shared repositories, such that each library does not need to duplicate the holdings of another. One key here is the availability of print materials in electronic format, so that they can be accessed widely. That availability will be affected by both commercial publishers and the rate at which libraries and other organizations digitize print materials. Another key is the willingness and ability of organizations to enter into partnerships.

A Mix of Print and Electronic Holdings

Library collections will continue to offer a mix of print and electronic holdings, with the percentages varying based on discipline; increasingly, science materials will be in electronic format, while the humanities and social sciences will continue to see a high percentage of print monographs, but also some increase in electronic journals. Libraries may choose to increase their acquisitions of e-books because of their searchability, but will also obtain print versions, since many users will still want to work with that format.

Rapid Increase in Electronic Materials and Ways to Access Them

The availability of electronic materials, particularly journals and items of limited length, will increase rapidly. Many will be available only electronically ("born digital"); others will offer a parallel print version or print-on-demand option. Digitization of existing materials will boost the volume of electronic materials, and will do so significantly if the Google and other library book digitization projects proceed as planned. A significant unknown of the major digitization projects is whether and how the copyright issue will be resolved. OP&A presumes that agreements will be reached that will permit digitization and access to post-1923 materials.

In parallel with the increase in electronic materials will be a trend toward more and better search tools and ways to access information. It is likely that people will continue to search for, access, download, and store electronic materials on their computers, but they will want to use an array of tools such as cell phones, PDAs, and possibly e-book readers. New technologies such as the aforementioned Recommender Systems and "intelligent" web portals will continue to make access to and use of electronic materials increasingly user-friendly. Libraries are paying a great deal of attention to providing electronic access to information by as many means as possible, and are emphasizing the importance of adapting their space to new technologies and the changing ways in which researchers access information.

All that said, the consensus is that the fully electronic library will not emerge in the next 20 years. Monographs will still be in demand, and researchers are likely to continue working with print/hard copies of electronic materials, particularly in the case of longer items, because of the greater ease of reading and annotating. This is true for both older and younger researchers. Although younger generations of researchers have greater dexterity with electronic searches and access, and tend to resort to the Internet first to look for and access materials, they also make use of library materials as needed and prefer working with print/hard copies.

Continuing Need for Offsite Shelving/Storage

The pressure for shelving space in libraries will grow even more intense because of both the competing demands for existing space in prime locations and the difficulty and cost of expanding existing buildings, especially in urban areas. To address the need for additional shelving/storage, many research libraries have or are resorting to high density, environmentally controlled offsite shelving/storage facilities. The best offer a user-friendly online request service, robotic retrieval of requested materials and timely delivery in materials in original print, copy, or electronic formats. Some facilities have a reading room for onsite use of materials, available by appointment. These services appear to mitigate the inconvenience of shelving materials offsite and may help convince researchers to accept offsite shelving/storage. Finally, the facilities can be expanded by constructing additional modules.

User-friendly Library Work Space

Academic and public libraries are placing increasing importance on the physical work spaces available to users. New designs emphasize maximum support for learning, collaboration among researchers, and easy access to user services and technology. Studies have found that at libraries offering these types of spaces, library use increases.

The spaces are designed to be flexible to permit adaptation to the rapid emergence of new technologies. The implication is that well-designed centralized spaces will play a vital role in the future of libraries. The clear trend at university research libraries is toward more collaborative work among students and between students and faculty. It appears there is a parallel trend in the research community toward more collaborative work, e.g., with researchers from other departments and other organizations.

A Preference for Consolidated Library Space

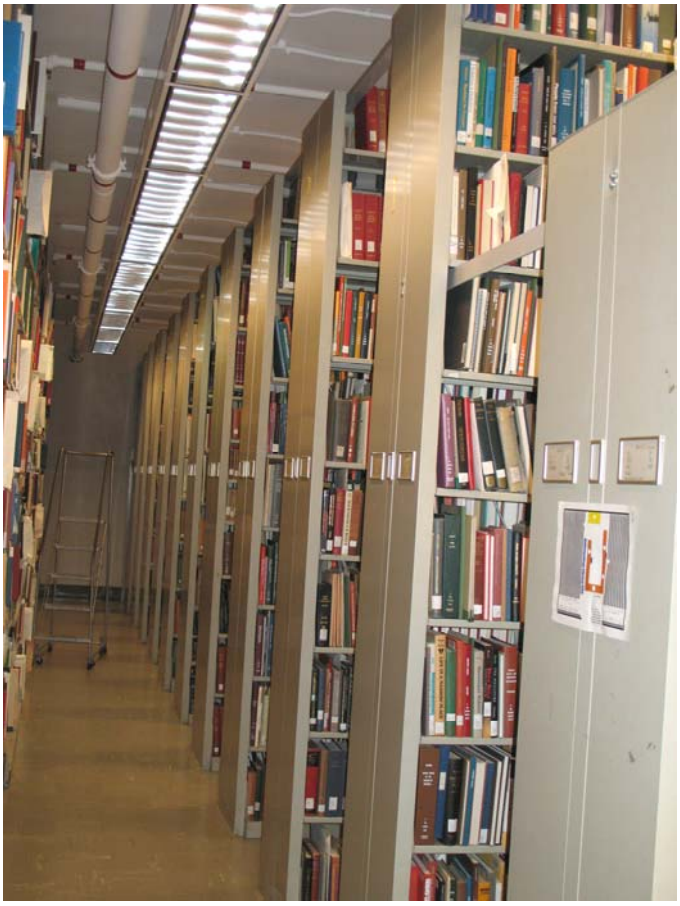
Academic research libraries, including museum ones, present a mixed picture as to how they are configured, but the trend seems to be toward consolidation into a single library or small number of affiliated libraries/library spaces. Even with consolidation, some libraries continue to provide 24/7 access to stacks through key cards. The reasons for consolidation typically are more efficient operations and better control over the collections; better use of space; recognition of the greater availability and use of electronic materials; and the trend toward interdisciplinary research. Libraries that have undertaken consolidation report eventual acceptance once researchers get used to it.

Mobile Library Model and Decentralized Library Space

In some specialized library environments, such as medical and scientific facilities, close partnerships between library staff and researchers in the delivery of services are becoming more popular. Electronic materials are fundamental to this model, and it therefore may not be workable at all libraries.

Collaboration

Increasingly, libraries are looking to collaboration as a way to deal with issues such as the high cost of journal acquisition, digitization of print materials, offsite shelving/storage, and long-term maintenance and preservation of print and electronic materials. Inasmuch as the pressures of limited funding and space are likely to persist, consortia should continue to be attractive. Their implementation should become easier as the lessons learned become available and experience grows.



PART B.
OBSERVATIONS

The Future of the NMAH and NMNH Library Spaces and Offsite Shelving/Storage

Over the course of the study, it became apparent to OP&A that definitive conclusions would be difficult to formulate, for reasons described in the Methodology section. A more useful approach was to generate observations that reflected the analysis of the findings and identified the questions, considerations, and further analysis that need to underlie master planning of library spaces.

This part of the report presents OP&A's observations about the future of NMAH and NMNH libraries and offsite shelving/storage for library collections 20 years out. Most observations are made from the perspective of users, the mandate for this study: how researchers will be using libraries over the next two decades, what changes in technology the future might bring, and what researchers want from library space. Some, however, relate to the decision-making process for master planning of SIL space and to the broader SIL and Smithsonian-wide framework of which the libraries in the two museums and any offsite shelving/storage are a part.

The observations draw on the findings from interviews with internal and external users of NMAH and NMNH libraries, opinions from the secondary literature and interviewees about where research libraries appear to be heading in terms of user services over the next 20 years, and current thinking of management and OFEO about library space as indicated in interviews and the two museums' master plans. They also proceed from a belief that physical libraries will continue to be a critical resource for research by both internal and external users at NMAH and NMNH, and that SIL is a necessary partner in the pursuit of excellence in research. As such, libraries need to be fully integrated into the master planning for both museum buildings.

The final section of this part presents the OP&A study team's recommendations. Some address NMAH, NMNH, and 1111 North Capitol Street specifically, but others respond to the broader issues of systematic planning, coordination, and collaboration.

An Uncertain Framework for Master Planning: Unanswered Questions at the Two Museums

OP&A observed a lack of clarity around four points that are essential to effective master planning:

What will the balance between research and public programming and other functions at NMAH and NMNH look like over the next 20 years?

What will be the role and composition of the research programs that the museums will want SIL to support? The answer to this question is a foremost driver in determining the level of resources, particularly funding and space, that need to be allocated to the libraries relative to other museum functions. The answer will also greatly influence how much library space is to be provided onsite versus offsite.

In what directions will the research programs of the museums be moving?

For example, what disciplines/fields of research will be continued, expanded, diminished, and eliminated? What will be the size and composition of curatorial/scientific staff, and where will the staff and object/specimen collections be housed? Each of these considerations bears significantly on the content of library collections and where they should be located, and the types of work space needed to provide optimal support to the researchers. At NMNH, for example, the move of some collections and staff within a department to Suitland while others remain at NHB raises questions about the best location for related library collections. A shift away from purely taxonomic and toward

systematics research has important implications for the configuration of libraries within NHB as well as for the movement of library collections offsite. Expansion of research in areas such as molecular biology, which tend to use more electronic materials and fewer historical materials than does, for example, vertebrate zoology, similarly has significant space implications for library collections. NMAH curators say they spend the bulk of their time on public programs, particularly exhibitions, and are carrying out little academic research aimed at the general advance of knowledge in their areas of expertise. There is also discussion at NMAH of moving toward more generalist curators able to work in different areas within a discipline, as opposed to the highly specialized curators there today. Both considerations have implications for library collections and space.

What should NMAH and NMNH library holdings look like 20 years from now?

Following close on the heels of the above two questions is a third one: in what direction should the collections at the two museums move? The library collections at NMAH and NMNH are considered treasures by the research community globally because of their breadth and depth, particularly the historical holdings. Continued growth of both older and current materials is essential to sustain that reputation and support research. But OP&A heard repeated concerns about the rapid decline in resources available for acquisitions and the growing imbalance between journal and monograph expenditures, with the latter declining at a steady rate. To what extent will the Smithsonian commit to maintaining the quality and quantity of the NMAH and NMNH library collections through adequate, balanced acquisitions? OP&A highlights "the Smithsonian" because the decision about resources for acquisitions begins at the central administrative level, followed by the unit management level. How much support is given to acquisitions, both purchases and acceptance of donations of materials, will have a critical impact on future space requirements overall, as well as the type of offsite shelving/storage in which the Smithsonian should invest.

What importance do the museums attach to the role of libraries in supporting continued excellence in research?

OP&A asks this question because it finds a gap between the importance that researchers attach to the libraries and the resources being allocated to them. The condition of many Smithsonian library spaces and the shrinking acquisition budget suggest that the libraries are a fairly low priority. Certainly, the NMAH and NMNH libraries, and the offsite space at SISC, lag far behind those of other major national and academic research libraries here and abroad in terms of the quality of space relative to users' needs, application of technological tools, planning for future technologies, care of collections, ability to develop the collections, and investment in offsite shelving/storage. OP&A was not surprised at this finding. In other of its studies, OP&A has observed that the "silent" infrastructure of museums, of which libraries are a part, often suffers from neglect because it is not in the public eye and rarely poses an immediate crisis (floods being one exception). Moreover, researchers at NMAH and NMNH make few demands of the libraries because they are getting what they value most—proximity and 24/7 access to exceptional library collections. Their major concern, as they observe annual cutbacks in subscriptions to journals and declining acquisitions of print materials, is whether the Smithsonian is committed to maintaining the quality of library collections.

Accommodating the future effectively requires important decisions now. SIL's desire to develop a master plan is an important move toward accommodating that future, but it can only realize its plan to the extent that the central Smithsonian administration and museum management support it. How much importance will the Smithsonian attach to maintaining the reputation of its library collections and to providing state-of-the-art libraries designed and configured to maximize productivity and excellence in research?

Some Thoughts About Future Library Space at NMAH AND NMNH

This section addresses four key space-related issues: desirable characteristics of library space; dispersed versus consolidated library space; the composition of library collections 20 years out, particularly the relative ratios of print and electronic materials and the implications for space; approaches to offsite shelving/storage; and consortial arrangements. It also looks at two other space-related considerations and trends: co-location of IT services and libraries; and continued adaptation to new information retrieval and manipulation technologies.

Desirable Characteristics of Library Space

As noted, OP&A heard very few complaints about current library spaces or services. It surmises that the *very* high value placed on the proximity of library holdings to offices and object/specimen collections, the limited time researchers spend in the libraries, and resignation about the limitations of the spaces outweighed other considerations. Nevertheless, the points that users made provide insight into what characteristics other than proximity they find important:

- 24/7 access to the stacks to permit browsing and to accommodate irregular work hours
- A central place with seating in which to identify and review new acquisitions
- Availability of library copiers, including color and scan/email
- Pullout shelves/places in the stacks, and possibly seating, to facilitate review of materials

- Basic work spaces
  - Reading areas for reviewing non-circulating materials and new acquisitions
  - A combination of communal and a limited number of individual work tables
  - Comfortable seating
  - Good lighting
  - A small number of computer terminals for access to the SIL catalog, Internet, and word and data processing
  - WiFi or laptop hookups

- Adjacent shelving for divisional/departmental print materials, especially the reprints and related card catalogs

Also important to researchers is the ability to use the libraries as collegial space for getting together informally, even over lunch. Researchers do not consider the staff cafeteria or conference rooms to be a substitute. This use, however, is perhaps inconsistent with library operations at the Smithsonian. A possible compromise might be to locate dedicated meeting/conference areas adjacent to the libraries.

To the above features that users mentioned OP&A would add:

- Greater and easier access to, and retrieval of, information via electronic media and tools, such as cell phones and PDAs, and multiple screen computers that permit simultaneous viewing of different materials. Other desirable tools might be:
  - Hardware and software that runs and displays integrated media materials, which increasingly are used in electronic scientific literature
  - Sophisticated, interactive display technologies
  - Personalized, "intelligent" web portals and Recommender Systems that allow customization for individual users
  - E-book readers for browsing/searching and annotating books

- Flexibility imbedded in the design of library spaces to accommodate new technologies

Dispersed Versus Consolidated Library Spaces

Users of the libraries at NMNH and NMAH were virtually unanimous in their *very strong* desire to maintain the current proximity of divisional/departmental libraries to their divisional/departmental offices and collections/specimens. OP&A is sensitive to the value of easy access to the library collections, and it noted the relatively recent investments made in upgrading some dispersed divisional libraries such as Entomology and Botany. That said, OP&A sees benefits to some level of consolidation, which it believes offers strong trade-offs with easy access:

- *More state-of-the-art, user-friendly library space*. Many NMAH and NMNH library spaces are stuck in a permanent time warp. They are products of bygone days and are as good as they can get—finite square footage and other limitations of the museum buildings preclude upgrading them to enable application of modern, sophisticated library technologies, provide state-of-the-art user tools/services for accessing information and collections, and create high quality user-oriented work space. Upgrading current spaces is not possible from either an engineering or cost perspective. Consolidation would allow an optimal location(s) to be identified where modernization is feasible. Moreover, it would be possible to build into the design the flexibility needed to accommodate future advances in technologies and use of space. Consolidation is consistent with the increasing availability of electronic materials: to the extent that researchers can access materials from their offices, proximity becomes less important and consolidation more sensible. Electronic access will become far greater if the BHL initiative proceeds as envisioned, the NMAH trade literature collection is digitized, and the various major library book digitization projects are implemented (see also the next

section on digitization/electronic resource materials). Finally, consolidation makes sense as research becomes more interdisciplinary.

OP&A does not assume that consolidation will result in more space for shelving collections onsite. At best, capacity would remain at its current level, and a net loss of shelving capacity is more likely. The master plans seem to show a reduction in the overall floor space to be allocated to the libraries. That loss cannot be counterbalanced by greater use of compact shelving. Studies show that in the best-case scenario, compact shelving would result in the same level of capacity, because bringing the library space up to code leaves less room for shelving.

- *More efficient deployment of SIL resources.* Consolidation would allow SIL to staff all the collections full-time and allow the librarians to work more efficiently. SIL would be able to maintain better control over the collections through a daily presence and provide better maintenance of equipment such as copiers. However, consolidation by itself will likely not make it easier to track and locate library materials. This problem arises because users remove materials from the libraries without checking them out and retain them for long periods in their offices, which may be locked when librarians come looking. Consolidation will only address this problem if it is accompanied by some type of check-out and tracking system such as key cards or RFID.

- *Facilitation of interdisciplinary research.* The evidence suggests that a consolidated library facilitates interdisciplinary research. The experience of research libraries elsewhere indicates that consolidation does support this type of research while not materially affecting the productivity of those working mainly in a single discipline. Once researchers have become accustomed to the consolidated library, most accept it.

- *Consolidation is more the norm than dispersed spaces.* While some university libraries have retained a dispersed structure, largely only because of

strong opposition from researchers, the overall trend appears to be toward pulling libraries spaces together.

For the above reasons, OP&A believes there is merit to consolidation of library spaces at both museums. It cannot, however, say exactly what consolidation at NMAH and NMNH should look like. It did not receive enough information about the costs and benefits of different alternatives to support a recommendation, and development and analysis of alternatives were beyond the scope of this study. Similarly, it was not aware that any "business case" had been developed for choosing one alternative over the others. Nor was OP&A aware of analyses that might have looked at the trade-offs of allotting additional space to libraries versus other functions, which would also need to be considered in recommending a specific configuration for the libraries. Perhaps, most importantly, decisions on where staff and object/specimen collections will end up appear to be up in the air; without that information, it is hard to recommend what should happen to the library spaces.

That said, OP&A offers the following observations. With respect to NMNH, OP&A's "gut" sense is that consolidation into an expanded main library and single east and west wing sub-libraries (plus the Cullman Library) merits consideration. This alternative might strike the best balance between the expressed interests of researchers for proximity, better designed space from the perspective of both users and library operations, and modernization of space to take advantage of technologies. This approach recognizes the very large size of the NHB and the time required to move around it. OP&A wonders if "stacked" departmental/divisional libraries within each wing—perhaps on every two floors—might be another option. It would maintain a level of proximity to holdings related to departments/divisions' offices and object/specimen collections and offer greater ease of access by interdisciplinary researchers. It is also desirable to offer, within the consolidated library space, 24/7 access to those collections now in the divisional/departmental libraries.

Two observations on the current (as of June 2006) master plans for the two museums are merited:

- *NMNH.* OP&A understands that the NMNH master plan calls for consolidation of some library spaces on the first floor as part of the imminent renovation of the basement and ground floor. The plan is vague on what will happen with the other library spaces (and the MSC library collections related to the molecular biology laboratory, which occupy an estimated 500 LF of shelving). OP&A is concerned that NMNH is moving forward with changes to two divisional libraries absent an overall master plan for library spaces in NMNH. Once an overall plan is available, will this initial reconfiguration prove optimal?

- *NMAH.* The NMAH master plan calls for a consolidated library, exclusive of Dibner, centrally located on the 5th floor. This approach seems reasonable. The research staff and collections remaining in the building will be located on the 4th and 5th floors, and the NMAH building, which is considerably smaller than the NHB, is easier to traverse. Consolidation could enable better control over the collections—which is currently a serious problem—if effective security measures are also in place: reliable mechanisms for tracking and accounting for materials that are checked out and a controlled access system to the stacks, such as a key card system. The option of constructing an attached building in the east parking lot for collections of both objects and libraries looks interesting on its surface, but the paucity of details and great uncertainty over funding make even a tentative observation unwise.

Consolidation of the libraries and renovation of the office spaces at NMAH and NMNH raise some additional unknowns that merit further consideration. There is a possibility that the researchers' offices will become smaller as a result of the renovation. At NMAH, will that contribute to decreased retention of library materials in curators' offices? Or will consolidation lead them to other "solutions" that enable them to have print materials close at hand? For example, might they use the meeting spaces adjoining the offices to house either library materials or print collections that the divisions develop

on their own? If offices at NMNH are smaller, what will be the impact on the extensive personal library collections housed in current offices?

A number of interviewees stated that consolidation could result in lower productivity and perhaps quality of work. OP&A does not agree. Based on evidence from other museum research libraries that have consolidated, and given the overall ethic of excellence in research at the Smithsonian, OP&A believes that researchers will do whatever is necessary to access needed materials. OP&A does see the potential for diminished/less timely response to outside inquiries if it takes more time to access materials required to answer them.

The Composition of NMAH and NMNH Library Collections 20 Years out and the Space Implications

OP&A believes that the NMAH and NMNH library collections will continue to consist of a mix of print and electronic materials. The NMNH library is likely to offer more electronic materials, particularly journals and current publications, and that might mean some slight reduction in the need for shelving, particularly within NHB. However, it will also continue to acquire new print materials and maintain existing ones. Most probably, print materials will continue to predominate at the NMAH library, but the availability of electronic materials will likely grow faster than at present.

OP&A believes that the use of electronic materials will expand significantly at NMAH and NMNH. Although OP&A heard strong reservations about electronic materials from many interviewees, most were in fact making extensive use of the Internet to search for and locate materials and were downloading them. Many were developing their own "electronic libraries" of materials on their computers. At the same time, they still worked off of hard copies of electronic materials, and that pattern should continue.

For users to fully embrace and use electronic materials to the extent that print materials could be housed offsite or at a collaborative repository, those materials must be of superior quality, meaning:

- A *very low* error rate
- Very high resolution, particularly of images, and true colors (although variability in color seems to have more to do with the user's monitor than with the digitized original)
- A complete scan of every part of the printed item, e.g., including the inside cover and annotations by previous readers
- A complete scan of different versions/editions of the same item
- Full text searchability
- Ease of access electronically
- Assurance the electronic materials can and will be preserved over the long term.

It is impossible to predict at this point how many of the NMAH and NMNH library holdings will be digitized in the next 20 years either by SIL or other libraries/ organizations with duplicate holdings. In the case of NMAH, only a small percentage of holdings are likely to be targeted for digitization by SIL, such as the rare book collections, trade literature holdings, and old journals. Even here, OP&A did not sense that finding funds for digitization is a high priority, except for the trade literature. NMNH is likely to see digitization of a large percentage of its holdings if the BHL initiative is fully implemented.

Two important caveats relating to digitization and library space require mention.

- Digitization is not a panacea for resolving space constraints as some believe, at least not in the next 20 years. SIL, as is generally true of other libraries, is committed to preserving the digitized print originals to serve as essential back-ups to the electronic version, given the present uncertainty over long-term preservation. In addition, SIL recognizes that the print originals will always be needed by some researchers, e.g., to see the actual colors of an image, and the originals have inherent value as collection objects. Digitization does, however, raise the possibility of:
  - Moving some print materials into offsite storage, rather than having them occupy valuable space on the Mall
  - Disposing of holdings that are duplicated across libraries, if agreement were reached on a joint repository for retention of one or more original print copies. Such a facility is envisioned in the BHL initiative. But such collaborations are not yet widespread and face many obstacles. In other studies it has conducted, OP&A has sensed some resistance within the Smithsonian to entering into long-term collaborations with outside organizations.

- The BHL initiative calls for development of an expanded digitization capability, which has space implications relating to NMNH holdings specifically, but also more broadly to other Smithsonian library holdings. OP&A heard two proposals for the location of the digitization facility—within NHB or at some regional location. If the digitization facility is to be "owned" and operated by SIL (internally or through contractors), OP&A believes that its location needs to be addressed within a system-wide framework that takes into account overall Smithsonian library digitization plans and requirements and, potentially, those of Smithsonian Archives and other units. Another consideration is whether the digitization facility might best be included in an offsite shelving/storage library facility. Yet another possibility is a shared regional digitization facility, e.g., with the National Agricultural Library. In light of resource constraints and the breadth of need across the Smithsonian,

serious consideration of at least a Smithsonian-wide facility under SIL, and perhaps a regional facility, is called for. OP&A is not aware to what extent different alternatives have been developed and subjected to cost-benefit analyses. Such analyses have an important role in decision making.

Offsite Library Shelving/Storage

There is a clear need for an offsite shelving/storage facility to meet both immediate and future needs. NMAH already houses over half its materials at SISC and will definitely need additional space, not only temporarily during the initial stage of NMAH's renovation, but also permanently in order to accommodate growth in the collections and the reduction in library space under the master plan. The NMNH master plan appears to provide for virtually the same square footage as SIL now occupies. However, a shift to compact shelving and to code-compliant space could lead to less capacity for housing collections onsite, and there is the issue of collections growth. If the BHL initiative allows SIL to move digitized print materials offsite, there will be an increased need for offsite capacity. In terms of collections growth at both museums, it bears restating that both are looking at possibly significant offers of personal materials from retiring curators/scientists in the next decade.

The discussion that follows looks at an offsite facility mainly from the perspective of researchers' use of library collections. However, it needs to be borne in mind that additional perspectives have to be considered alongside those of users: collections preservation—that is, provision of the environmental conditions required to ensure the long-term protection of the collections (a critical point that this study does not address); co-location of other library functions such as digitization and conservation; and resolution of other Smithsonian storage needs, such as for archival materials, through co-location. Note also that the discussion does not address the disposition of the space that other units such as the Office of Exhibits Central occupy in SISC, as their functions do not need to be housed with SIL's. Finally, it does not address the possible housing of library collections coterminous with space occupied by staff and object/collections that

move off the Mall. These other factors should be part of the master planning of any movement of library collections off the Mall (just as there needs to be consideration of whether to move the MSC library collections relating to molecular biology to the NHB).

- *What users require of an SIL offsite shelving/storage facility.* The starting point for a SIL offsite shelving/storage facility is to support efficient, high quality research. For that to happen, users need rapid, easy access to materials. There are three ways to provide that access: use of materials at the facility itself; at least daily delivery of physical items to the NMAH or NMNH libraries; and delivery of an electronic version of print material within one or two hours of a request. All three presume a timely retrieval capability at the offsite facility. Access to a digitized format presumes a scanning/electronic delivery system.

  If the offsite facility permits use of materials onsite, it needs to:

  - Be located within a reasonable distance of Smithsonian researchers' offices, with a timely shuttle service or convenient public transportation. OP&A considers a one-way travel time much over 30 minutes to be excessive, and even that short a time still constitutes a major chunk of an eight-hour work day.
  - Provide dedicated, appropriate work space, meaning:
    * Adequate tables/desks and seating in terms of capacity and comfort
    * Access to the stacks or rapid retrieval of desired materials (e.g., within an hour of a request onsite and through an advance request system). Because of the high value users place on browsing the shelves, this feature is desirable, but would not be feasible in a high density facility. It is also likely that technology will be developed that affords electronic "real-time" browsing, and the timeframe for such a capability becoming available should be part of the selection of the optimal type of offsite facility, looking 20 years out.

* Good lighting
* Laptop hookups and/or WiFi
* Computer stations providing access to the library's electronic catalog, Internet, and data/word processing
* Copiers, including color and scan/email
* Microfiche/film readers
* Staffed information/service desk

If the offsite facility does not permit use of materials on the premises, it needs to ensure:

- Delivery of materials at least by the next business day following the request
- Rapid electronic delivery (e.g., within 1-2 hours of request) of materials that do not exceed a certain number of pages/file size. This service requires a staffed scanning and copying station.

➢ *Tradeoffs in designing an offsite library shelving/storage facility.* The offsite facilities that OP&A covered in its study are wide-ranging in terms of quality. At the low end is SISC, which offers minimally suitable environmental conditions and shelving, and very basic work spaces and work environment. At the high end is the new, highly automated facility being constructed by The British Library (see the findings). Its automation would be eclipsed by the CAPM project, were it to come to fruition.

A number of trade-offs arise in selecting an approach to offsite shelving/storage for library collections. The primary ones are noted below.

- A location that, although more expensive, provides a reasonable travel time and easy user access versus a more remote and less costly site that would not provide onsite use of materials but would offer rapid delivery of physical and electronic materials

- A new design-built facility with higher short-term costs for construction, possible negative political costs, and more complicated financing, but lower term operational costs and far higher functionality, versus a retrofitted leased building with lower short-term costs, easier financing, and greater political acceptability but higher long-term costs in the form of rent and operations and a significant loss in functionality (as well as the opportunity costs that those factors represent).
- The ease and speed of leasing and renovating an existing building versus the more time-consuming and complex construction of a new building.
- Investment in a high-end facility with room for growth decades out, flexibility to adapt to new needs and technologies, and an optimal storage environment versus a leased, renovated building that solves immediate space needs but meets only the minimum requirements for environmental control and collections growth, and offers minimal flexibility to adapt to changing circumstances.
- Development of a Smithsonian-only facility that uses just Smithsonian funding but offers total control versus entering into a partnership that brings in outside funding but requires sharing the facility.

The Smithsonian has often chosen the approach of leasing and retrofitting existing buildings to address immediate space needs. Its experience with leased facilities has not been entirely satisfactory from the perspective of functionality and cost. Too often the facility has not, even with renovation, been able to serve its intended purpose effectively, and the life-cycle costs have not measured up well against investment in a new building. Current and likely future utility expenses make leasing an even costlier solution, given the energy efficiencies possible with new construction. Leased space, because it is developed hastily to meet immediate needs, typically offers no flexibility to address future needs or changing conditions.

OP&A believes there is a strong business case for investing in a new design-built offsite shelving/storage facility for library collections. Ideally, it would be a high density, environmentally controlled facility of modular design to permit expansion and would offer the user services discussed above. Most major libraries, both public and university, have constructed offsite facilities at the high end of quality, with modular designs that permit expansion decades out. Some are jointly owned and operated by several libraries; others are owned by a single library but offer rental space.

The Smithsonian could anticipate a number of advantages from construction of a high-density offsite shelving/storage facility:

- Location on less expensive land outside the immediate DC area
- High functionality and cost-savings possible with a new design-built facility that offers state-of-the-art environmental controls to maximize preservation and minimize conservation needs; energy efficiency; use of robotics to reduce labor requirements; and maximization of shelving capacity per square foot of the building
- Low construction costs
- Rapid construction time—high density facilities can be built in 1-2 years
- Flexibility to expand to accommodate growth and new technologies
- Other savings, such as reduced need for journal binding because of the controlled environmental conditions

OP&A also believes there are good opportunities now for a collaborative venture, for example, with other government agencies and/or local universities, that would allow the Smithsonian to leverage its scarce resources, and this makes the option of new construction particularly attractive. OP&A did not get a sense that OFEO has yet

engaged in systematic development of alternative scenarios for offsite library shelving/storage and trade-off analyses, although it understands that such an effort is being staffed and will get underway soon. OP&A urges that investment in a high-end facility not be rejected out of hand, simply because it involves new construction.

Consortial Arrangements

Space constraints, costs, and the competition of libraries—which are part of the unseen research infrastructure—with other more visible functions are increasing the viability of consortia as a cost-effective means of meeting space needs. SIL has been at the forefront in a number of areas and has been playing a leadership role in the Research Libraries Group and other such organizations and in initiatives such as the BHL (in conjunction with NMNH). SIL has a strong track record with collaborations. OP&A believes that SIL and OFEO should explore all opportunities for consortial arrangements, particularly, in the near term, a high-end offsite shelving/storage facility for print materials, as discussed above, and joint repositories for print materials that would permit disposal of duplicate materials across libraries.

Two Other Space-related Considerations

Two other points with library space implications emerged from the study that merit consideration.

- *Co-location of IT services and libraries*. Electronic access and retrieval through a variety of means are the future of information use and will become increasingly sophisticated. Beyond close collaboration in the planning stages, some libraries are planning to co-locate IT services in the library to provide better and faster service to patrons. The Smithsonian might look into this possibility.

- *Continued adaptation to new technologies for retrieving and working with information.* Because of the rate at which the technology of information access, retrieval, and manipulation is progressing, SIL and OFEO will need to update the library master plan regularly, based on a scan of how users conduct research with published material and databases and what is the latest in technology. This also argues for library design with built-in flexibility to accommodate new technologies and ways of using space.

Systematic and Coordinated Master Planning of Smithsonian Library Spaces

SIL embodies a network of branch libraries that serve the various museums and research units and museum management generally, along with the administrative functions and support services, such as acquisitions and cataloging, intra- and inter-library lending, a conservation laboratory, and a digitization center. Some aspects of SIL's operations are distinct to particular research units/museums, such as the composition of the collections. Others, however, cut across all libraries, such as the need for offsite shelving/storage and access to a digitization service.

OP&A acknowledges the importance of rapid development of long-term master plans for NMAH and NMNH. It understands the immediacy of the need to focus on planning for the libraries at NMAH and NMNH because renovation of the buildings is imminent. At the same time, it is greatly concerned that this sense of immediacy will lead the Smithsonian to lose sight of the fact that the NMAH and NMNH libraries are part of the larger Smithsonian libraries system, of the larger Institution as a whole, and of the research library community outside the Smithsonian. In focusing narrowly on immediate needs, decision makers may ignore potential opportunities for long-term economies of scale, leveraging of resources, and effective operation of the entire library system. Similarly, the need to move quickly to replace SISC could result in a failure to consider

the full range of alternatives that might yield important benefits to users and cost savings to the Institution over the long term.

In short, the Smithsonian will be better served by taking a long-term and broad-based view of how the libraries can best serve the Institution. Planning for NMAH and NMNH library space, and for a replacement facility for SISC, needs to be carried out within the bigger context of the entire Smithsonian library system, the Institution as a whole, and the regional and global library communities. For example, options for replacing the library component of SISC are best studied not just in terms of the needs of NMAH and NMNH, but rather in the context of broader SIL offsite storage needs, and even of other comparable Smithsonian storage needs, such as those of Smithsonian Institution Archives and the Archives of American Art. There may be other functions that could appropriately share offsite space for shelving/storing library collections. OP&A believes there may be opportunities for entering into collaborative regional arrangements with other organizations facing similar shelving/storage needs, such as Johns Hopkins and Maryland Universities and the National Agricultural Library. In a persistent environment of scarce resources, the Smithsonian cannot afford to overlook opportunities that allow it to leverage its resources through collaboration. The fragmented approach to library space planning seen to date is not, in OP&A's opinion, likely to produce modern library spaces able fully to meet the current and future needs of researchers and take advantage of evolving technologies in either the short or long term.

Along with systematic and coordinated master planning, OP&A believes there is a need to strengthen communication among the key players—SIL, museum managers, and OFEO project executives/managers—who need to be involved in master planning of the NMAH and NMNH library spaces and offsite shelving/storage. Not uncommonly, OP&A came away from interviews with information that other key players were not aware of or to hear that a key player had become aware of a change in the master plan through casual conversations with people outside the process. Effective master planning of library spaces requires that all three parties to the effort be in regular communication and have access to the same information.

PART C.
RECOMMENDATIONS

RECOMMENDATIONS

- Develop a clear baseline for library use and space needs 20 years out at NMAH and NMNH as the starting point for planning. The baseline should include the balance between research and public programming and other museum functions at NMAH and NMNH; future directions for those functions; library holdings needed to support those functions; the current and likely future state of library technology; and modern technologies that affect the retrieval of information, digital content, and pedagogical concepts.

- Conduct systematic studies of the costs and benefits of alternative library consolidation schemes at NMNH, e.g., a single consolidated library and a central branch and a sub-branch in the east and west wings, related to departments located in each. (The OP&A study team assumes the Cullman Library will remain as is.)

- Design libraries that provide:
  - 24/7 access to circulating materials to permit browsing and accommodate irregular work hours, with limited seating and shelves on which to rest materials being reviewed
  - Space for displaying new acquisitions, with nearby seating
  - An adequate number of copiers, including color and scan/email
  - Infrastructure to support both library and personal computers, including WiFi
  - Adjacent shelving for divisional print materials
  - Flexibility in design to accommodate new technologies and different patterns of use

- Strengthen communication among the key players—SIL, museum management, and OFEO project executives/managers—who need to be involved in master planning the NMAH and NMNH library spaces and an offsite shelving/storage facility.

- Assuming a permanent, long-term need for offsite shelving at NMNH and NMAH (and at other Smithsonian libraries).
    - Develop a system-wide plan that addresses the off-site shelving needs of libraries throughout the Smithsonian to take advantage of opportunities to leverage costs and enhance the efficiency of retrieval and shelving. The plan should also address the potential to incorporate other functions that have similar facility needs, such as archives, and that multiple libraries use regularly, such as digitization and conservation units.
    - Ensure that the solution to offsite shelving provides users with rapid, easy access to materials, including electronically, and develop a performance standard against with to plan for and measure user access.
    - Conduct systematic feasibility studies of alternative ways to provide offsite shelving. The studies should include life-cycle costs and user requirements, and address at least the following offsite shelving options: construction of a new, high density, environmentally controlled facility, a shared new or existing facility with one or more other organizations, renovation of an existing building, and leasing of existing building or facility that is built to order.

- Prepare a master plan for all of the Smithsonian libraries that addresses them as an entire system and explores in detail the potential opportunities for long-term economies of scale, leveraging of resources, and effective operation of the entire library system, and that looks at the needs that other collections, such as archival, film, and photography, have in common with library collections. Master planning should include:

- A study of the use of all Smithsonian library spaces (the study of the library spaces at NMAH, NMNH, and 1111 North Capitol Street has been completed, and a study of the art libraries is underway); and
- An assessment of possible collaborative arrangements that might improve the efficiency and reduce the space requirements of libraries, such as shared digitization facilities and conservation laboratories, collaborative acquisitions, joint library repositories, and off-site shelving (see below). The assessment would include potential relationships within the Smithsonian, including SERC, STRI and SAO, and the regional and global library communities, both public and private.

➢ Ensure that each library is fully integrated into the master planning for its museum, research center, or other unit that it serves.

APPENDIX A.
ORGANIZATIONS CONTACTED FOR THE STUDY

Smithsonian Institution

National Museum of American History
National Museum of Natural History
Office of Facilities Engineering and Operations
Smithsonian Institution Archives
Smithsonian Institution Libraries
Smithsonian Institution Service Center

External Organizations

American University, Department of Anthropology
Association for Research Libraries (ARL)
The British Library
Carnegie Mellon University
Center for Research Libraries
Coalition for Networked Information (CNI)
George Washington University Department of Anthropology
J. Paul Getty Museum
Google
Harvard Museum of Comparative Zoology Ernst Mayr Library
Institute of Museum and Library Services
Johns Hopkins University Milton S. Eisenhower Library
Library of Congress, Digital Initiatives
Mellon Institute
National Agricultural Library
Natural History Museum (London) Library
Online Computer Library Center (OCLC), Digital Archives
San Diego Natural History Museum Library
University of Maryland
University of Michigan

APPENDIX B.
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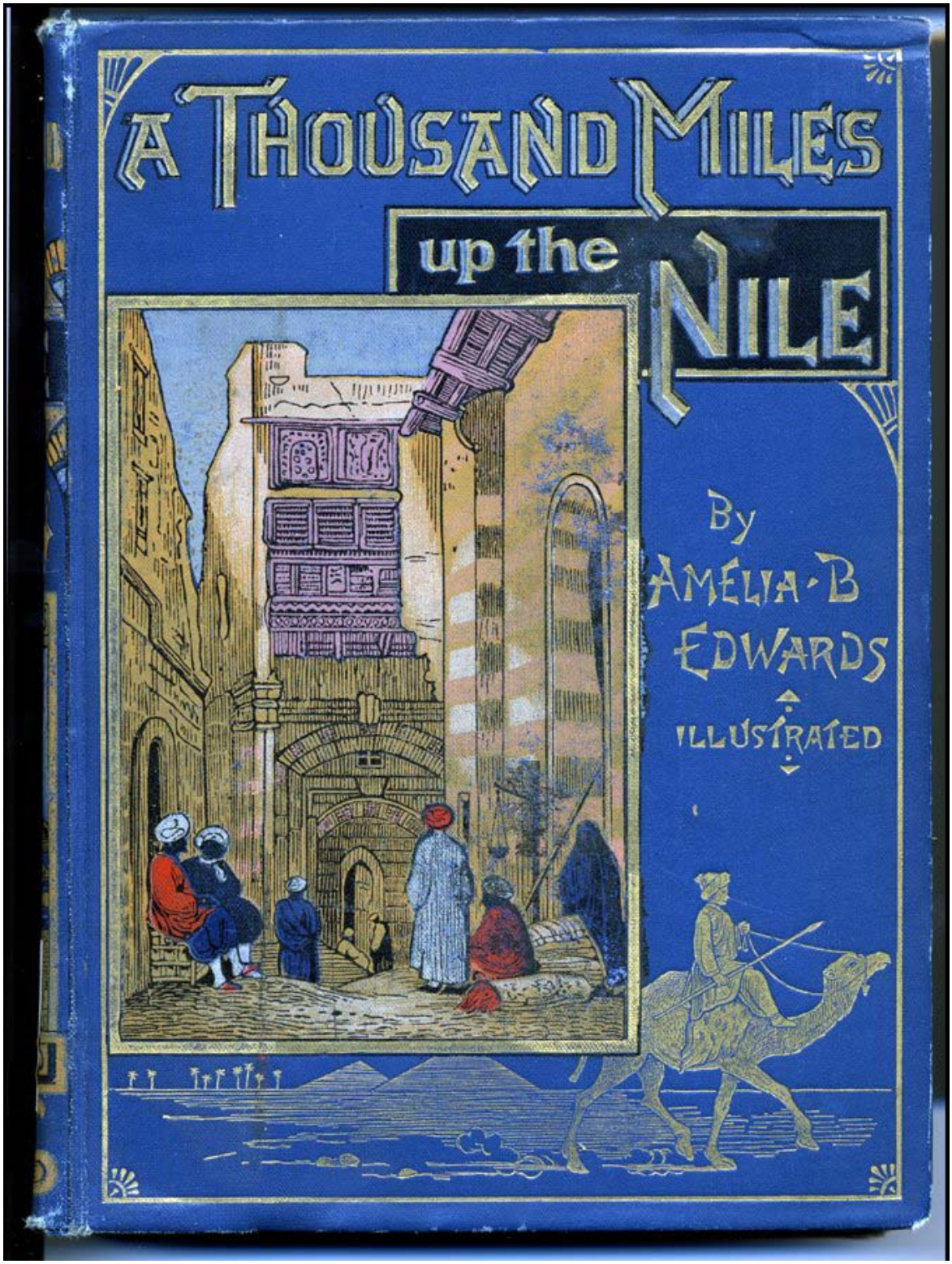
A THOUSAND MILES
up the NILE
By
AMELIA·B
EDWARDS
ILLUSTRATED

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