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Handling the "Curation Crisis:" Database Management for Archaeological Collections

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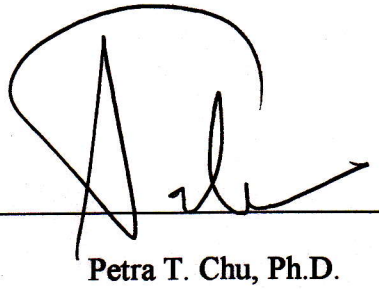
Approved by: 

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Abstract

Archaeological collecting practices have created a predicament for museums and archaeological repositories that today is commonly referred to as the "curation crisis." As new excavations continue to be organized each year, accumulated collections find themselves haphazardly stored in museums with few plans for their long-term management, care and preservation. While the existence of a "curation crisis" has been widely accepted in the United States since the 1970s, there is little agreement as to a solution that can be accomplished in a practical, affordable, and effective manner. As a consequence, it may take a long time for the crisis to be resolved.

Focusing on American museums and archaeological repositories, this thesis will demonstrate that a well-developed collections management system provides one potential avenue to resolve the crisis by allowing museums to become better stewards and caretakers of their collections and by enabling them to advocate more cogently for their care and preservation. In the course of exploring its hypothesis, the thesis will offer suggestions as to how institutions managing archaeological collections can maximize the potential of specific collections management systems.

Introduction

Archaeological collecting practices have created a predicament for museums and archaeological repositories that is now commonly referred to as the "curation crisis." As new archaeological excavations continue to be organized each year, accumulated collections find themselves haphazardly stored in museums with few plans for their long-term management, care, and preservation. Until archaeologists and museum professionals can come together to determine a long-term strategy for the proper management and care of these collections, researchers, educators, and the general public will remain unable to reap the benefits of their cultural and historical significance.

While most archaeologists and museum professionals agree that there is a crisis when it comes to the long-term management of archaeological materials, there is little agreement as to a solution that can be accomplished in a practical, affordable, and effective manner. The main responsibility lies with archaeologists, who are largely accountable for planning the long-term curation of excavated materials. But because so many materials now reside in museums and other repositories, the solution must extend beyond one discipline alone and needs a dialogue between archaeologists and museum professionals.

A solution to the "curation crisis" may reside in the realm of data management technology. Well-designed collections management systems may serve as a way for archaeologists and museums to come together and resolve the crisis in an efficient, financially responsible, and practical manner. Specifically, a well-designed and highly functional collections database management program will provide a tool to get a handle on archaeological collections. Such a program can provide a starting point from which research can be conducted and the educational experience of researchers and visitors can be improved. At this point in time, discussions pertaining to the "curation crisis" have not dealt specifically with this potential solution.

Focusing on American museums and archaeological repositories, this paper will explore the hypothesis that a form of database management more specifically tailored to archaeological collections will allow these institutions to become better stewards and caretakers of their collections, which, in turn will allow audiences to benefit from them. In exploring these issues, this paper will offer suggestions as to how institutions managing archaeological collections can maximize the potential of a collections management system so that they can be managed, used, and interpreted to their full potential.

Section I will provide a historical overview of archaeological collecting practices since the nineteenth century. These practices have largely influenced the position in which museums and archaeological repositories find themselves today. Section II will discuss the "curation crisis," which became widely recognized in the 1970s. It will address how this crisis manifested itself and will explain the ways in which it currently impacts collections management in museums. Section III will introduce the concept of collections management systems, suggesting that they may provide a highly useful avenue for museums to pursue as they attempt to grapple with unprocessed, poorly documented, or inaccessible archaeological collections. It will cover the current usages and benefits of collections databases used to manage archaeological collections, particularly in museums.

Section IV will discuss several of the standard collections databases used by museums today, often used as a result of limited funding, and how a collections manager might be able to maximize the potential of the database in managing and interpreting archaeological material. Section V will address the ways in which a properly managed collections management system might alleviate some of the storage problems associated with the large quantities of unprocessed archaeological material. A concluding section will attempt to summarize the information presented in previous sections, discussing some of the difficulties and issues surrounding databases used in an attempt to alleviate the "curation crisis."

Section I: Archaeological Collecting Practices: An Historical Framework

Over the past century, archaeologists have excavated and amassed vast quantities of both tangible artifacts and informational data, but the manner in which they have done so has changed over time. The history of archaeological collecting practices in the past century is complex; to tell it in detail would fill several volumes. Yet a broad understanding of past collecting practices, as well as the laws and social phenomena that shaped them, allow us to understand their impact on museums, particularly with regards to collections management and curation. Once we understand the causes of the current issues in archaeological collections management, we can find the solutions that may help to alleviate them.

The histories of museums and of the discipline of archaeology have long run parallel. In the nineteenth century, several leading museums throughout the United States, especially of natural history, organized and partook in methodical collecting expeditions. These include the American Museum of Natural History in New York, the Peabody Museum of Archaeology and Ethnology at Harvard, the Museum of the American Indian or Heye Foundation in New York, and the Smithsonian Institution (Swain 2007, 29). Museums employed professional archaeologists to do fieldwork. In the course of the century, these archaeologists increasingly conducted systematic, recorded excavations (ibid, 27). They also employed highly professionalized staff members to curate these collections (Sullivan and Childs 2003, 7).

In the U.S., during the early twentieth century, archaeologists became increasingly interested in understanding and explaining the origins of Native Americans in North America, and viewed archaeological research as a means to understand these origins (Swain 2007, 31). The Bureau of American Ethnology (BAE) of the Smithsonian Institution took the lead in the search for Native American origins through an active program of archaeological fieldwork (Sullivan and Childs 2003, 8).

While the late nineteenth century saw the introduction of systematic, recorded excavations, in the early twentieth century the federal government began to write legislation intended to protect archaeological sites and the objects found in them (Swain 2007, 29). For instance, the Antiquities Act of 1906 stated:

> That the examinations, excavations, and gatherings are undertaken for the benefit of reputable museums, universities, colleges, or other recognized scientific or educational institutions, with a view to increasing the knowledge of such objects, and that the gatherings shall be made for permanent preservation in public museums (16 U.S.C. 431-443, Section 3).

The upshot of the law was that, unless arrangements could be made for the proper care and management of the objects to be excavated, a permit for fieldwork would not be granted (Sullivan and Childs 2003, 9). Using highly generalized terms, laws like the Antiquities Act provided for the preservation of excavated materials, but expressed little specific instruction as to how excavated materials should be properly processed, managed, and curated on a long-term basis.

By the early twentieth century, museums in the United States moved away from research including archaeological excavations and expeditions, towards an emphasis on public education and service (ibid, 7). As museums shifted their attention to public education, universities became the primary institutions involved in archaeological research (ibid, 9). From the 1920s onwards, museums were no longer focusing on curating archaeological collections. Instead, anthropology and archaeology departments at universities became responsible for both conducting archaeological fieldwork and curating the collections they excavated. Over the course of the twentieth century, these trends caused archaeological fieldwork and museum curation to increasingly diverge.

As the division between museums and archaeological fieldwork was firmly established in the early twentieth century, public works projects of the 1930s and 1940s drastically impacted

archaeological excavation and curation. In response to the Great Depression, the federal government began to implement excavation projects in an attempt to provide work for the unemployed, during which workers amassed large quantities of archaeological material. As Sullivan and Childs explain, "a few of these projects actually spawned museums and filled them with large collections, but long-term curation was not part of the New-Deal era programs" (2003, 11). The National Museum of Natural History played a large role in these excavation projects, particularly through its participation in the River Basin Surveys (RBS) program. During this program, the National Museum of Natural History worked in conjunction with the Smithsonian, National Park Service, Army Corps of Engineers, and Bureau of Reclamation, visiting over 275 reservoirs and excavating material from over 500 sites (Krakker, Rosenthal, and Hull-Walski 1999, 10). Through these River Basin Surveys, the museum collected an incredible three-quarter of a million artifacts (ibid).

Although these projects often provided funds for the initial laboratory processing and analysis, most budgetary plans failed to consider the long-term curation of these collections. The Chickamauga Basin project in Tennessee amassed such a large quantity of material that the University of Tennessee constructed the McClung Museum two decades after the end of the project to serve as a repository for these collections (ibid, 15-16). As Anne Woosley explains, "Though repositories represent a much needed attempt to conserve archaeological collections, interestingly, most came about after projects were completed and the truly critical state of archaeological curation needs was recognized" (1992, 150). Often, solutions intended to properly house and manage archaeological materials were not created until well after the excavation of a site.

After World War II, the United States experienced a drastic increase in construction and development. As a result, many archaeological sites were threatened. In response, archaeologists made attempts to pass federal legislation to prevent their demise. The movement to salvage and document whatever was possible from these "doomed" archaeological sites is often referred to as "rescue archaeology" or "salvage archaeology." New cultural resource management (CRM) institutions, specializing in "salvage archaeology" sprang up across the country (Swain 2007, 32), and the federal government passed several laws, particularly in the 1960s, to protect historic and archaeological sites. The National History Preservation Act of 1966, for instance, required federal agencies to look into the potential impact of construction projects on archaeological sites and historic properties (Sullivan and Childs 2003, 18). While these laws aimed to protect archaeological sites, they did not provide any specific instruction regarding the long-term curation and protection of excavated materials. As Lynne Sullivan and S. Terry Childs explain, "Site salvage was the battle cry of the day; [but] no one had time to think about what was to happen to the materials once they were saved from the bulldozers" (2003, 18).

Along with an increase of archaeological fieldwork aimed at salvaging sites came a new interest in archaeological artifacts, beginning in the 1970s. Sharon Macdonald suggests that, during this time period, "Collecting was a means of bringing together and reveling in the newly discovered, and also of trying to make some sense of it" (2011, 84). Archaeologists became increasingly interested in the ways in which artifacts could be interpreted to better understand culture. With this new interest came an escalation in the type of artifacts that were collected. Anne Woosley explains how "by the mid-1970s literally everything was saved: entire ceramic and lithic assemblages, all manner of complete and fragmentary bone, and any number of organic and inorganic samples" (1992, 149). Archaeologists also incorporated screening at

archaeological sites as a standard procedure, in which they sifted excavated soil and sediment to collect smaller samples that may not have otherwise been found during the excavation (ibid). While the expanded interest in archaeological material meant that more physical materials were excavated, it also meant that new forms of documentation were required to properly record these excavated materials, including soil maps, climate maps, aerial photographs, unit and feature forms, and special sample forms (ibid). The 1970s was, therefore, a decade during which archaeological materials became once again valued for their research potential. However, it also represented a time of new data sets and documentation that needed to be managed, curated, and conserved. Although it is difficult to quantify the number of objects that entered different types of repositories, much of this newly excavated material found its way into museum collections.

Trends in archaeological practice, particularly the extensive New-Deal era "salvage archaeology" of the post-war era, meant that archaeologists excavated massive quantities of material over the course of the first half of the twentieth century. New ideas emerging in the 1970s in archaeological theory emphasized the importance of gathering more diverse artifacts and compiling diverse archaeological data sets and documentation, much of which entered museum collections. However, these increasingly exhaustive collecting practices did not include long-term collections management and curation strategies. Unfortunately, it was not until the 1970s that archaeologists began to realize that the result of these collecting practices created a large practical and ethical crisis.

Section II: The "Curation Crisis"

The history of archaeological collecting practices has raised a variety of practical and ethical issues that impact not only the discipline of archaeology but also the museums that hold archaeological objects. Many of these issues came to the surface in the 1970s when archaeologists began to reflect on the consequences of earlier and current archaeological collecting practices. As Mark Miller neatly summarizes, "Archaeologists have been excavating prehistoric and historic sites for much longer than we have been focusing on the need for long-term curation" (1999, 6). In general terms, this crisis means that accumulated archaeological collections find themselves haphazardly stored in museums with little plan for their long-term management, care, and preservation. S. Terry Childs, writing about federal archaeological repositories, most poignantly and disturbingly describes this issue as it affects federal repositories:

> Decay threatens to cave in the canyon of cardboard boxes, water-soaked and crumpling from the weight of their contents. Here and there artifacts poke through or spill from bags with labels long gone or blurred beyond legibility. Mice droppings litter the floor; the stench is thick. Clearly this is a forgotten corner of the universe. Welcome to a federal curation facility (1995, 11).

A 1987 GAO report titled "Cultural Resources: Problems Protecting and Preserving Federal Archeological Resources," based on data gathered from 37 respondents from both federal and nonfederal agencies through surveys and questionnaires, highlights the depth of this crisis in detail. According the report, the National Park Service, at the time, had a cataloging backlog of 22.6 million objects (GAO Report, 74). Over fifteen million of these objects were archaeological, and it would have required $19.7 million to catalog them in the National Catalog of Museum Objects (ibid). In 1987 alone, the National Park Service spent $1.1 million to catalog museum objects (ibid). Based on this level of funding, it would take thirty years to completely remedy this backlog, assuming, of course, that the collections do not grow (ibid). The report also

indicates that 24 out of the 37 questionnaire respondents did not have a complete inventory of their collections (ibid, 85). In addition to cataloging issues, the report indicated that storage was also a major concern. Thirty percent of questionnaire respondents had reached their storage capacity at the time of the survey (ibid, 88). These statistics highlight the grim reality facing federal repositories housing archaeological material, and most likely pertain to museums as well. If the problems seemed insurmountable in the 1980s, one can only imagine the situation today, as collecting by the National Park Service, museums, and other archaeological repositories has steadily continued.

This curation crisis raises a host of ethical issues pertaining to both archaeology and museum work. Primarily, it raises the issue of responsible archaeological research. Because the original context of an archaeological site can never be recreated, the proper recording of all excavated artifacts is extremely important. Childs appropriately suggests that "The reality is, once a site is excavated, these materials are often the only remaining evidence of a past culture" (1995, 12). As a result, to not properly manage an archaeological collection is to run the risk of completely destroying this original context, and consequently, to lose significant information about the people who once lived at that site. As Arlen Chase et al summarize, "to put it simply, archaeologists do not and should not dig unless they can expect to fully record and then publish their findings" (2006, 21). It is unethical for archaeologist to excavate material without first considering how it is to be curated on a long-term basis.

The improper management of a collection prevents archaeologists from properly researching it. Furthermore, a lack of proper collections management means that these materials cannot be made accessible to the general public and researchers. While these materials are typically not worthy of exhibition, their research potential is what largely makes it significant to

make them available to researches in particular. In turn, these researchers may discover new information that the general public may greatly enjoy and benefit from. In this sense, a museum that fails to properly manage an archaeological collection also fails in its mission to educate and cater to the general public it is supposed to serve.

Today most archaeologists agree that there is a curation crisis and many eagerly wish to address it. Michael Trimble and Eugene Marino describe how, since 1976, discussions have taken place at professional archaeological meetings on the need to address this issue. At these meetings, "Though topics may vary, each time archaeological curation is discussed a common theme quickly surfaces: something should be done and done quickly to address the long-term care of archaeological collections" (Trimble and Marino 2003, 100). The crisis is no longer contestable, but the manner in which it should be resolved has yet to be fully determined.

Through understanding the historical framework of archaeological collecting practices through the 1960s, it becomes clearer how this crisis came to fruition. Though few museums in the 20th century still conduct excavations, they continue to receive objects as archaeologists, working in the context of universities or CRM firms, continue to view museums as safe repositories for excavated collections. Alex Barker explains that "archaeology has long implicated museums in a kind of 'mañana mentality,' a sense that, because museums held their collections for posterity, curated collections were already safe, freeing the discipline to focus on fieldwork and research generating new collections" (2003, 80). As a result, once archaeologists have safely deposited an excavated collection in a museum, they often became eager to move on to other excavation projects, all the while holding on to the idea that they will return to research the deposited collection at a later time (ibid). This type of mentality prevents the alleviation of this issue, even in the present day.

Barbara Voss, in an article in *Archaeological Dialogues*, also raises the issue of "orphaned collections," which are created "by museum closure or cutbacks; by the retirement of faculty, agency staff or independent researchers; by abandonment by private collectors; and, increasingly, through salvage and compliance-oriented excavations with inadequate curation provisions" (2012, 147). These abandoned collections often contain artifacts that have been separated from excavation records and other significant contextual documentation (ibid, 146). Orphaned collections are particularly daunting to both researchers and collections managers, as background research must be conducted on the objects before they can even be accessioned, let alone processed, properly recorded, and researched (ibid).

Federal law has attempted to alleviate this crisis, at least in as far as federally owned collections are concerned. On September 12, 1990, the federal government created a piece of legislation titled "Curation of Federally Owned and Administered Archaeological Collections," or 36 CFR Part 79. This regulation provides an outline of the procedures and guidelines that should be followed regarding long-term collections management and preservation (Section 79.1). Furthermore, it also provides guidelines for adequate curation in terms of a collections storage facility. The legislation promotes fire suppression systems, emergency planning, environmental controls, security systems, secure building construction, handicap accessibility, and routine inspection to ensure the proper maintenance of the storage facility (Section 79.9). The law also addresses issues of collections use and research (Section 79.10), and the importance of inspections and inventories (Section 79.11). While the law provides clear guidelines and regulations, it also encourages collaboration and communication. Lynne Sullivan suggests that "These regulations […] bring the involved parties – field archaeologists, regulatory agencies, and repositories – together to make curation arrangements" (2001, 94). It encourages all scholars and

professionals involved in these collections to come together and determine how to accomplish these standards.

While 36 CFR Part 79 seems to provide a strong collections management framework, it is not widely upheld. A survey conducted by Bobbie Ferguson and Myra Giesen, nine years after the implementation of 36 CFR Part 79, allowed them to draw several conclusions:

> (1) Most agencies do not appear to have formal policies governing curation; (2) many agencies do not have a grasp of where their collections are housed, do not report all locations, or do not view collections as their responsibility; (3) units used in reporting collection size are not comparable among sources; (4) when reporting is done, it is often inaccurate or inconsistent; and (5) there is no real source of current information on government-wide accountability for collections (1999, 23).

As a result of these conclusions, Ferguson and Giesen provide several recommendations to encourage federal agencies to manage archaeological collections in a uniform, consistent manner, as well as to encourage accountability. Primarily, they urge federal agencies to develop policies in compliance with 36 CFR Part 79, as well plans to implement these policies (Ferguson and Giesen 1999, 26). Secondly, they suggest that agencies conduct a full and complete inventory of their holdings as a means to increase their accountability (ibid). Thirdly, agencies that have deposited collections in a separate repository or facility should work in consultation with this repository to bring these collections up to standard in compliance with 36 CFR Part 79. They also suggest that federal agencies "should work to establish agree upon units for reporting collection information," particularly in the form of uniform and consistent collections databases (ibid).

Although 36 CFR Part 79 laid the foundation for curatorial standards in managing archaeological collections on the federal level, it does not address problems in non-federal repositories, including museums. S. Terry Childs provides extensive commentary on this issue:

> The current crisis in archeological curation can only be downgraded to a 'problem' and then redirected to a 'fix' through concerted efforts in a number of areas. A grants program for non-federal repositories, in concert with increased training in curation for archeologists, full accountability of federal collections, good access to collections for the public, and new construction or renovation of facilities for long-term collections care, are vital to a successful outcome. Progress has been made. The momentum must be sustained (1995, 15).

Childs points to the multi-faceted aspects of the curation crisis and emphasizes the importance of funding, professional training, accountability, accessibility, and long-term care and preservation to address them. Trimble and Marino, in an article entitled "Archaeological Curation: An Ethical Imperative for the Twenty-First Century," recommend that archaeologists consider curation from two perspectives: curation planning before fieldwork even begins and long-term management of the collections (2003, 102-103). For curation planning, archaeologists should at minimum consider how artifacts will be labeled, how they will be housed for storage, how documentation will be maintained, what types of conservation may be required, and what policies and procedures are to be written (ibid, 104-106). For long-term management, they first advocate the importance of assessing the building, repository, or storage facility (ibid, 103-104). They also stress the importance of an infrastructure assessment, including an evaluation of the museum's business plan and administrative capabilities (ibid, 107).

In general, cooperation and collaboration between archaeologists and museum professionals, particularly curators and collections managers, is a first way to solve the curation crisis. Hedley Swain explains that "one of the challenges of museum archaeology in the twenty-first century is to build an equitable relationship between the two worlds of archaeology and museums, and between the worlds of museum archaeology and the public" (2007, 12). Until archaeologists and museum professionals can come together to determine a long-term strategy for the proper management and care of archaeological collections, researchers, educators,

scholars, and the general public will remain unable to reap the benefits of their cultural and historical impact.

Of course, there are a variety of issues that need to be addressed if this crisis is to be resolved, or at the very least, prevented from worsening. One is the matter of education and training. Barbara Slivac explains that "the problems of people who deal with feather headdresses and boxes of pottery sherds are different from those of people who deal with folios of botanical specimens or paintings of oil on canvas" (1988, 15). Thus, museum professionals who manage anthropological and archaeological collections must receive a specific form of training that includes knowledge about environmental monitoring and control, storage issues, the use of collections for exhibition purposes, packing and handling, numbering and labeling, methods of cataloging, inventorying, and condition reporting, photographing objects, and computerization and documentation (ibid). More importantly, however, museum professionals need to understand how these materials will be used on a long-term basis. Archaeological material is not typically considered for exhibition purposes, but rather, for research and educational purposes. As such, they need to be properly managed with these intended research needs in mind.

Not only should museum professionals managing archaeological and anthropological collections undergo a tailored form of training, but, according to Mark Miller, training should be reciprocal; "Curators need training in archaeology and archaeologists need training in curation" (Miller 1999, 7). It is impractical and inefficient for museum professionals to learn how to manage archaeological collections in isolation. Lynne Sullivan argues that it is unrealistic to expect a collections manager to be trained in archaeological research, let alone the multiple facets of modern archaeology (2001, 93). William Marquardt, Anta Montet-White, and Sandra Sholtz, in their jointly authored article "Resolving the Crisis in Archaeological Collections

Curation," argue that archaeology students should be taught the importance of collections management: "It is inconsistent to lecture to archaeology students about their responsibilities for planning, research design, laboratory work, and publication, while continuing to consign the resulting documents and specimens to closets, basements, and attics where they benefic only those creatures taking up residence within the containers" (1982, 417). They believe that it is the primary responsibility of archaeologists to consider the long-term preservation and care of the artifacts they excavate, as well as the informational data and documentation archaeologists generate in the process of excavation. It is only through a collaborative training effort that archaeologists and museum professionals can come together and learn how to properly manage and preserve archaeological collections for years to come.

The curation crisis is especially difficult to resolve as museums face growing financial constraints. As Trimble and Marino explain, "Even through the passage of laws like the Archaeological Resources Protection Act of 1979 and regulations such as 36 CFR Part 79 have supported more planning for curation at the budget-programming level, additional funds are still required" (2003, 107). Even if newly acquired collections receive the funding they need to guarantee their long-term care, old collections may still be in need of proper processing and management, funding for which is difficult to come by. While many donors are eager to provide funding for new expeditions, many are hesitant to donate money for the unglamorous work of properly caring for collections excavated a long time ago (ibid, 108). It is difficult to advocate on behalf of collections, but the only way to gain the attention of donors is to stress their importance for research and education.

Barbara Voss raises another significant consideration in current discussions on how to resolve the "curation crisis." She suggests that "discussions of the curation crisis similarly focus

on the logistical challenges – funding, facilities, storage materials, staffing, regulatory enforcement – which reinforces the perception that curation is a rote process that simply requires sufficient resources to be made efficient and effective" (2012, 149). As a result, she argues that a resolution to this crisis should be guided entirely by the notion that archaeological collections are "a source of knowledge about the past in their own right" (ibid). She furthermore suggests, through her research with an orphaned collection, that curatorial practices such as accessioning, cataloging, and inventorying often lead to significant research discoveries, indicating that "this slow, iterative and collaborative process of contextual study, collections inventory and cataloguing that has given rise to some of the most interesting research on the collection to date" (Voss 2012, 157). Such results may be difficult to achieve within the context of museum work, particularly as collections managers are often untrained in this type of in-depth archaeological research. However, it is certainly important to consider how the research potential of these collections might actually help guide the process of proper documentation and management.

In conclusion, Lynne Sullivan urges archaeologists and museum professionals to question: "how do we manage this growth so that collections care does not mean loss of significant research materials or a return to substandard basements, barns, and warehouses? We've been there, done that – what can we learn from this experience?" (2001, 93). Archaeologists and museum professionals alike have clearly identified the problem. Moving forward, the challenge is how to alleviate the problem in an effective and practical manner that considers the long-term needs of both archaeological research and museum missions.

Section III: The Collections Management System (CMS)

Due to the massive quantity of archaeological materials left unprocessed and undocumented in museums, the "curation crisis" has rendered many of these collections useless to archaeologists, museum registrars, researchers, curators, and the general public. In developing a strategy to resolve this crisis, it seems relevant to question how we can we properly process and manage archaeological collections and their associated documentation in order to maximize their full potential. How can museums carry out their missions to act as proper stewards of these materials? And finally, what tools can we use to facilitate the process of managing and maintaining these collections?

Technology may provide a viable solution to several of the key problems that have led to the "curation crisis." For instance, Ross Parry explains how the motivation of museums to incorporate computer automation "was the expansion in collections and, in some quarters, an increased loss of control over their management" (2007, 24). In other words, as collections expanded, museums looked to computer automation and technology to help regain control, albeit at a slow pace.

Computerized collections management systems (CMS) serve a variety of functions that facilitate the management of museum collections and documentation. A CMS may be a highly appropriate avenue to alleviate certain aspects of the "curation crisis," particularly due to the fact that it can streamline the process of information input, access, and retrieval. Collections databases allow users to access, catalog, or inventory large quantities of objects and records. They also allow staff to identify objects, track their locations and loan status, and record their conditions and conservation needs. For archaeological collections, databases facilitate research through the documentation of contextual information from excavation sites. Christian Emil-Ore

explains how "the power of modern databases enables the user to access, virtually instantaneously, information which might require months to collect with manual methods" (1994, 277). A CMS enables quicker and more efficient retrieval of information than the manual card catalog system.

The applications of collections management systems may help archaeologists and museum professionals more appropriately handle the massive quantity of unprocessed archaeological material for both administrative and research purposes. As Anne Woosley suggests, "Computerization may well be the key to enhancing the future use potential of all archaeological collections by helping to resolve access problems," since it "allows us to access the range of available data, to select those pertinent to our needs, and to do it without returning to original materials" (1992, 152-153). Museum professionals and archaeologists need to consider how they can maximize the potential of contemporary computerized collections databases as they attempt to resolve the "curation crisis."

In many ways, archaeology as a discipline has encouraged the use of these collections databases. Ross Parry explains that "the interplay of information science, systematics, new archaeology and structuralist modes of thought – and, crucially, the assumptions that each made about naming, patterning and ordering – provided the intellectual backdrop to the formation of the new collections management" (2007, 31). While the 1970s saw an increased desire to make use of new data sets for archaeological research, it also encouraged the introduction of computers to better organize and make sense of this accumulated information. Although the use of collections databases seems to be a current standard in archaeological and museological practice, the question becomes: what specifically can these databases do to enhance archaeological research and assist with the resolution of the "curation crisis"?

It should be noted that even a near-perfect collections database is not a replacement for proper collections storage facilities. Trimble and Marino explain how they "have encountered many curation facilities with exemplary computer systems and database abilities for recording information about their collections, but with collections stored in buildings with no fire-suppression systems or no security of any kind" (2003, 101). A proper CMS is a strong way to promote the long-term maintenance of archaeological collections in museums, but it is certainly not compensation for poor collections management in other regards.

Database Management Systems: Historical Trajectory and Terminology

A Database Management System (DBMS) is a computer program that automates "the collection, storage, manipulation and retrieval of structured bodies of information" (Lock 2003, 89). A collections management system (CMS) is therefore one type of DBMS used by museums. The first database management systems were comprised of "flat files." For museums, these systems "reflected the simple hierarchical data structure of a card index in which each record (card) consists of a series of logically related records" (Lock 2003, 89). In addition, these databases "tended to tolerate only data models based upon a hierarchical logic. It was a 'tree-like' cascading series of levels and nests" (Parry 2007, 54). They are therefore limited in their ability to relate objects to one another in a complex way, and instead only interpret objects' hierarchical relationship to one another. This method of database management is now considered outdated and inefficient, mainly because it requires unnecessary repetition of information. For instance, 500 objects may pertain to the same archaeological site. In a "flat-file" database, the site and all of the information pertaining to it needs to be manually entered for each individual object record.

In the 1980s, databases evolved to include relational database management systems. In a relational database, objects are distinguished by unique identifiers. In a museum database system, the unique identifying feature would most likely be the accession or catalog number that differentiates each object from one another. These types of databases are more complex in their ability to allow flat files of data to be cross-referenced and related to one another in tables. Unlike "flat file" databases, relational databases eliminate the need to enter repeated information. For an archaeological site, the site's attributes such as city, state, GPS coordinates and date of excavation only need to be manually entered into the database once. Once this information is entered, all of the site's attributes will automatically relate to the site in the database. For a group of 500 objects, the archaeological site alone needs to be entered into each object record in order for the site's various attributes to relate to these objects.

Another main benefit of a relational database is that it allows a user to perform a variety of data manipulation operations and query searches (Lock 2003, 89). As Gary Lock explains, "'Query-by-Form' or 'Query-by-Example', are popular methods of building a query by filling in values on a screen form which are then searched for by matching" (ibid). For example, these types of databases allow a user to search for all of the objects that pertain to a particular excavation unit or feature. Julian Richards discusses a relational database in archaeological terms by how it "reflects and defines the relationships between the archaeological entities recorded in the structure of its table" (1998, 333). For instance, he explains how a single excavated grave might be put in a separate "graves" table, which "may contain several artifacts recorded in a 'grave-goods' table, linked to graves by a unique burial reference number" (ibid). It therefore becomes possible to manipulate these data and retrieve a range of complex information about how these objects relate to one another by performing search queries within the relational

database. Most databases allow users to perform four components, including tables, queries, forms, and reports (Quigley 2010, 162). Data are stored in tables, which can then be searched using queries. Forms are generated to mimic paper records, thereby allowing the database user to enter data in a clear, visually organized manner (ibid). "Forms also frequently are used to specify search or sort criteria to be used by predefined queries" (ibid). Finally, reports allow a user to see the results of a query in an organized fashion.

Another type of database is known as the object-oriented relational database. Lene Rold summarizes how "Database management systems have in this short time gone from hierarchical systems through networks to relational, and are now on the way toward object orientation" (1993, 213). This type of database emphasizes the ways in which objects participate in events, "and so have to be defined not just in terms of what they are, but what they *do*" (Richards 1998, 333). Rold uses the example of an object found in a grave. The grave would constitute as an "event" in which the object partook, potentially alongside other objects (Rold 1993, 214). Object-oriented relational databases attempt to relate objects and their individual qualities to the activities and past events in order to better understand the context in which they occurred. According to Anderson et al, this type of database has a great deal of potential to assist with archaeological interpretation. However, most museums and archaeologists are still making use of the relational database model simply because it is most commonly used and therefore most available and accessible (Anderson et al 2014).

Database management for archaeological collections is somewhat challenging, as it requires a marriage of two disciplines: museum professions and archaeology. It is difficult to determine how to maintain the highest standards in both disciplines simultaneously. A main standard in collections management practices is to ensure that each individual object has its own

unique identifying number. This standard should certainly still apply to archaeological collections, ideally following Rebecca Buck's numbering guidelines (2010, 206-208). Typically, information entered into a collections database, at its most basic level, includes: the accession number or catalog number, object name, location in the museum, material, dimensions, condition, and provenance.

While one main consideration is how to manage archaeological collections according to museum standards, another is how to enhance their research potential. Angela Labrador argues that "archaeological databases structure how we 'do' archaeology as a component of our social scientific toolkit" (2012, 239). In order to achieve this potential with the assistance of a collections database, Lynne Sullivan describes three broad considerations: "(1) the project designs or plans, (2) the quality of recording and recovery, and (3) redundancy of information" (20021, 96). In order for a database to contain valuable information on archaeological material, it must also include contextual data. Lynne Sullivan argues that "Basic descriptive and contextual data must accompany a collection if it is to have future research potential" (ibid). In a collections database, it is therefore significant to enter information including the collector or archaeologist, site and site number, excavation unit, level within the excavation unit, GPS coordinates of the site, an archaeological feature in which the artifact may have been found, and the date of excavation. It is especially significant to record information about archaeological features, such as a fire pit or trash heap, since they "may have a different significance from other objects collected in the same layer" (Miller 1999, 29). Features therefore provide unique archaeological contexts to research and interpret.

There are several "rules of thumb" concerning data management for archaeological collections. Suzanne Quigley provides several important points regarding computerized systems,

particularly regarding what types of information should be entered into the database. Primarily, she suggests that "A cardinal rule of good database structure is that no piece of information should ever be entered more than once" (Quigley 2010, 162). The use of a relational database promotes adherence to this rule during the data entry process. She also suggests that not all data needs to be entered into the database, particularly if there are time constraints or if information is sensitive or confidential (ibid, 169). It is difficult to find a balance between properly documenting archaeological materials and having the time and resources to maintain this information. It depends entirely on circumstances of the institution to determine how much information they are able to enter into the database. For example, the measurements of every single archaeological specimen may not be entirely necessary to record and enter, particularly if there are time constraints.

Furthermore, it is important to recognize that "Not all data must be entered online; it is perfectly acceptable to decide that certain kinds of information will remain in a manual system with pointers from the automated system" (Quigley 2010, 169) For instance, it is entirely appropriate to make a note in the database that says something along the lines of "See object file for provenience information," or "See curatorial file for donor information." Furthermore, Quigley argues against entering data simply because the CMS has a field that accommodates the information; it is only necessary to input the information that will prove useful and searchable (ibid).

Not only should these databases incorporate excavated archaeological material, but they should also include relevant documentation pertaining to these materials. Sydel Silverman appropriately argues that "personal papers allow for contextualization and enrichment of the data generated by an anthropologist and illuminate the research process" (1993, 101). Without proper

maintenance of their documentation, archaeological materials lose a great deal of their research potential. Harrison Eiteljorg suggests that archaeological field directors are responsible for not only excavating archaeological material as a form of data, but also the "documentation along with the data files" (1998, 23). Much of the information contained in this documentation can be entered into the various fields of a collections database, facilitating the ability to search for the information they contain.

A CMS is highly useful in its ability to "provide many additional points of access, and many more in combination with each other" (Quigley 2010, 173). However, in order to allow a database user to successfully access information about the collections, terminology control comes into play. According to most collections managers, it is important to choose a single term to describe a particular object. As Angela Labrador explains, the typical rule suggests: "thou shalt count thy artifacts *once"* (2012, 241). Many collections databases contain authority lists, which contain a list or thesaurus of terms that can be used in order to control and standardize vocabulary. A museum working on cataloging archaeological materials should consult a lexicon appropriate to the collection at hand. For archaeological collections, there are several potential lexicons; the Art and Architecture Thesaurus (AAT) created by the Getty Museum is one appropriate option.

However, archaeology as a discipline is concerned with interpreting objects in their cultural contexts, often in a complex and multifaceted manner. Angela Labrador suggests that "Alternative ontologies, or other ways of conceptualizing and organizing the archaeological knowledge domain, must be better represented in our databases if we are to truly engage with multiplicities of meaning" (2012, 241). In this regard, she challenges conventional notions of cataloging in museums. Typically, an artifact catalog only describes one facet of an object. For

instance, she explains how typically, "an artifact is either a brass point or a glass bead – it's not both" (2012, 240). However, she argues that this approach limits archaeological interpretation. It would be more beneficial for archaeological research to structure a database to contain a series of relationships between an object and its attributes. For instance, she suggests that "identifying a 'ceramic sherd' in an artifact assemblage is the first step in a chain of more detailed descriptive observations relating to the sherd's paste, surface treatment, and decoration (which can be classed according to density, color, motif, etc.)" (2012, 240). Thus there are multiple ways of classifying and describing an object, all of which should be contained in a database in a clear, consistent, and standardized manner.

Theoretically, Labrador's approach to classification is beneficial from an archaeological perspective. However, this level of classification may be unrealistic in a museum setting, as collections managers untrained in archaeology may be unable to describe artifacts in such a level of detail. It may, however, be possible to achieve this type of classification and description in the context of a collaborative effort between archaeologists and museum professionals during the cataloging process.

Cooperation and Collaboration in Database Management

In managing archaeological collections in a collections database, museums need to consider not only how to manage these materials from an administrative point of view, but how they can meet the needs of researchers, educators, and even the general public. They need to think beyond how to manage these collections to simply conduct their everyday managerial duties. In this sense, museum professionals need to act in collaboration, particularly with archaeologists, in order to make sure that these collections are made accessible and available. To

summarize this point, Gary Lock suggests that *"*The move is towards a single digital environment which will serve the administrative needs of museum staff and the needs of researchers and other museum visitors" (2003, 216). By keeping the needs of archaeologists in mind, museum professionals can act as proper stewards of these archaeological collections and help to bring their research potential to light. In turn, by working more closely with museum professionals and coming up with a collaborative plan for long-term curation, archaeologists can do their part in alleviating the "curation crisis" and enhance archaeological research.

Several archaeologists, including Barbara Voss and Angela Labrador, have suggested that the process of database management has tremendous benefits in shaping our understanding of archaeological collections. In many ways, the act of entering information into a database not only helps to maintain control over these collections, but it largely shapes their research potential as well. As Angela Labrador suggests, the process of cataloging and entering data into a database greatly influences "how we see our data and how we predetermine future modes of access and interpretation" (2012, 239). Labrador's argument is that archaeologists can play a large role in shaping the research potential of archaeological collections simply by cataloging and managing a database. Museums suffering from the "curation crisis" may greatly benefit from this type of collaboration with archaeologists as they attempt to catalog and perform data-entry on the collections.

Limited Funding: Justifications of a Collections Management System

Funding becomes an immediate consideration with regards to database selection, installation, and maintenance. There is a great deal of tension concerning the cost required to fund database management projects. One of the biggest concerns is technological obsolescence.

As Sullivan and Childs explain, "automation requires long-term maintenance of both the software applications and the data gathered. Maintaining a database of any type requires upgrading the application software as new technology develops and/or migrating all existing data to a new application as a repository develops new data management needs" (2003, 105). Updating software can be quite an expensive investment once it has been initially purchased.

However, most museums seem to agree upon the notion that the functions and features of databases far outweigh the costs. For instance, Michael D. Wiant, in his 2004 article "If You Build It, Will They Come? Archaeological Collection Use at the Illinois State Museum," argues in favor of making archaeological data available in order to promote the use of collections for research. Peter McCartney, in his article "Long-Term Management and Accessibility of Archeological Research Data" (1999, 60-65), urges archaeologists to consider issues of data management, metadata standards, accessibility, and solutions to preserve digital data threatened to become obsolete, particularly for the sake of finances. In many ways, he urges us to expand upon Wiant's notion that "if you build it, they will come," and instead create a situation in which the "data projects are of significant value to current and future research – that is, new proposals are expected to provide *application*, not just availability, of data" (1999, 64). Sections IV and V attempt to address the ways in which a collections management system may provide the means to not only make data available to researchers in a realistic manner, but provide the means for researchers to interpret and apply the information made available to them.

Other authors have discussed funding in the context of proper database selection and maintenance. Suzanne Quigley, for instance, discusses in depth how to choose and maintain a database management system that best tailors the needs of the museum in the most applicable, cost-effective manner (2010, 161-183), while Elana Carpinone (2010, 24-131) discusses how to

choose a commercial collections management system based on the needs of the institution, incorporating costs into her findings.

Museums that make use of a collections database increase the accessibility of their collections to researchers and the general public. As a result, they are not only more equipped to carry out their missions to cater to the public, but are advocating for themselves and demonstrating their value as institutions that serve a greater good. The following sections will touch upon collections management systems using a variety of case studies and examples. Section IV will discuss commercial collections management systems commonly used in museums today, and how museums might use these databases to their full potential in managing archaeological collection. Section V will discuss some of the deeper implications of the "curation crisis," particularly storage and accessibility. It will address the potential ways a collections management system may greatly improve upon the lack of storage and accessibility that museums face, particularly by advocating on behalf of the collections and justifying their importance to the broader community.

Section IV: Commercial Collections Management Systems

Collections management systems have the potential to alleviate the "curation crisis" in a variety of ways. First, they may facilitate the accessioning and cataloging process, thereby allowing museums to maintain intellectual control over their collections. Most collections management systems are based on a relational database model, so that, once certain piece of information have been entered once, it is possible to link objects to this information in the future without having to enter it repeatedly. This method saves a great deal of time and effort during the data entry process. While there are numerous management systems, all providing different structures for cataloging information, only some of them are truly beneficial to museums processing a large quantity of information, as is often the case with archaeological collections.

In addition to facilitating the cataloging process, collections management systems also have the potential to increase accessibility to archaeological collections, which in turn may greatly alleviate the "curation crisis." For instance, one solution is to encourage archaeologists to make use of already excavated materials for research purposes rather than excavate new materials that require a long-term curation plan. Childs and Sullivan suggest that one of the main issues associated with the "curation crisis" is that of access and use (2004, 17). As Alex Barker summarizes:

> […] collections and their associated documentation are not static objects, frozen at the moment of accession by a museum or repository. Ongoing research, on both the collections and their broader documentary and disciplinary context, energizes and informs subsequent research and adds to the value and utility of those portions of the excavated or collected archaeological record already curated and available for study (2004, 38).

Improving the accessibility of these materials, particularly through a collections management system, may encourage the ongoing research of previously excavated materials, renew their

untapped research potential, and dissuade archaeologists from excavating new sites when old materials have yet to be fully explored and interpreted.

Many museums already make use of a CMS to manage their collections, which is a cost-effective option. In addition, museums may simply need to determine how to make the best use of their current system when processing and managing archaeological collections. In order to alleviate the "curation crisis," it is highly relevant to determine the best commercial CMS for properly cataloging, processing, and managing archaeological collections at this point in time. Unfortunately, unlike natural history collections that have developed uniform cataloging across museums, "There is no such coordination for archaeological collections research" (Keene 2005, 57). It is difficult to create uniform cataloging standards for archaeological collections, as materials pertaining to each culture are distinct. It is the responsibility of the museum, in collaboration with archaeologists, to determine how to properly catalog and manage a specific archaeological collection.

Many commercial collections management systems have features that are well suited to properly accession and catalog these materials, as well as to improve the accessibility and research potential of archaeological collections. Several options currently exist for museums interested in cataloging and managing archaeological material in a cost-effective manner. This section will explore three commercial CMS's that are arguably the most tailored to archaeological collections: PastPerfect 5.0, Re:Discovery 8.14 Software, and KE-EMu 4.0.01. In particular, it addresses how these systems assist with the cataloging process and improve accessibility for research. This section does not aim to promote one CMS over another. Rather, it intends to encourage museums to explore the ways in which a collections management system

might assist them in processing archaeological material to the best of their ability, with administrative, research and educational endeavors in mind.

PastPerfect 5.0 (PastPerfect Software)

PastPerfect is a collections management system that helps to manage and control archaeological collections at a relatively low cost compared to other CMS's. Fortunately, this software's entire user guide is available to the general public online and a trial version of the software is available for free download, allowing for an in-depth analysis of how this CMS might help to alleviate the "curation crisis." Museums interested in this software can explore all of its features at no cost and learn how to use it for functions pertinent to archaeological material.

PastPerfect 5.0 has a unique objects cataloging module that contains several different tabs: *Archaeology*, *Art*, *Geology*, *History*, and *Natural History*. This allows a museum to manage a variety of different collections under one roof. It is also one of the few commercial databases that have an Archaeology-specific cataloging tab. This tab allows for additional information to be entered on a particular object. The top portion of the cataloging module remains the same for all cataloging tabs, and allows users to enter the object ID, object name, other name, other number, old number, accession number, home location, date range, and catalog and status information. The *Archaeology* tab also has a section in which a long description can be written about the object. It allows the user to also enter archaeological information in areas titled Collector, Excavated by, Identified by, Collection date, Excavation date, Identification date, Site/Site number, Unit, Level, Stratum, Feature, Material, Dating Method, Provenance, and X, Y, Z Coordinates.

Not only is PastPerfect tailored to archaeological collections through its *Archaeology* cataloging module, it can save the user time during the cataloging process, specifically through the "Default Data Record" feature in the cataloging module. This feature saves time to users entering catalog information by automatically filling out fields when new catalog records are entered. For instance, a user cataloging archaeological collections from a single excavation or collection "may want to create a default data record with your name as the cataloger in the Cataloged by field, a radio dot in the Archaeology Object Type, and the collection's name in the Collection field. When new records are added, the Cataloged by, Object Type, and Collection fields will be pre-filled with the default data" (PastPerfect Software 2013b, 117). The user's guide contains further instructions on how to implement this feature. The "Default Data Record" feature may save a great deal of time during the cataloging process, which is highly beneficial in light of the "curation crisis" and the vast quantity of archaeological material that has yet to be fully cataloged and processed.

Another PastPerfect feature is the Repatriation screen in the Other Views section. In this section, users can enter information pertaining to repatriation including Repatriation Type, Authorized by, Authorized Date, Date of Notice in Federal Register, Claimants, Handling Requirements, Disposition, and additional notes (PastPerfect Software 2013b, 145). Users can also indicate that an object has been repatriated in the Status view.

Aside from the cataloging module, PastPerfect allows users to enter a variety of archaeological data. On the software's main menu, the Site & Localities section allows additional site information to be added and linked to catalog records. Once a Site Name has been entered for a particular catalog record, it will link this object to the site and all of its associated information. PastPerfect is therefore capable of relating objects from the same provenance

location at an archaeological site to one another for research purposes. In addition to these relational features, one of the main benefits of this CMS is that it takes into account the potentially sensitive nature of site information; PastPerfect allows a museum to implement restricted access to site record information in the Sites & Localities files (ibid).

The software user guide explains that, in the Sites & Localities section, users can enter a variety of information including Description Range, Section, Quarter, Township, County, State, Country, Prime Meridian, Maps & Publications, Latitude, Longitude, Elevation, and Notes (PastPerfect Software 2013c, 307-308). In addition, this section allows the user to enter information on the site's position based on GPS readings and check off whether these readings were taken using a Global Positioning System reading (ibid, 309). However, there is no indication that the database allows these GPS readings to be entered directly from the device on which they are recorded, such as a Total Station. As a result, it seems as though all of these readings need to be manually entered into the database, when in reality it would be far more efficient to allow all of these numerical values to be transferred digitally from a device on which they have already been recorded.

This specialized functionality allows a large quantity of information regarding archaeological material and site information to be entered into PastPerfect in a relatively organized manner. In this regard, this particular CMS not only assists with the cataloging process thereby improving the issues pertaining to the "curation crisis," but also improves accessibility and research. According to the software user guide, "The Research section of PastPerfect provides staff and visiting researchers with a variety of finding aids and access points. […] The search results may be put on a Catalog List, viewed as full catalog records or images in a light box, exported to MS-Excel, and printed to a variety of report formats" (PastPerfect Software

2013a, 5). Because of the relational structure of this database, a researcher can potentially conduct a wide variety of searches and queries to assist with research endeavors. Furthermore, they can perform several functions with the information found in the query. Researchers can print a list of all of the records found in their search results, print the catalog record for each individual search result, print catalog cards or labels, or export the query results to Microsoft Excel. A museum can also include the search results on the web if they own the PastPerfect Online program (PastPerfect Software 2013d, 271). This program lends support to Childs and Sullivan's notion that museums and archaeologists should work together to "encourage use of those collections through web-based catalog databases and publications" (2004, 17). However, these features are not necessarily unique to PastPerfect; most commercial databases understand the significance of collections research and enable a variety of search functions to facilitate these investigations. The PastPerfect Research section and Online Program attempt to make the collections accessible for research once the cataloging process is complete, which may assist archaeologists conducting research on processed collections in museums.

Another unique feature of the Site & Localities section is the ability to map archaeological sites. The "Map this Site" feature allows the user to manipulate the latitude and longitude fields located in the Location Information screen to "create a data file to export." As the user guide explains, "This file contains the site name, latitude, longitude, and address fields. This file may be used by a mapping program such as Microsoft Streets & Trips, Microsoft MapPoint or Google Earth Pro to pinpoint the site's location" (ibid, 314). As a result, the information previously entered into the Sites & Localities section can be exported from PastPerfect, and imported into mapping software such as Google Earth Pro in order to map the archaeological site.

However, the user's guide does not make it clear precisely how this "mapping" process functions. In particular, it is unclear whether the mapping feature will allow the object records to be tied to the site. It would also be interesting to know whether objects excavated through a metal detection survey, each with their own individual GPS coordinates, can have their coordinates entered into PastPerfect individually and placed onto a spatial map from the database. While PastPerfect is highly flexible in certain regards, it has a great deal of limitations when it comes to assisting with research endeavors. While an archaeologist can perform search queries on previously entered material, this particular CMS does little to assist with the process of interpretation and evaluation of the archaeological material itself. It simply allows researchers to know and understand what types of objects are available in the collection; there is little indication that PastPerfect allows archaeologists or other researchers to analyze their search queries in a meaningful, interpretive manner. Their research may begin with the collections management system, but access to the physical objects may be necessary when research needs become more in-depth.

In terms of dictionaries and terminology control, PastPerfect lexicon "is based on the latest standard, *Nomenclature 3.0 for Museum Cataloging*, edited by Paul Bourcier, Ruby Rogers and the Nomenclature Committee. *Nomenclature 3.0* is expanded from the previous version and includes thousands of new and up-to-date terms." (PastPerfect Software 2013a, 3). In addition, in order to improve consistent terminology during the data entry or cataloging process, the software checks newly entered object names and makes sure the terminology coincides with its pre-approved list of terms (ibid). While the software attempts to make use of standard terminology, PastPerfect also allows a term to be added to the dictionary if need be (Miller 2012, 51). However, it does not allow a user to categorize added terms, thereby "essentially making the

addition useless" (ibid.). A similar issue arises with the lexicon implemented in Re:discovery Software, Inc. and KE-EMu Software, as we shall see.

While PastPerfect 5.0 may be an appropriate and cost-effective choice for museums containing a large quantity of archaeological materials, it seems unequipped to properly manage archival materials. As Elana Carpinone suggests, "PastPerfect may not actually be a great fit for institutions with a large archival collection" (2010, 76). Since a large portion of managing an archaeological collection is also maintaining its associated documentation, this aspect of PastPerfect is highly disadvantageous for archaeological collections. Without proper maintenance of the archaeological records, the objects lose a great deal of significance and research potential. For instance, if the user chooses to purchase PastPerfect's Multimedia Upgrade for an additional charge, they can add up to twenty photographs of the site in the Sites & Localities section. For archaeologists, this number of images is low; many take a wide variety of photographs, particularly of features and excavation units, which are all highly relevant to the research potential of the site. In order to properly document more than twenty images taken at a site, the user can either choose not to digitize the images, or catalog them using the Archives cataloging module and relate the catalog records to the site. Although there are options to get around this problem, perhaps PastPerfect could do more to make these documents and photographs more accessible and useful for research purposes.

Re:discovery 8.14 (Re:discovery Software, Inc.)

Re:discovery is a CMS that has a wide range of benefits for museums with archaeological and ethnographic collections. The software was first developed in 1988 by David L. Edwards in order to manage the archaeological excavations conducted at the Thomas Jefferson Foundation's

sites at Monticello and Poplar Forest (Re:discovery Software Inc., 2013c). In 1997, the National Park Service chose to use this software to manage collections of over 300 sites (ibid). Although it has evolved a great deal over the past decade, this system finds its roots in the discipline of archaeology and has largely stayed true to this foundation into the present day.

According to the software website, Re:discovery is "used by registrars, collections managers, curators, archivists, archaeologists, slide librarians, private collectors, educators, and researchers every day" (Re:discovery Software, Inc., 2013a). Similar to PastPerfect, Re:discovery makes use of several cataloging screens, including *Cultural Resources, Natural History, Archaeology,* and *Archives.* This software specifically caters to managing archaeological sites through its *Archaeology* module. As Elana Carpinone explains, "At a significant extra cost, Re:discovery has a distinct *Archaeology Module,* which is rare […] This makes Re:discovery particularly well suited for archaeological collections" (2010, 100). This module, although costly compared to PastPerfect, "documents all site information, from the general location down to the individual artifacts" (Re:discovery Software, Inc., 2013b), and enables five different types of records, all pertaining to the various components of the archaeological site: site record, context records, master context records, artifact records, and object records (ibid.).

In order to improve the data entry process, Re:discovery has incorporated several features users can take advantage of during the cataloging process. For instance, the system has enabled tools including Copy a Record, Set Defaults, Carry Over Values, Auto fill, Quick Entry, Global Search, Replace, and Modify All. Each of these tools "reduces the number of keystrokes required to add and update records" (Re:discovery Software, Inc., 2013d). This system therefore makes

attempts to improve the cataloging process, which may prove useful when processing large quantities of archaeological collections.

Re:discovery provides particular support to clients associated with a National Park Service (NPS) site, which is highly advantageous for sites containing archaeological material striving to meet NPS standards. In addition, the system "has a rare NAGPRA feature, NPS report templates, and is the only CMS that has NPS classification terms built-in to the system" (Carpinone 2010, 102). The NAGPRA feature allows collections managers to record inventory information about sensitive materials pertaining to NAGPRA, including human remains and funerary objects, and track how museums can comply with NAGPRA (ibid, 48). Carpinone suggests that "These features would be advantageous for museums that have archaeology and ethnology collections with objects subject to repatriation of have special handling restrictions due to their sacred nature, such as Native American pieces" (ibid, 104). In addition to its unique NAGPRA feature, the system also incorporates report templates required by the NPS (ibid, 101). Though geared towards NPS affiliated sites and institutions, it is useful to museums containing archaeological materials. In light of the "curation crisis," this CMS might be a useful avenue for museums to pursue if they are interested in meeting NPS standards on properly processing and managing archaeological collections.

Another advantage of Re:discovery is its terminology and related dictionary. Users can choose between the Art and Architecture Thesaurus (AAT) or the Revised Nomenclature for Museum Cataloging (Re:discovery Software, Inc., 2013d). In addition, as Theresa Miller explains, users can edit the dictionary in the database. She suggests, "This is a huge advantage because very specific terminology is utilized in different research areas. For example, the terminology used for objects in Greece is different from the terminology used for North

American Plains objects" (Miller 2012, 49-50). However, Theresa Miller warns, this feature also raises concerns in that users can simply continue to add terminology to the dictionary. This feature therefore requires a great deal of control, lest the concept of continuity and categories is "rendered moot" (Miller 2012, 50).

Re:discovery provides unique search features that allow researchers to choose how they like to obtain the information they are looking for. In particular, the system provides a variety of search options, including "Google-like word searches, *Quick Search, Advanced Search*¸ Boolean Search, and lexicon searches" (Carpinone 2010, 103-104). According to Elana Carpinone's 2010 survey, respondents found the Re:discovery search options useful and beneficial (ibid).

KE-EMu 4.0.01 (KE Software)

KE-EMu is a collections management system that is considered applicable and relevant to natural history collections but also works well for archaeological collections. Similar to natural history collections, archaeological collections are acquired through field collection and are typically intended for research and education rather than exhibition. Carpinone suggests that only 2% of surveyed clients are archaeology/anthropology museums, which is an interesting statistic given how "the features that make it well suited for natural history collections are also quite useful for archaeology collections" (2010, 127). In this respect, KE-EMu's potential seems to have remained untapped by museums containing anthropological and archaeological materials.

Unlike PastPerfect and Re:discovery, whose organizational structure is based on the type of collection, KE-EMu has one cataloging module "broken down hierarchically according to discipline" (Carpinone 2010, 119). Whereas Re:discovery has an entire cataloging module

dedicated to archaeological collections, "the archaeology portion of the *Cataloging* module is included in EMu's basic software package and does not cost any extra […] EMu's archaeology cataloging is just a part of its Cultural History *Cataloging* module" (ibid, 120). All types of objects are cataloged under this Cataloging module, although there are a variety of sub-categories and disciplines that users can choose to designate the objects they catalog. One of these sub-categories is Cultural Collections, with has further subcategories of Ethnology, Anthropology, Archaeology, and Science and Technology (KE Software, 2013b).

While the cataloging module in KE-EMu is generalized to incorporate a wide variety of object types, it is adaptable to the specific needs of the institution's collection. It also ensures that the "same management processes can be applied within each discipline" (ibid). In this regard, the database is customizable so that all objects considered archaeological will be cataloged and managed in a consistent, standardized format.

According to KE-EMu, one of the main advantages of its cataloging module is that storing "the data of multiple disciplines in the one Catalogue facilitates cross-discipline research as it's possible to search across the entire collection and draw or discover associations between disparate but related items" (KE Software 2013b). This methodology allows KE-EMu to function well for interdisciplinary research ventures. While this feature may assist museums in making their collections more accessible to researchers in general, it does not necessarily assist archaeologists interested in studying a very narrow subject.

KE-EMu greatly emphasizes its capability to assist with research and interpretation of the objects in the collections management system. The system has a *Collection Events and Sites* module, which "records information about specific collection localities (field trips and archaeological digs)" (KE Software 2013b). Specifically, this module allows users to record

information on the original collection or excavation of the objects, including the dates of collection, collector, date and time, expedition details, location and places, geographic description, mapping coordinates, latitude, depth, and object condition (ibid). In addition, this system allows researchers to perform "queries by proximity, ranges, groups, phonetics, or morphology" (Carpinone 2010, 104), which may greatly assist archaeologists search for a variety of information to assist with their interpretation of the objects.

Furthermore, the system has a Geo-referencing and Mapping feature, which allows users to map objects, artifacts, and specimens using Imu Web Maps (KE Software 2013b). Imu Web Maps is a "web browser utility that can be accessed from within EMu or directly from a website and which plots the location and distribution of data (typically specimens) on maps" (ibid). This feature has the potential to assist archaeologists with spatial mapping of excavated materials if GPS coordinates for the objects or excavation units are known. It also allows different types of species, or perhaps even different types of artifacts, to be shown in different colors, thereby emphasizing the distribution of different objects (ibid).

In terms of lexicon and terminology, KE-EMu supports the Getty Art and Architecture Thesaurus (AAT), the Library of Congress Subject Headings (LCSH), as well as other thesauri specific to a particular discipline and a user-approved thesaurus (KE Software 2013b). This allows for a great deal of flexibility in terms of lexicons museums use for the database; it is essentially up to them to choose the most appropriate lexicon. Museums with archaeological collections can choose a lexicon that is more specific to the discipline, although the AAT is considered a good option to describe these materials.

KE-EMu also emphasizes its ability to assist museums in facilitating public engagement. EMu allows the database information to be used in exhibition management, visualization tools,

self-guided tours, and most importantly, publication on the web (KE Software 2013c). For publication on the web, EMu is managed by Imu, or Internet Museum, which is a "toolset for publishing your content on the Internet and Intranet, for use on desktop computers, in-house kiosks and on mobile devices such as tablets and smart phones" (ibid). This public engagement emphasis of EMu meets the often expressed need to make archaeological collections more accessible and available to the public and researchers. By increasing the accessibility and visibility of these objects, KE-EMu not only promotes the significance of archaeological research, but emphasizes the fact that these collections do not belong unprocessed in storage; they are intended for the public to benefit from and enjoy.

The National Museum of the American Indian uses KE-EMu as its collections management system. According to KE-EMu's website, this database "currently holds over 390,000 records representing a collection of photos and objects of about 825,000 items" (KE-EMu Software, 2011). The museum made these materials more accessible to the general public by using this CMS to place items on its website. The objects can be searched by "Artist/Individuals," "Object Types," Techniques," "Materials," "Places," and "Peoples/Cultures" (ibid). The museum's efforts to use this CMS to make its materials more accessible to the public, particularly researchers, are commendable.

Summary

A main concern regarding these commercial databases pertains to the lexicon and terminology embedded in the software. As Theresa Miller explains, "Most systems currently available offer some form of terminology control or flexibility, but few offer both" (2012, 53). On the one hand, it is important for a collections management system to implement a specific

type of lexicon, preferably one suited to archaeological collections, in order to maintain consistency and standardization. On the other hand, many of these systems recognize that the lexicon often does not meet the needs of users, and therefore allow them to add terms to the dictionary. While this is arguably a beneficial feature, it detracts from the underlying purpose of the pre-approved lexicon in the first place. It is also difficult to choose a specific lexicon for a museum that contains a wide variety of collections from multiple disciplines. There seems to be a great need in both the field of archaeology and museum studies to solve issues pertaining to terminology in collections databases.

Another large problem that Elana Carpinone identifies in her study is that "none of the systems in this study appear particularly well suited to handle both objects and archival collections" (2010, 120). As Natalie Drew (2004) suggests, properly preserving archaeological records, along with the excavated objects, is a highly significant way to preserve the research potential of the site as a whole. While many of these collections management systems have features that incorporate archival material and documentation, there is little indication that it is possible to connect these archival materials to archaeological objects in a relational database so that they can be properly managed in conjunction and interpreted in research.

The solution to these problems is beyond the scope of this paper. However, if museums intend to act as proper stewards of archaeological collections and attempt to alleviate the "curation crisis," there is a great need to address these concerns and find ways to resolve them. These solutions need to be developed in consultation and collaboration with archaeologists if they are to meaningfully enhance the research potential of these collections. While the features of these systems will assuredly change over time, it is important for museum professionals to consider how they might be able to make use of a commercial CMS in order to maximize the

research and educational potential of archaeological collections. By better understanding how these systems function, museum professionals may feel more comfortable tackling some of the problems they face in dealing with archaeological material, particularly pertaining to cataloging, accessibility, and facilitating research.

Section V: The Role of a CMS in Resolving Underlying Problems of the "Curation Crisis"

While a collections management system provides a means to document and maintain control over archaeological collections, the "curation crisis" entails a much larger problem: collections suffering from a severe lack of storage, and consequently, accessibility. A collections management system alone cannot resolve the storage crunch; museums will require funding and staffing to properly store and care for archaeological collections in perpetuity, especially as archaeologists continue to excavate new materials. However, a properly developed collections management system has the potential to serve a significant role in alleviating several key components pertaining to the lack of museum storage. This section will address the potential ways in which a collections management system may actually contribute to resolving storage and accessibility problems inherent in the "curation crisis."

Collections Management Systems: Practical Applications

Several authors have studied the perpetual storage of archaeological material, particularly in light of the "curation crisis." The complexity of museum storage is beyond the scope of this paper, but the general consensus seems to be that "A rigid, standardized approach to archaeological storage is a mistake" (Ford 1980, 60). Not all archaeological materials are the same, and consequently, no two storage models should be identical. For example, Richard Ford suggests that the "collections that are referred to frequently should be located in close proximity to the researcher. Those that have been studied or that do not require continuous attention do not have to be located at hand […] this plan for the segregation of collections is functional" (1980, 55-56). He then divides archaeological collections into several classes for storage purposes, based largely upon the research attention and processing they have already received. He also

claims that "Archaeological storage is more analogous to an automobile-parts store than it is to a traditional museum […] To keep this diversity together in identical cabinets with removable drawers is misguided" (Ford 1980, 57). As a result, a storage plan should take into consideration the unique nature of the archaeological collection at hand, what type of research potential it has already demonstrated, the potential it may have in the future, and the type of curatorial processing it has already received. To summarize, Steven Miller suggests that "Collections are the materials upon which museums justify their existence and build their programs […] Good storage represents the breadth and depth of a museum's soul" (2006, 57). Museums have a large role to play in resolving the archaeological "curation crisis," particularly in caring for collections in perpetuity through proper housing and storage.

While a CMS cannot necessarily tackle the storage planning itself, one primary way in which it may assist with the long-term storage issue is by improving administrative tasks. By improving intellectual control over their holdings, museum staff members can become more informed about the problems and concerns surrounding the collections. In particular, they may gain a better understanding about the types of storage issues that currently exist and how they may be able to resolve them.

The question then becomes, how can museums use a CMS to improve storage? In general, a CMS facilitates the processing and management of materials in preparation for proper storage and housing. A large move of two million specimens from the Department of Anthropology at the National Museum of Natural History to an offsite storage facility demonstrates many of the advantages of a CMS and other supplemental forms of technology to properly process, move, and store large quantities of collections. In preparation for the move, the museum entered catalog records into a computerized database in the mid-1970s. Initially, they

only processed basic object information into the database "so that a collection-wide database could be quickly created" (Hansen and Sawdey 1999, 14). Greta Hansen and Catherine Zwiesler Sawdey explain how "This merged database, while dramatically refined and improved over the intervening years, became a critical tool for planning various collection requirements and for tracking collections throughout the move process. It is the inventory device used today" (1999, 14). As a result, the database created by the museum not only assisted with administrative functions, but also provided a tool to assist with the proper rehousing of materials.

A CMS in itself may greatly facilitate administrative museum practices. In addition, other forms of technology that work in congruence with these systems may enhance their potential, particularly bar codes and data matrix codes. Jorge Martinez-Moreno et al. argue in favor of using data matrix (DM) codes in order to properly manage the archaeological record (2010). DM codes provide a means to label and track artifacts, on an individual basis, and encode significant information pertaining to each object (Martinez-Moreno 2010, 1). The authors explain:

> These codes have a two-dimensional structure consisting of square cells that store numeric and/or alphanumeric data. The quantity of information they can contain depends on their size, but is sufficient to identify an artefact. In our study, this information corresponds to the site name, archaeological context or level from which the artefact has been recovered, and inventory number (ibid, 2).

As a result, information about the artifact is translated into a physical code, which is printed out and attached to the artifact.

Martinez-Moreno et al suggest that this method of labeling is advantageous for archaeological collections in particular, because the codes themselves can be printed very small on a laser printer to accommodate small excavated materials. As a result, the codes "can be attached directly both onto a bag and to the surface of the object, thus reducing the possibility of

loss or errors while handling objects during analysis, or mixing identification codes on containers" (ibid).

Furthermore, the authors argue that because DM codes encode significant information about archaeological materials, they are preferable over traditional labeling methods. In particular, they suggest that "Marking by hand is not uniform and is conditioned by imponderables such as the porosity, irregularity, texture and, a very important variable in our case, size of the artefact" (ibid, 3). Although the longevity of printed versus hand-written labels is still debated at this point in time, the main advantages of DM codes is their ability to facilitate and speed up the process of labeling a massive quantity of materials, which are clearly present amidst the "curation crisis." Finally, the main advantage of these codes is that they allow the encoded information to be entered directly into a collections database when the code is scanned by a laser scanner (ibid). This type of technology has a great deal of potential in assisting the proper processing and management of large quantities of archaeological materials.

Another viable option to label and track archaeological material is using bar code tags. Some authors caution that the purchasing price of the equipment as well as the labor to apply the codes may prevent most museums from going this route: "Many museums find this technology to be too costly to implement because either the hardware and software are too expensive to purchase and maintain, or the amount of time it would take to apply the barcode to objects already marked is prohibitive" (Johnston and Meador-Woodruff 2010, 246). However, for museums that need to process large quantities of archaeological material, the initial expense and investment of time may prove worthwhile. Furthermore, given the fact that so many archaeological materials are entirely unprocessed as a result of the "curation crisis," it may be worth exploring new technologies to handle this large-scale labeling and tracking process. In

order to track artifacts, bar code labels must be read using a scanning device. It is highly preferable to purchase a hand-held scanner with a built-in keypad, so that the scanner can be brought to the object, especially as it is being re-housed, rather than bringing the object to the scanner (ibid).

Gabor R. Racz and William L. Gannon describe the implementation of barcoding at the Museum of Southwestern Biology's Division of Mammals. They argue that bar-code labeling during the initial processing of artifacts is advantageous because it eliminates the need to record individual object locations in the database; the scanner updates locations instantaneously. Their argument is relevant for the large quantity of entirely unprocessed archaeological material that exists today. Racz and Gannon provide useful logistical information for museums interested in exploring this technology, specifically about the hardware necessary to implement bar-code labeling. They emphasize that, when creating a bar-code labeling plan, it is important to choose one that can be integrated into an existing CMS (Racz and Gannon 2005, 232). This point is important because many collections management systems have built-in features that facilitate bar-code labeling. Racz and Gannon suggest, "The major advantage of a bar-code system is increased data entry and speed of efficiency, making repeated human data entry unnecessary" (ibid, 229-230). For instance, it is possible to print multiple labels on a single sheet of paper, label multiple objects at a time, and scan all of these objects and have their locations updated automatically into the collections management system. In this regard, bar code systems may greatly facilitate the processing of a large quantity of archaeological material in conjunction with a collections management system.

The National Museum of Natural History relied heavily on bar-code technology throughout the moving process of their ethnographic and archaeological materials to off-site

storage. Hansen and Sawdey explain how, "with the bar code tracking system, bar code labels were printed based on the database of drawer inventories, allowing the technicians to process objects more efficiently. The catalog number was printed on the bar code label, requiring only that the technician associate the correct label with the correct object. As a result, transcription errors were greatly decreased" (1999, 32). In this instance, the bar codes simply encoded the catalog number for each artifact. When an artifact was properly stored in its new location in off-site storage, the bar-code containing its catalog number was scanned, and the proper location was automatically updated into the museum's database. This saved the museum staff a great deal of time, particularly since they did not need to physically update object locations in the database; they simply needed to scan barcodes (ibid).

While the arguments for and against bar coding and data matrix codes are complex, it becomes quite clear that technology may play a key role in entering objects, their tracking numbers and their locations into a collections management system. The digital organization of objects within a collections management system simplifies the inventory process, facilitates the proper storage and location tracking of all objects, and allows for easy future access and retrieval of objects. It may also greatly facilitate the processing of large quantities of material, which is of the essence in resolving the "curation crisis." As a result, museum staff can use a collections management system either in isolation or in conjunction with other supplemental forms of technology in order to better maintain control over their collections, especially in the process of improving storage conditions.

Accessibility and Advocacy for Archaeological Collections

Collections management systems have a great deal of potential in providing museums with the tools to alleviate storage issues. But they cannot solve the main underlying reason of the "curation crisis," the one that prevents museums from properly caring for museum collections, particularly when it comes to storage: funding. I will argue that museums need to advocate on behalf of the collections to justify the need for funding to resolve this crisis. Specifically, by maintaining a proper collections database and making the information it contains available to the public, museums can actively defend the importance of the collections and the need for their long-term care. For archaeological collections in particular, making object information available to the public encourages accessibility, promotes research, and suggests the significance of these materials to the general public. All this, in turn, justifies an increase in funding.

As S. Terry Childs and Lynne P. Sullivan explain, "An increasing number of archaeologists, as well as interpreters, educators, culturally affiliated groups, and members of the public are now asking why we keep collections if they are not accessible for research, interpretation, heritage-oriented activities, and exhibition" (2004, 16). By making collections available to the public online, museums are not only opening up their significant collections to scholarship and research, but are advocating on behalf of the collections and demonstrating the importance of their long-term care and curation. As a result, one of the main needs Sullivan and Childs address with regards to the "curation crisis" pertains to accessibility and use for research. They suggest that archaeologists and museums need to work together "to identify the collections they curate and encourage use of those collections through web-based catalog databases and publications" (Childs and Sullivan 2004, 17). Both museums *and* archaeologists alike need to

collaboratively address how to make these collections more accessible, particularly with the assistance of a collections management system.

By attracting attention to their collections, museums may garner the attention of potential donors, who may financially support the further care and management of the collections. Making their collections accessible to researchers and the public is one way to do so. As Suzanne Keene argues, "If museums could point to extensive use of their collections for research at several levels, professional, commercial, and individual, then justification for them would be more convincing" (2005, 61). Museums must be able to point to the use of their collections in order to receive funding for storage and care, and making content accessible through an online platform is a strong way to advocate for research as a primary collections use.

Virginia H. Pifko, in her thesis "Designing Museum Websites for Collection Records," emphasizes the ways in which online accessibility to collections is both a trendy and significant topic in the museum world. While the issue of online collections accessibility in the museum world is beyond the scope of this paper, S. Terry Childs and Peter McCartney provide specific commentary on how to make archaeological collections available and accessible to researchers. Federal archaeologists, for example, use the internet to "provide unique services, such as interactive databases that allow researchers to search for and explore particular interests and topics" (Childs 1999, 52). Childs cites examples including the National Archeological Database and the Reports module it contains, as well as the Native American Consultation Databases, which provide information on tribal contacts (ibid). Although they have been updated since Childs' publication, these federal databases may serve as an appropriate model for museums interested in making their materials more accessible to the general public. However, Childs also explains, "It is difficult to design and create materials for both the general public who pays their

taxes and are interested in archeology yet often access the Web via modem, and professional colleagues who want very different materials and often have direct connections to the web" (ibid). Although the internet is far more accessible than it was when Childs wrote this article in 1999, his point that it is challenging build an online collections database that caters to both the general public and researchers is still valid. Childs also laments the fact that most federal web sites lack organizational structure, which makes it difficult to access the information the user seeks (ibid, 55). He presents the issue of updates and maintenance of interactive databases and websites, which are costly endeavors that need to be considered during the budgeting process (ibid).

While Childs and McCartney provide useful commentary on the advantages of on-line databases to increase accessibility to archaeological collections, it is clear that creating such databases requires funding. Questioning the ability of museums to cater to researchers, Suzanne Keene explains:

> "The requirements seem straightforward, but measured by cost per researcher they are expensive, requiring investment in staff, storage, documentation, and secure facilities for study. Without an assured demand it is difficult to justify expenditure on these. On the other hand, without this investment, will this demand ever materialize? […] It seems that it is more a matter of will than of finance" (2005, 61-62).

Although most seem to agree with the notion that "if you build it, they will come" (McCartney 1999, 68), it is difficult to justify the expense of creating an on-line collections database when the collections in question have yet to receive any interest or attention by researchers. It raises the question: is it financially worth spending time putting information into a database if researchers will never actually use it? Suzanne Keene suggests that museums need to make their collections available for research by outsiders rather than focusing inward on the research conducted by museum curators. To do so, it may not actually be necessary to put *all* information

about *all* objects in a collection into a database if researchers have yet to show interest in them. It may be sufficient to present an overview of what is there. This concept will be addressed in further detail.

It is difficult to predict how increased accessibility to museum collections online will impact the demand for access to the physical objects in storage. On the one hand, by making collections available to researchers online complete with searchable data, the retrieval of objects from storage may become less of an issue. Childs suggests, "If researchers can examine a whole object in three dimensions from home or office, do basic measurements and examine decorative style and basic technological features, then they do not necessarily have to visit the museum in which the objects are housed" (1999, 58). Archaeologists can often use the database alone to glean a great deal of information about an archaeological assemblage.

On the other hand, increased accessibility through database management may make the physical collections more desirable to researchers. Collections managers may therefore face greater demand from researchers to access the physical collection. While such a demand is positive as it indicates interest in the collections, it also requires a great deal of staff time, between retrieving the objects from storage and supervising research. One thing is certain, once researchers are aware of the presence of certain objects in a museum's possession and request access to them, it becomes the museum's responsibility to ensure that these objects are made physically accessible and easily retrievable in storage. As a result, it seems both relevant and important to consider how storage constraints can be addressed *during* the cataloging and data entry process. Museum professionals need to consider how computerization can actually assist with improving storage in the event that increased accessibility online means increased demand for access to the physical materials.

For instance, if basic measurements are taken during the cataloging or data entry process, a collections management system may also assist with the actual creation of a storage plan in order to maximize the use of space in a tightly packed room. The National Museum of Natural History demonstrated this principle in their rehousing project. Hansen and Sawdey explain how they attempted to store like objects together, not only for the sake of proper object care, but in order to maximize storage space (1999, 25). They explain how, using data collected in their 1970s inventory, "rough volumetric calculations were made to determine the type and number of storage units that would be required to accommodate the entire anthropology collection. Quattro Pro (a spreadsheet program) was used to run the calculations" (ibid). Although in this instance the museum's collections system is certainly complex, it is important for museums to consider how they may be able to make use of their own CMS' capabilities in order to make the most of the storage available to them. In a similar vein, databases can also serve an important role in tracking collections during a moving process, as storage is improved, as was the case at the NMNH.

Some museum professionals advocate in favor of a collections center or separate storage facility outside the museum. There are both advantages and disadvantages to this type of storage solution, depending on the individual institution. However, each museum needs to consider accessibility and availability of the collections in the event that they are able to choose a proper storage environment. For archaeological collections, accessibility for researchers is of course a primary consideration.

Collaboration: Museums, Universities, and Archaeological Research

One of the ways in which museums can advocate on behalf of their collection is by establishing partnerships with universities. As Suzanne Keene explains, "To achieve greater use of collections requires those in universities to consider how objects could be used in teaching, and museums to be active in approaching them" (2005, 78). While this collaboration would especially benefit archaeological research, it may extend to other disciplines and academic areas as well. To summarize, Keene astutely suggests, "A greater use of collections and objects in education could transform collections practice, purpose, and their recognition in society" (2005, 79). In establishing partnerships with universities, museums must assume a responsibility to make their collections easily accessible and researchable by maintaining a user-friendly collections management system and placing the findings online.

In order to achieve this collaboration, museums need to consider how they can make their data available to researchers, particularly those at universities. Peter McCartney suggests that a current impediment to sharing data is that many forms of data storage are not only threatened by obsolescence, but are not accessible to all. Consequently, he suggests, "Responding to these challenges calls for the application of information technology beyond simple data storage […] to develop an active, globally integrated information network within the capacity to discover, access, interpret and process data fluidly across comparability and scaling barriers" (1999, 62). In using a collections management system, museums therefore need to consider issues of technological accessibility in order to make their endeavors worthwhile, lest researchers will not be able to access the information they seek.

Barbara Voss (2012) provides an excellent example of this type of collaboration, in which the inventory, cataloging, and storage process of an "orphaned" collection gleaned a great

deal of information about the materials, as well as sparked an interest among undergraduate anthropology students conducting artifact research. She emphasizes the lack of research attention "orphaned" collections receive, and how a "lack of theoretical attention to curation procedures – accessioning, inventory, cataloging, rehousing and conservation – exacerbates this problem. Most archaeologists commonly view curation procedures as routine activities that manage, rather than investigate, archaeological collections" (Voss 2012, 146). Furthermore, she powerfully argues that "discussions of the curation crisis similarly focus on the logistical challenges – funding, facilities, storage materials, staffing, regulatory enforcement – which reinforces the perception that curation is a rote process that simply requires sufficient resources to be made efficient and effective" (ibid, 149). Archaeologists can and *should* actively participate in the processing of excavated materials, as these processes in themselves are often research activities.

Steven Miller laments the fact that "Collections held in storage are equated with collections lost" (2006, 57). On a positive note, Barbara Voss' research demonstrates that, while museums certainly need to strive to make storage improvements, a collection placed in storage is far from "lost." All collections, even those that have remained in storage for decades, contain potential waiting to be discovered.

More Product, Less Process

A properly maintained CMS has the potential to alleviate several key components of the "curation crisis." It may facilitate administrative tasks, make collections more accessible, encourage research, advocate on behalf of the collections, and potentially alleviate storage constraints. However, museums may find taking the initial step to accessioning, cataloging, and processing archaeological collections both daunting and financially draining. As an alternative,

archival practice may provide a solution for those museums that simply lack the funding and staffing to carry out such an in-depth project, despite the fact that the rewards seem to far outweigh the challenges in conducting this type of project.

Mark Greene and Dennis Meissner, in their 2005 article "More Product, Less Process: Pragmatically Revamping Traditional Processing Approaches to Deal with Late 20th-Century Collections," make the bold suggestion that archivists should simply spend less time processing material and more time making the materials generally accessible and available to the public. While this theory has certainly received criticism and is not wholly accepted by all archivists, it is becoming a widely accepted practice in archival processing. The underlying concept of this theory is that, by spending less time processing archival material, the institution can dedicate more efforts to making basic information about the records available to the general public, particularly through online finding aids. In doing so, the archive therefore draws attention to the collection whose basic information has been placed online. Rather than including a description of each individual document, the institution may place a finding aid online that provides a brief overview of the records as a whole. An interested researcher or donor may therefore come to the archive and dedicate time, effort, and potentially financial backing to more fully process, organize, and describe the records that pique his/her interest.

Green and Meissner suggest that, by spending excessive time processing a collection, archivists are wasting precious time that they could be spending making the collection more generally accessible to the public. The public may wait months, and often even years, to learn about new collections and records in an archive during the initial accessioning, processing, and finding aid creation. The longer an archive takes to process these incoming collections, the longer the public needs to wait to learn about them, and consequently, the less likely they are to

actually *use* them. However, by making basic and even skeletal information about a collection available online, the public is more likely to encounter these collections and grow eager to access and use them. Furthermore, a detailed level of description is not always a necessary practice for archivists themselves; the researcher interested in the records may be able to provide basic descriptions of the records as he or she sorts through them for academic or personal endeavors.

How can museums containing archaeological collections adopt aspects of this theory as they attempt to resolve the "curation crisis"? At some point, these collections need to be properly documented, recorded, and organized if the "curation crisis" is to be resolved. However, the theoretical underpinnings of Greene and Meissner's theory may provide some guidelines for museums that simply cannot afford to properly process the collections and organize them into a collections management system.

For instance, a museum may not have the time or money to properly catalog an archaeological collection and enter all of the relevant data into a collections management system. While the museum may make many collections searchable online, they may find that this initial collections processing is beyond the current scope of their financial capabilities. They may, however, know that the materials were excavated by a particular archaeologist in Lancaster County, Pennsylvania, and pertain to the Native Americans of the Eastern Woodland Period. They may also know that they have approximately five square feet of boxed archaeological material pertaining to this site that need to be processed. The museum may choose to make this general information available online, despite the fact that specific catalog information for each artifact is not available.

Consequently, an archaeologist may discover the collection online and take interest. S. Terry Childs explains how, in 1999, the National Park Service was embarking on a large-scale

project “to put online summary information of museum collections housed in all their national parks and regional centers” (1999, 58). However, he laments the fact that the information provided online by the NPS is “not detailed enough to determine the nature of particular collections in a repository in order to facilitate the development of a research project” (ibid). As a result, he argues that the efforts of the NPS are somewhat fruitless, since the information is not sufficiently detailed to promote research. Museums may therefore need to provide at least the basic information about the collection in order to make it valuable for an archaeologist interested in conducting a research project. Childs recommends that a collections database include search fields such as the “source project name, source project location, the range of materials in the collection, cultural affiliation, and condition to facilitate research project planning for professionals” (ibid).

Once the museum receives an inquiry to access or study a collection, it may become more justified to ask for funding to process the collection. Furthermore, the collaborative process between archaeologists and museum professionals may prove highly useful during the cataloging process should the archaeologists choose to participate in this endeavor. Although this method of advocacy and accessibility is certainly not ideal, it may prove useful in a less than ideal economic climate; some museums simply cannot afford to process collections in which there is little or no expressed interest. Museums need to take the first step in making archaeological collections more accessible, even if it is in a basic and skeletal format, in order to justify the processing and creation of accessible storage of these collections. It is important to consider the concept of advocacy from all angles, as one approach alone will not suffice in justifying the need to properly curate archaeological collections for years to come.

Conclusion

A properly managed collections management system can play a major role in resolving the "curation crisis." CMS's facilitate the inventory or cataloging process, enable the tracking of object locations, and can assist with the proper housing and storage of materials as well. In addition, they provide a means to make collections information accessible to researchers by placing the information online in a searchable format. In many museums, this is now becoming a standard practice.

While the concepts of advocacy and accessibility are well-known in the museum world, museums containing archaeological collections have a special responsibility to advocate on behalf of these materials and make them more accessible to researchers in order to actively combat the "curation crisis." There are many ways in which a museum may go about advocating for a collection, especially to justify the need for funding in order to care for the collections in perpetuity. Some museums take the "if you build it, they will come" (McCartney 1999, 68) approach and strive to make as much information available as possible to the public on the archaeological collections. This approach is not always financially realistic. At its heart is a collections management system that provides researchers with the means to search through data and obtain the information they seek about the objects. Section III of this paper encourages museums to make the best use of a CMS in order to achieve these goals.

Other museums, particularly those lacking the start-up finances to fund such a large-scale project, may elect to simply place general information on their collections on line in order to garner the attention of researchers or potential donors. Still other museums may establish collaborative partnerships with universities and research institutions. Some may find that they choose a combination of these approaches best suited to the needs of their institution. It is only

by advocating on behalf of these collections, and striving continually to make them more accessible to research, that museums and archaeologists can truly resolve the underlying issues of the "curation crisis."

While the consequences of the "curation crisis" have been widely accepted in the United States since the 1970s, there is still a long way to go before the crisis can be resolved. By advocating collaboratively on behalf of these collections, particularly with technological assistance, archaeologists and museum professionals can actively resolve this problem. The solution is certainly not straightforward, but with some creative thinking amongst archaeologists and museum professionals, these historically and culturally significant objects can receive the research and public attention they merit.

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